Macroeconomic factors: Cereal Grains Output and Prices in Nigeria

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Abstract: **Despite the facts that less attention is given to the effects of macroeconomic variables on cereal grains output in Nigeria, this study examine the effect of macroeconomic factors, output and prices of selected cereal grains in Nigeria using OLS technique and quarterly data from 2006 to 2016. The study analysed secondary data obtained from a time-series for cereal grains prices sourced from FMARD. While, data for macroeconomics variables and cereal grains outputs were obtained from the publication of Central Bank of Nigeria (CBN) Statistical Bulletins. The estimated outcome form the output model for rice reveals that quarterly interest rate and money supply increases rice output, while oil price reduce rice output. However, exchange rate and inflation have no effect on the rice output. The estimated outcome for maize output model shows that inflation rate maize output in Nigeria. The result also indicates that exchange rate increase Sorghum output level. Nevertheless, interest rate, inflation, and money supply does not determine the level of Sorghum output. In addition, the estimate form the price of rice model illustrates that exchange rate, inflation and money supply increase price of rice, while interest rate decreases the price of rice in the nation. In the maize price model, exchange rate, inflation and oil price accelerates the price level of maize and money supply decelerates the price. The outcome shows that interest rate has no effect on the price of maize. Furthermore, exchange rate, inflation and oil price rises price of Sorghum in the nation. Nonetheless, interest rate and money supply does not determine the price level of Sorghum. Hence, the study suggest that since, exchange rate, inflation, interest rate and money supply affect the level of price and output of cereals grains policymakers in Nigeria should design appropriate policies to mediate and control exchange rate and inflation for sustainability of the output and price of cereal grains as well as the stability of the economy. This could be done through price control measures and fixed interest rate as well as exchange rate policy to financial institutions in the nation.**

Key word: **Macroeconomics factors, price, output, cereal grains, OLS, CBN**

I. INTRODUCTION

The excessive increase in the price of Agricultural produce and the declined level of output have become a global issue. It is acknowledged that the situation have induce high poverty level and less economic performance (World Bank ,2019). It is evident that markets in the emerging nations were unable to absorb internal shocks due instability in the price of cereals grains(FAO, 2012). The global population is projected to rise up to 9 billion people and the increase in food demand to about 70% by 2050 that can cause increase in the prices of agricultural commodities. In Nigeria over the last decade GDP growth is largely depend on agriculture and other services. Nevertheless, economic policies and government capabilities have not change the deteriorating nature of poverty with almost 62% of people live in poverty in the nation. Agriculture provides about 70% of the workforce with a total of 57.46 million labour force. Nigeria is the 11th largest producer of maize in the world and providing about 18% of total maize production in the world, the retail prices for 2012/2013 were higher than for 2011/2012 (Anne, Ayinde & Falola 2015). Similarly, consumption of cereal grains have been increasing over the years particularly in urban area (Cedoni & Angellucci 2013). Post 2015/2016 indicates a rise in sorghum production to 6.2 million tons, although there was a shape decline in the output production due excessive attacks by Boko haram fighters in the north part of the nation. Prices of this crop tends to be higher in the southern part of the country, the 2015/2016 consumption estimate is 6.1 million tons, a decrease of nearly eight percent from the 2014/2015 assessment. Post 2015/2016 rice production drop by 2.3 million tons due to ineffective prices in relation to current global prices (Uche, 2015). For instance, domestic price of rice is over $370 per ton compared to the global price of about $300 per ton. In this regard, Nigerian government came up with a strategy for self-sufficiency in rice production.

However, fluctuations in outputs and prices of most agricultural produce leads to hunger and starvation of most Nigerian populous. It is evident that farmers in Nigeria in particular, and in Africa in general face dramatic fluctuations in prices of the crops they produce (Akpan & Udoh 2009). Similarly, the fixed character of inputs of agriculture, especially land and partly labour force as well as the nature of production coupled with several changes in policies and the dynamics of macro-economic factors, agricultural producers very often are not able to respond in the most economical way to the changes in prices of agricultural products and inputs. It is believed that in emerging nations both consumers and producers suffer from the rise in prices and cost of agricultural output as well as inputs especially during the period of high inflation.(FAO, 2012). Several factors have been identify as the responsible cause of changes in the price of agricultural production in the country. This therefore include, food insecurity, famer's welfare and the country's GDP. The grain sub-sector plays an important role in the economic development of Nigeria; the output of the sub-sector

constitutes a large proportion of staple food stuffs in Nigeria (Ismaila, Gana, Twanya, & Dogara, 2010).

Therefore, the unprecedented changes in prices and output of cereal grains can be as a result of the fact that there is huge difference between demand of most cereal grains and supply, eventually leads to changes of prices always, since the deficit is mate up through importation from outside the country, thus macro-economic variables however plays the most significant role, thereupon leading to difference in the prices of cereals imported and the locally. Consequences of the risk in cereal grain production are the existence of deviations from the balanced volume of cereal grain production demanded by the market, leading to price fluctuations and instability of this sub-sector. Hence, this study examines the effect of macro-economic factors on cereal grains output and price in Nigeria.

II. LITERATURE REVIEW

The link among the macro economic factors, price and output of cereals grains have discuss in the literature. For instance study by Rude and An (2015) studied the effect of interest rate on price and output of maize, rice and wheat in developed economies by applying GMM technique from 2006 to 2011. The result shows that interest rate increases the level of price and output cereal grains. Kapusuzoglu, Liang, and Ceylan (2018)investigate the effect of macro-economic factors on output and price of cereal grains in Turkey using SVAR method from 1980 to 2016. The outcome indicates that macro-economic shocks accelerate the level of price and output growth. Similarly, Damba, Birinci, and Bilgic (2019)examine the influence of oil price and exchange rate on the price and output of cereal grains in Ghana by employing VECM technique. The outcome reveals that oil price and exchange accelerates price and output level of cereal grains. Bendinelli et al. (2019) emphasized that macro-economic factors influence cereal grains positively. In another, development, Min (2020) analyzes the influence of exchange rate on price and output of cereal price in industrialized nations form 1964 to 2013. The study reveals that exchange rate increases the level of cereal grains price and output. Based on the reviewed literature it is observed that association among macro-economic factors, price and output of cereal grains have been studied. However, examine the effect of money supply on the cereal grains price and output have not been investigated. Similarly, most of these studies were found in developed nations and very few in less developed economies particularly, Nigeria. Hence, this study examine the influence of macro-economic factors on price and output of cereals grains in Nigeria.

III. DATA AND METHODS

Quarterly data of cereal grains (Rice, Maize, and Sorghum) output, price, Inflation rate, exchange rate, interest rate and oil price are utilized for the study's analysis for quarterly period of 10years (2006-2016). The Data for cereal grains prices were sourced from FMARD(2012). While, data for macroeconomics variables and cereal grain outputs were obtained from the publication of Central Bank of Nigeria (CBN, 2018) Statistical Bulletins.

3.1 Model specification

The study utilized a transformed model by Danlami (2016) for the models analysis

$$LOT = \alpha + \beta_1 LIF_t + \beta_2 LER_t + \beta_3 LPO_t + \beta_4 LIR_t + \beta_5 LMS_t + e_t \quad (1)$$

$$LPR_t = \alpha + \beta_1 LIF_t + \beta_2 LER_t + \beta_3 LPO_t + \beta_4 LIR_t + \beta_5 LMS_t + e_t \quad (2)$$

Where, OT and PR represent output and price of selected cereal grain (Rice, Maize, and Sorghum), IFIllustrates Inflation rate, ER represents Exchange rate, PO is Price of Crude oil, LR denotes Interest rate, MSShows Money Supply and e denotes error term. Hence, the employ Ordinary least squares (OLS) technique for the long run estimate of the model. The variables used in the models are change to their natural log.

IV. RESULT

Table 1 shows the outcome of the stationarity test. It illustrate that the variables are stationary at first difference. Moreover, table 2 presents the result of the estimated models. Result from Table 2 shows the estimates for rice output. The R^2 70.1% confirms the fitness of the model. The result revealed that Quarterly Interest Rate and Money Supply in Nigeria accelerates the level of rice output, implying that an increase in any of these factors leads to increase in the level of the output of rice by 0.369 and 0.319 respectively. The result also shows Quarterly Crude Oil Prices decelerates rice output. This means that an increase in oil price results a decrease in the output by 0.378. However, Exchange and Inflation Rates in Nigeria does not influence the level of output. Moreover, the estimated result of Maize output illustrates that the R^2 adjusted is 63% confirms the fitness of the model. The outcome revealed that Quarterly Inflation Rate in increase the level of maize output by 0.905. Quarterly Crude Oil Prices have negative effect on Maize output, implying that an increase in oil price lead to a decrease in Maize output by 0.948. Nonetheless, Quarterly Exchange Rate and Money Supply in Nigeria have no effect on the Maize output. In addition, the result from the model of Sorghum indicates that the adjusted R^2 84% confirms the fitness of the model. The result shows that Quarterly Exchange Rate positively increase the level of Sorghum output by 4.1%. Nevertheless, Interest Rate, Inflation Rate, Money Supply and Crude Oil Prices in Nigeria have no relationship with the level of Sorghum output. The result implication of this finding shows that quarterly interest rate and inflation increase the level of cereal grains output by 0.36%, 0.31% and 0.09% in Nigeria. Hence, the study suggest that the policymakers should design appropriate policies to mediate and control interest and inflation for sustainable grains output and the stability of the economy. This could be done through price control measures and fixed interest rate policy to financial institutions in the nation. This finding

found similar to the report of previous studies (Rude & An 2015). However, the findings of the studies by (Damba, Birinci & Bilgic 2019) have contradicts this outcome that interest and inflation rate have no effect to the level of cereal grains output.

Furthermore, the estimated price model for rice, maize and sorghum is presented in table 3. The R^2 92% confirms the fitness of the rice model. The outcome illustrates that Quarterly Exchange Rate, Inflation rate and money supply positively increase price of Rice. It implies that a percent increase in these factors lead to a rise in the price of rice by 0.66% and 0.04% and 2.17%. Interest rate reduce price of rice by 1.05%. However, oil price do not determine price of rice in Nigeria. In another development, The R^2 76% confirms the fitness of the Maize model. The result indicates that Quarterly Exchange Rate, Inflation rate and oil price increase the price of Maize in Nigeria. This means a percent increase in these factors cause price of Maize to rise by 2.8%, 1.6% and 3.4% respectively. Money supply decelerates price level of maize in the country. Nonetheless, interest rate has no effect to the price of maize. The estimated outcome form the Sorghum model reveals that the R^2 61% confirms the fitness of the model. It further reveals that Quarterly Exchange Rate, Inflation rate, and oil price positively influence the price of Sorghum. It implies that a percent increase in exchange rate, inflation and oil price result to rise in the price of Sorghum by 0.07%, 1.4% and 1.6%. However, interest rate and money supply does not determine price of Sorghum in the nation. The result implication of this outcome reveals that quarterly exchange rate, inflation and oil price increase the price of cereal grains by 0.66%, 0.04% 2.83%, 1.64%, 3.40%, 0.067%, 1.47% and 1.672% in Nigeria. Therefore, the study suggest that the policymakers should design appropriate policies to mediate and control exchange rate and inflation for sustainability of the price of cereal grains and the stability of the economy. This could be done through price control measures and fixed interest rate as well as exchange rate policy to financial institutions in the nation. This finding found similar to the report of previous studies Min (2020). Nevertheless, the outcome of the studies by Bendinelli et al. (2019) have contradicts this outcome that exchange rate and inflation rate does not influence price of cereal grains output.

Table 1: Test of stationarity

Variable	ADF LEVEL		ADF First Diff	
LER	-1.13531	(0.6898)	-5.55675*	(0.0001)
LIF	-2.50746	(0.1229)	-5.01692*	(0.0003)
LIR	-2.59713	(0.1037)	-6.253656*	(0.0000)
LMS	0.42907	(0.9813)	-5.30242*	(0.0001)
LOP	-3.08158	(0.0378)	-9.23807*	(0.0000)

Notes:* illustrates statistically significance at one percent level.

Table 2: Estimated outcome for Rice, Maize and Sorghum Output

Rice	Co-efficient	SD error	T-value	Prob.
LER	0.414	0.445	0.931	0.358
LIF	0.369	0.160	2.310	0.026*
LIR	-0.061	0.104	-0.588	0.560
LMS	0.319	0.085	3.746	0.001**
LOP	-0.378	0.109	-3.456	0.001**
Constant	1.903	0.773	2.461	0.019*
R^2Adjusted = 70.1				
Maize				
LER	7.202	3.705	1.944	0.059*
LIF	-0.444	2.133	-0.208	0.836
LIR	-0.555	0.766	-0.725	0.473
LMS	0.905	0.500	1.808	0.078*
LOP	-0.267	0.409	-0.654	0.517
Constant	-0.948	0.524	-1.810	0.078*
R^2Adjusted = 63				
Sorghum				
LER	4.162	0.930	4.477	0.000**
LIF	-0.334	0.535	-0.624	0.536
LIR	-0.085	0.192	-0.443	0.660
LMS	-0.094	0.126	-.0752	0.456
LOP	0.165	0.103	1.614	0.115
Constant	-0.82	0.131	-0.621	0.538
R^2Adjusted = 84				

Table 3: Estimated outcome for Rice, Maize and Sorghum Price

Rice	Co-efficient	SD error	T-value	Prob.
LER	0.661	0.143	2.731	0.058*
LIF	0.042	0.239	2.175	0.017*
LIR	-1.052	0.197	2.014	0.086*
LMS	2.173	0.056	4.183	0.004**
LOP	0.182	0.203	0.671	0.591
Constant	1.703	0.825	2.146	0.016*
R^2Adjusted = 92				
Maize				
LER	2.831	4.012	2.101	0.009**
LIF	1.642	1.035	3.041	0.001**
LIR	0.913	0.956	0.043	0.483
LMS	-0.184	0.205	4.209	0.000**
LOP	3.402	0.601	2.405	0.004**
Constant	5.039	0.821	1.948	0.068*
R^2Adjusted = 76				
Sorghum				
LER	0.067	0.930	5.362	0.000**

LIF	1.479	0.413	1.967	0.024*
LIR	0.746	0.826	0.078	0.275
LMS	3.472	0.581	0.561	0.347
LOP	1.672	0.901	2.871	0.056*
Constant	0.037	0752	1.963	0.017**
R^2Adjusted = 61				

Table 4 presents the diagnostic tests for the model. The result shows that the model has no issues of autocorrelation and errors are normally distributed.

Table 5 Diagnostic test

Test	F-statistics		Prob.	
Serial correlation	0.461		0.925	
Breusch-Pagan	0.083		0.762	

V. CONCLUSION

This study examines the effect of macro-economic factors on the price and output of cereal grains in Nigeria using quarterly data form 2006-2016 by applying OLS technique. The estimated outcome form the output model for rice reveals that quarterly interest rate and money supply increases rice output, while oil price reduce rice output. However, exchange rate and inflation have no effect on the rice output. The estimated outcome for maize output model shows that inflation rate maize output in Nigeria. The result also indicates that exchange rate increase Sorghum output level. Nevertheless, interest rate, inflation, and money supply does not determine the level of Sorghum output. In addition, the estimate form the price of rice model illustrates that exchange rate, inflation and money supply increase price of rice, while interest rate decreases the price of rice in the nation. In the maize price model, exchange rate, inflation and oil price accelerates the price level of maize and money supply decelerate the price. The outcome shows that interest rate has no effect on the price of maize. Furthermore, exchange rate, inflation and oil price rises price of Sorghum in the nation. Nonetheless, interest rate and money supply does not determine the price level of Sorghum. Hence, the study suggest that since, exchange rate, inflation, interest rate and money supply affect the level of price and output of cereals grains policymakers in Nigeria should design appropriate policies to mediate and control exchange rate and inflation for sustainability of the output and price of cereal grains as well as the stability of the economy.

This could be done through price control measures and fixed interest rate as well as exchange rate policy to financial institutions in the nation. The study is limited to the fact other macro-economic factors are not included in the models like, percapita GDP, urbanization, population growth. It is also limited that time frame used in the study is quarterly based. Therefore, future studies should incorporate other macro-economic factors that were not used in this study model as well as use of annual data instead of quarterly for the purpose of widening the analysis.

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