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MSME FINANCING, AGRICULTURAL OUTPUT, EMPLOYMENT AND FOOD SECURITY IN NIGERIA

Abstract

Food (in)security is a critical problem in the Nigerian economy despite large parts of the population in agricultural activities and observation of agricultural surplus. Nigeria's policy problem is thus, to identify policies that address the demand and supply side sources of food (in)security under economic conditions of adverse link of agricultural production to food security, poverty, lack of assets, and inadequate access to productive and financial resources. The objective of the study, therefore, was to examine the study's proposition that MSMEs financing helped to ameliorate the adverse effect of agricultural output and unemployment on food availability and food access. The least squares regression with interactive terms technique was employed. The study finds that MSMEs financing improves the effect of real agricultural output and unemployment on food availability and food access with the implication of a threshold level of the loans at which the moderating influence become strong. The study recommends MSMEs financing as a policy for food security. The design of the policy should address loan adequacy, investments in agricultural value added and storage infrastructure goals.

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MSMEs financing; agricultural output; unemployment; food security.

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5 Tables, 33 References.

Problem Statement and Literature Review

Food (in)security in Nigeria is in a critical state evidenced by the country ranking 119 out of 125 in the Economists impact food security index (2023). 70% of Nigerians are in agricultural and allied activities. Unemployment stood on the average, at 4% in the 2000 decade and 5.6% in the 2020 decade, and the economy has high agricultural surpluses. High food insecurity in association with agricultural surpluses is shown to be typical of developing countries with large parts of the population engaged in agricultural activities (Thomas et al., 2023; Smith et al., 2000). It, however, leaves conventional policies for increasing agricultural productivity as a panacea for food security redundant. There arises therefore, need for policies that moderates the link of food insecurity to its major supply and demand side sources that is, agricultural output and unemployment. This study posits that high agricultural surplus, poverty, lack of assets and inadequate access to productive and financial resources rationalize the use of Micro, Small and Medium Scale Enterprises (MSMEs) financing strategies to address supply and demand sides of food security.

According to FAO (1996), food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. This definition establishes four pillars of food security, (1) availability, (2) access, (3) utilization and (4) stability. Food availability describes the adequacy of the production or stock of food to meet the dietary energy requirements of the country in terms of quantity and quality and is seen as the supply side of food security. Food

access in turn, refers to the adequacy of households' access to available national food supply and depicts the demand side. The notion of food access extends the earlier view of food security as a function of food supply to include the effect of households' purchasing power on their demand for food in response to Sen's (1981) work.

MSMEs financing is a part of economic development policies in Nigeria. Implementation has taken different forms, and two of the older forms that also have substantial amount of disbursements are the Agricultural Credit Guarantee Scheme Fund (ACGSF) of 1977 and loans to SMEs by the Deposit Money Banks (DMBs) made up of commercial banks and Microfinance banks (and Merchant banks up to 1994). Total amount of loans channeled from ACGSF to small holder farmers was N1. 05b in 2002, N9.33b in 2012 and N8.48b as at 2022. DMBs loans to SMEs in turn amounted to N82.37b as at 2002, N3.86b in 2012 and N93.45b as at 2022. In Nigeria MSMEs account for 96.7% of businesses, 87.9% of employment, and 49.7% of GDP as at end 2020 (SMEDAN, 2022). High and adequate MSMEs finances involving proper terms should improve the aggregate liquidity, encourage investments in agricultural value added and storage infrastructure as well as reduce the number of unemployed household members. These effects on the economic environment in turn, should have desirable influences on the adverse food security effects of agricultural output and unemployment. However, the average interest rate and loan maturity for SMEs in Nigeria are rather stringent, amounting to 20% and 12 months respectively (Ketley, 2012).

The suggestion from previous studies is that agricultural productivity and value-added influence food security (Abdelhedi & Zouari, 2020; Modi, 2019) and that lack of agricultural storage infrastructure results in large harvest losses. Wudil et al. (2022) examined food security in Sub-Saharan Africa (SSA) and finds an adverse role for low investment in irrigated agriculture and research on food security in the region. Endris Mekonnen, & Kassegn Amede (2022), Etana & Tolossa (2017), Enakhe & Tamuno (2021) examined effect of unemployment on food security. Furthermore, Ogbonnaya et al. (2022) examined the effects of MSMEs financing from ACGSF and DMBs on agricultural output in Nigeria. Tambi & Bime (2019) examined the relationship between financing and agricultural production across formal and informal types of agricultural credit. Taiwo et al. (2022) finds that financing of different MSMEs sector and their contributions to GDP affects unemployment in Nigeria.

However, not much is known about the contribution of MSMEs financing to food security in Nigeria, nor the extent to which it could moderate the link of food security to agricultural output and unemployment.

The aim of this study is to ascertain whether MSMEs financing moderates the effects of agricultural output and unemployment on food security in the Nigerian economy. Given the above discussions, the general objective of this study is

to examine food availability and food access and the influences of two MSMEs financing instruments, DMBs loans to MSMEs and ACGSF loans to small scale farmers. The former is private sector finance, while the latter is owned by the Central Bank of Nigeria (CBN). Thus, the study contributes the comparative performance of public sector financing that targets small scale agricultural farms and private sector financing of MSMEs in food security to the literature on alternative interventions and policies. The specific goals of the study are to ascertain (1) the influence of the level of MSME financing on the effect of agricultural output on food security in Nigeria (2) the effect of MSME financing on the food security effect of unemployment in Nigeria.

Methodology

The study assumes causal relations of agricultural output and unemployment to food security and a moderating influence of MSMEs financing. Thus, a theoretical framework is developed to structure the relationships between food security and agricultural output, unemployment, and the moderating variables. The empirical model to be estimated is then specified, and theoretical restrictions on the expected effects of the independent variables are presented.

Theoretical Framework

A policy of MSMEs financing for food security works by raising incomes and simultaneously managing the food economy. The view is that rather than a direct relationship with food security, MSMEs financing instead moderates the effect of factors that cause improvement /deterioration in food security, employment and income generation (Rose, 2008), agricultural productivity and supply (Timmer, 2004; Qureshi et al., 2015), as well as potential for improved investment in storage and agricultural value added. MSMEs financing, therefore, constitutes both a demand side and supply side policy for food security.

Real agricultural output and unemployment rate are shown to be key demand and supply sides factors respectively, of food security. Studies show that real agricultural output typically has a negative effect on food security in such developing countries where large part of the populations work in the agricultural sector (Thomas et al., 2023; Smith et al., 2000). This outcome is associated with high loss of harvest due to poor storage. Unemployment also, has a negative effect on the two indicators of food security, due to its negative effect on household income (Etana & Tolossa, 2017; Enakhe & Tamuno, 2021). Reduction of household income and hence decreased purchasing power reduces household access to food.

MSMEs financing is conceptualized as an intervention in food security. The expectation is that it would make positive indirect contributions to food security, describing its moderating influence on the effects of agricultural output and unemployment on food security. On the other hand, the direct effects could also exist, and may have the potential to be negative when terms of the loans are stringent.

Variables of the study

Dependent Variables

The dependent variables of the study are the indicators of Food availability (Fav) and Food access (Fac). Fav and Fac are measured as average dietary energy supply adequacy (percent) (3-year average) and as prevalence of undernourishment (percent) (3-year average). They stand for outcome food security indicators at national scale (Pangaribowo et al., 2013).

Explanatory Variables

The independent variables of the study arise from the research objectives of the study and includ**e,** Real agricultural output (Ragr), Unemployment rate (Unem), and the two measures of MSMEs financing, DMBs loans to MSMEs (Dmbl) and ACGSF loans to small scale farmers (Agcs). The other explanatory variables are the interaction variables generated to capture the view that MSMEs financing moderates the effect of agricultural output and unemployment on food security. They include four interactive terms Dragr, Dunem, Aragr, and Aunem. Where the first two are the interaction of DMBs loans to MSMEs with Real agricultural output and of DMBs loans to MSMEs with Unemployment, respectively. The second two are the interaction of ACGSF loans to small scale farmers with Real agricultural output and with unemployment, respectively.

Empirical Model

The empirical models are exceptional cases of the interaction models of food security given as,

Model 1: $Fav_t = \beta_{10} + \beta_{11}Ragr_t + \beta_{12}Unem_t + \beta_{13}Dmbl_t\ \beta_{14}Agcs_t\ \beta_{15}Dragr_t + \beta_{16}Dunem_t + \beta_{17}Aragr_t + \beta_{18}Aunem_t + \lambda_{1t}$ (1)

Model 2: $Fac_t = \beta_{20} + \beta_{21}Ragr_t + \beta_{22}Unem_t + \beta_{23}Dmbl_t\ \beta_{24}Agcs_t\ \beta_{25}Dragr_t + \beta_{26}Dunem_t + \beta_{27}Aragr_t + \beta_{28}Aunem_t + \lambda_{1t}$ (2)

Where,

Fav_t = Indicator of Food availability

Fac_t = Indicator of Food access.

$Ragr_t$ = Real agricultural output

$Unem_t$ = Unemployment rate in time

$Dmbl_t$ = DMB loans to SMEs in time

$Dragr_t$ = The interaction of DMB loans to SMEs with Real agricultural output

$Dunem_t$ = The interaction of DMB loans to SMEs with unemployment

$Agcs_t$ = ACGSF loans to small scale farms

$Aragr_t$ = The interaction of ACGSF loans to SMEs with Real agricultural output

$Aunem_t$ = The interaction of ACGSF loans to SMEs with Unemployment

t indicates time period and λ_t is the stochastic error term

Equations (1) and (2) states that the indicators of food security, Fav_t and Fac_t depend directly on $Ragr_t$, $Unem_t$, $Dmbl_t$, $Agcs_t$ and indirectly on $Dmbl_t$ via the interaction variables, $Dragr_t$ and $Dunem_t$, $Aragr_t$, and $Aunem_t$, as well as a stochastic error term, λ_t. Special cases of Equations (1) or (2) are compact versions of the models, which will emerge when any one constitutive term of an interactive term is insignificant and the interactive term is therefore, dropped from the specification. Based on the theoretical framework, Fav_t and Fac_t are expected to depend negatively on $Ragr_t$ and $Unem_t$, but either positively or negatively on $Dmbl_t$ and $Agcs_t$ in Models 1 and 2. The interaction variables, $Dragr_t$, $Dunem_t$, $Aragr_t$ and $Aunem_t$ impact positively on Fav_t and Fac_t, representing the expectation that DMBs loans to SMEs and ACGSF loans to farmers reduces the negative effects of $Ragr_t$ and $Unem_t$ on food security in Nigeria.

Apriori Expectations

$\beta_{10} >= 0$, $\beta_{11} >0$, $\beta_{12} < 0$, $\beta_{13} < >0$. $\beta_{14} < > 0$, $\beta_{15} >0$, $B_{16} >0$, $B_{17} >0$, $B_{18} >0$.

$\beta_{20} >= 0$, $\beta_{21} > 0$, $\beta_{22} < 0$, $\beta_{23} < > 0$. $B_{24} < > 0$, $\beta_{25} >0$, $B_{26} >0$ $B_{27} >0$, $B_{28} >0$.

Data

Time series on FAO indicators of Food security, Fav and Fac for the years, 2001 to 2022 were obtained from the FAO website. Real agricultural output, Deposit money bank loans to SMEs, and ACGSF loans to small scale farmers for the same years were obtained from the CBN Statistical Bulletin, (2022). Data on unemployment was obtained from the World Bank database. All the variables except unemployment rate were transformed into their Natural logarithm forms while unemployment rate was transformed using its cube root. The Food access indicator use larger numbers to represent lower food access. The values of its Natural log range between 2 and 3.14. They were further transformed by subtracting the Natural log values from 5 to use larger numbers to stand for higher levels of food access. The interactive terms were derived as multiplicative terms.

Estimation Method

Estimations using time series data involves two critical steps described as follows:

Test of Unit Roots

Unit root tests are conducted to set up the stationarity of the time series. The study employs three tests for unit roots, the Augmented Dickey-Fuller (ADF), the Phillips-Perron (PP) and the Zivot-Andrews tests.

All the tests are based on estimating the coefficient of the AR(1) variable and comparing its estimated t-statistic with a theoretical t-value. For the ADF, PP and the Zivot-Andrew tests, the tests equations are respectively,

$$\Delta y_t = \alpha y_{t-1} + c_t'\vartheta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-1} + \cdots + \beta_\rho \Delta y_{t-\rho} + \mu_t \quad (3)$$

$$\Delta y_t = \alpha y_{t-1} + c_t'\vartheta + + \mu_t \quad (4)$$

$$y_t = \partial + \beta t + \delta DU_t(T_b) + \emptyset DT_t(T_b) + \varphi D_t(T_b) + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \mu_t \quad (5)$$

Where, Equation (3), the ADF estimates the difference in the time series y_t as a function of the AR(1), (y_{t-1}), an optional exogenous regressor, (c_t) p^{th} number of lags of y_t and the residual term (μ_t). Equation (4), in turn relates the difference in the time series y_t to the AR(1), the optional exogenous terms the residual term (μ_t).

The Zivot-Andrews test equation in (5) nests the null hypothesis that the time series is I(0) ($\varphi D_t(T_b)$) and the alternative that it is a trend stationary model with breaks in the intercept and trend ($\delta DU_t(T_b) + \emptyset DT_t(T_b)$).

For all the methods, the tests of stationarity assesses the null hypothesis against the alternative written as,

Ho: $\alpha = 0$ and no autocorrelation

H_1: $\alpha = 1$.

The ADF test is biased towards acceptance of unit root when sample size is small and holds structural break. The PP test has the same weaknesses as the ADF test but performs better in noticeably short time series (Arltová & Fedorová, 2016) and well in the presence of deviations from the assumptions of homoscedasticity. However, Perron (1989) notes that when there is structural break in the data, the previous tests are biased towards a false unit root. The Zivot-Andrews test, in turn, takes account of structural breaks and tests the null hypothesis that the variables are stationary with structural breaks (Hayashi, 2001).

Econometric Model

The second step involves specifying and applying to the empirical model econometric model that is proper based on the conclusion on stationarity conditions of the data and the implications of the specified model and the data for the validity of the assumptions of classical least square regression.

The Least Squares with interactive term technique is employed to estimate Models (1) and (2). The use of this technique is appropriate because the variables are all I(0) variables, and there is no apriori basis to assume existence of simultaneity or variable endogeneity in the specified models. The Least Squares with interactive terms technique represents a method for the estimation of non-linear effects of independent variables through the estimation of interactive terms. In contrast with the linear estimator which yields constant marginal effects of the constitutive independent variables, $Ragr_t$, and $Unem_t$, the Least Squares with interactive terms technique yield marginal effects that vary in sign, size and significance, based on the values achieved by the moderating variable (Brambor et al., 2006; Bernhardt & Jung, 1979) where the variation shows the moderating effects in the model.

Research Results

Descriptive Statistics

The summary statistics (Table 1) show that all the variables have non-zero means. The estimated standard deviations of the variables, with the exception of DMB Loans to MSMEs and Real agric. output interaction (19.72) and Agric. Credit Guarantee Loans and Real agric. output (18.4), are all rather small, ranging from the lowest value of 0.03 for food availability to the 4.36 for DMB Loans to MSMEs and Unemployment interaction. The implication is that the variables tend to cluster around the mean. Furthermore, based on the estimated probabilities of the Jarque- Bera statistic, the variables are normally distributed, with the exceptions of Agric. credit guarantee loans, Agric. credit guarantee loans and Real agric. output interaction, and DMB Loans to MSMEs and Real agric. output interaction for which the probability values of 0.08, 0.05 and 0.03 respectively rejects the null of normality.

Table 1

Descriptive Statistics

	Mean	Max	Min	Std. Dev.	Skew-ness	Kurtosis	Jarque-Bera	Prob	Obs
Food Availability	4.79	4.84	4.74	0.03	0.27	1.92	1.27	0.53	21
Food access	2.21	2.77	1.86	0.24	0.62	3.16	1.37	0.5	21
Real agric. output	23.32	23.67	22.78	0.29	-0.45	1.94	1.68	0.43	21
Unemployment rate	1.38	1.88	1.17	0.22	1.09	2.61	4.29	0.12	21
DMB Loans to MSMEs.	17.23	18.6	16.21	0.84	0.22	1.43	2.34	0.31	21
Agric. Credit Guarantee Loans	15.52	16.3	13.91	0.68	-1.17	3.56	5.11	0.08	21
DMB Loans to MSMEs. and Real agric. output interaction	401.78	439.28	381.47	19.72	0.53	1.85	2.14	0.34	21
DMB Loans to MSMEs and Unemployment interaction	23.81	33.7	20.37	4.36	1.31	3.14	6	0.05	21

	Mean	Max	Min	Std. Dev.	Skew-ness	Kurtosis	Jarque-Bera	Prob	Obs
Agric. Credit Guarantee Loans and Real agric. output interaction	362.07	381.94	316.85	18.4	-1.35	3.9	7.1	0.03	21
Agric. Credit Guarantee Loans and Unemployment interaction	21.41	28.66	16.66	3.53	0.65	2.33	1.86	0.39	21

Source: developed by the author.

Correlation among the Variables of the Study

Table 2

Correlation Matrix

	Fav_t	Fac_t	$Ragr_t$	$Unem_t$	$Dmbl_t$	Agcs	$Dragr_t$	$Dunem_t$	$Aragr_t$	$Aunem_t$
Fav_t	1.00*									
Fac_t	-0.95*	1.00*								
$Ragr_t$	-0.69*	-0.66*	1.00*							
$Unem_t$	-0.61*	-0.56*	0.62*	1.00*						
$Dmbl_t$	-0.33	-0.45*	-0.13	0.24	1.00*					
$Agcs_t$	-0.06	- 0.06	0.56*	0.03	-0.62*	1.00*				
$Dragr_t$	-0.51*	-0.62*	0.13	0.43	0.97*	-0.47*	1.00*			
$Dunem_t$	-0.64*	-0.63*	0.62*	0.96*	0.48*	-0.13	0.64*	1.00*		
$Aragr_t$	-0.22	-0.21	0.72*	0.20	-0.56*	0.98*	-0.37	0.04	1.00*	
$Aunem_t$	-0.61*	-0.56*	0.84*	0.97*	0.08	0.27	0.29	0.90*	0.42	1.00*

Source: developed by the author. (*) indicates statistical significance at the 5% level.

The estimated correlation coefficients, Table 2, shows negative correlations between the dependent variable, Fav_t and the other dependent variable, Fac_t and all explanatory variables. The coefficients are with the exception of $Dmbl_t$, $Agcs_t$ and $Aragr_t$, generally large, ranging from -95% in the case of Fac_t to -51% for $Dragr_t$. The correlation of the other dependent variable, Fac_t with all explanatory variables is similarly negative and except for $Agcs_t$ and $Aragr_t$, statistically signifi-

cant. Among the explanatory variables, the highest correlation coefficient in absolute value is 98% and the lowest is 3% respectively, depicting correlations of $Agcs_t$ with $Aragr_t$ and of $Agcs_t$ with $Unem_t$. A key finding here is that agricultural output displays negative co-movement with food security as posited by the study.

Unit Root Test Results

Table 3

Augmented Dickey-Fuller (ADF), Phillips-Perron, and Zivot-Andrews Unit Root Tests Results

Variable	Augmented Dickey Fuller Lag Length: (Automatic – based on SIC, maxlag=4		Phillips_Perron Lag length: Spectral GLS-detrended AR based on SIC, maxlag=4				Zivot-Andrews Break-point Test Lag Length: Automatic - based on Schwarz information criterion maxlag=4			Remarks
	Exogenous (Lags)(1)	ADF-Stat	P-value[a]	Exogenous (Lags)(2)	Test-Stat	P-value[b]	Exogenous (lags)(3)	T-Stat	P-value[c]	
Food availability	C, LT(1)	-4.99	0.004	C, (1)	-3.15	0.039	C, T (1)	-6.65	< 0.01	I(0)
Food access	C, LT (1)	-0.32	0.981	C, LT (1)	-6.01	0.001	C, T (1)	-4.78	0.0186	I(0)
Real agric. output	C, LT (0)	-1.26	0.862	C , LT (0)	-6.76	0.000	C, T (0)	-7.02	< 0.01	I(0)
Unemployment	C, LT (4)	-4.21	0.021	C, LT (1)	-6.39	0.000	C, T (4)	-10.76	< 0.01	I(0)
DMBs Loans to MSMEs	C, (0)	-1.32	0.852	C, LT (0)	-1.41	0.825	C, T (3)	-4.75	0.0673	I(0) with structural Break
Agric. credit Scheme	C, LT (3)	-1.06	0.907	C. LT (3)	-2.48	0.332	C, T (4)	-5.25	0.0414	I(0) with structural Break
DMBs Loan*Real agric. output	C, LT (0)	-1.38	0.835	C, LT (0)	-1.46	0.809	C, T (3)	-5.00	0.0327	I(0) with structural Break

Variable	Augmented Dickey Fuller Lag Length: (Automatic – based on SIC, maxlag=4		Phillips_Perron Lag length: Spectral GLS-detrended AR based on SIC, maxlag=4				Zivot-Andrews Break-point Test Lag Length: Automatic - based on Schwarz information criterion max-lag=4			Re-marks
	Exoge-nous (Lags)(1)	ADF-Stat	P-value[a]	Exoge-nous (Lags)(2)	Test-Stat	P-value[b]	Exoge-nous (lags)(3)	T-Stat	P-value[c]	
DMBs Loan * Unem-ploment	C, LT (2)	-5.97	0.001	C, LT (3)	-19.95	0.000	C, T (2)	-7.67	< 0.01	I(0) with struc-tural Break
Agric. Credi Scheme * Real agric output	C, LT (3)	-1.05	0.908	C, LT (3)	-2.41	0.365	C, T (4)	-5.17	0.0192	I(0) with struc-tural Break
Agric. Credi Scheme * Unemploy-ment	C, LT(1)	-2.06	0.534	C, LT (0)	-143.89	0.000	C, T (4)	-2.83	0.9805	I(0)

Source: based on the author's notes: *(1), (3) = Lag Length: (Automatic – based on SIC, max-lag=4;(2) = Lag length: Spectral GLS-detrended AR based on SIC, maxlag=4 ; a,c = MacKinnon (1996) one-sided p-value; (b)= Vogelsang (1993) asymptotic one-sided p-values.*

Table 3 includes results of the ADF, Phillip-Perron and Zivot-Andrew unit root tests. The results indicate that Food availability, Unemployment and DMBs Loan and Unemployment interaction are trend stationary. All the other variables, are however, stationary in levels with structural break based on the Philips-Perron and Zivot-Andrews tests. The I(0) status of the variables (and I(0) with structural breaks), rationalizes the application of the OLS method to the data to estimate the empirical models of the study.

Estimated Models of Food Security

Estimated results using OLS are presented in Table 4 for one special case of Model 1, and two particular cases, 2a and 2b, of Model 2. Each model was selected using goodness of fit and hypothesis testing. Moreover, in line with Bernhardt & Jung (1979), an interaction model is selected upon the fulfilment of the condition that the constitutive terms as well as the interaction term are each statistically significant. Thus, the results presented for Model 1 do not include the interactive term, $Dunem_t$, since the constitutive variable, Unemt, is not statistically significant. The variable was, however, significant in Model 2, therefore, the study includes $Dunem_t$

in Model 2b. Furthermore, the variable, $Agcs_t$ poorly performed the models, and it is dropped in Model 2b. Time dummies, T1 and T2, are included in Model 1 but T1 only, in Model 2b to account for structural breaks in the models. Each of the time dummies is statistically significant at the 5% level of statistical significance.

Table 4

OLS Estimates of Models 1 and 2 of Food Security

Dependent Variable	FAV_t	FAC_t	
Regressors	Model 1	Model 2a	Model 2b
Real agric output	-1.962*** (-5.29)	-0.875** (-3.12)	-0.789*** (-6.30)
Unemployment	-0.004 (-0.12)	0.399* (1.91)	-4.575* (-1.85)
DMBs Loan to MSMEs	-2.558*** (-4.84)	-10.576** (-2.82)	-0.562** (-2.79)
Agric. Credit Scheme Loans	-0.299 (-1.63)	-0.015 (-0.19)	
DMBs Loan and Real agric. output interaction	0.108*** (4.83)	0.444** (2.78)	
DMBs Loan and Unemployment interaction			0.278* (1.98)
T1	0.041** (3.52)		0.223** (3.07)
T2	-0.049*** (5.75)		
Intercept	51.709 (5.75)	210.629** (3.17)	30.549* (6.06)
Average Marginal Effects[(1)] 1._at minimum value of $Dmbl_t$ (16.21)	-0.211*** (-6.22)	-1.562*** (-5.36)	-0.073 (-0.30)
2._at mean value of $Dmbl_t$ (17.23)	-0.101** (-2.26)	-1.111*** (-5.43)	0.210 (1.27)
3._at maximum value of $Dmbl_t$ (18.60)	0.047 (0.82)	-0.502* (-1.94)	0.591** (2.71)
R-squared	0.9254	0.8508	0.8794
Adjusted R-squared	0.8852	0.8011	0.8392
F-Statistic (Prob)	23.02 (0.0000)	17.11 (0.0000)	21 (0.0000)
RMSE	0.011	0.1053	0.0947
Durbin-Watson Statistic	1.39	1.83	1.52

Source: developed by the author. (***), (**) & (*) represents statistical significance at the 1%, 5% and 10% levels, respectively. [(1)]: Average marginal effects are for $Ragr_t$ in Models 1 and 2a but are for $Unem_t$ in Model 2b.

Table 4 also include the estimated average marginal effects of real agricultural output ($Ragr_t$) and unemployment ($Unem_t$) on Fav_t and Fac_t, at the minimum, mean and maximum levels of DMBs Loans to MSMEs. These average marginal values stand for the moderating effect of the loans. The results are first presented for each model and then the findings are discussed.

Model 1: When Food availability is the dependent variable (Model 1), $Ragr_t$, $Unem_t$, $Dmbl_t$, and $Agcs_t$ all have negative effects but of these four explanatory variables, $Unem_t$ and $Agcs_t$ fail the test of statistical significance based on their t-statistic values. The interaction term, $Dragr_t$ has a positive effect and together with $Ragr_t$, and $Dmbl_t$ are statistically significant at the 1% level. Moreover, the average marginal effects of $Ragr_t$ on Fav_t are shown to be equal to -0.211, -0.101, and 0.047 respectively at the minimum, mean and maximum levels of $Dmbl_t$. The t-values of these estimated marginal effects show that they are apart from the effect at the maximum level, all statistically significant. The implication is that real agricultural output contributes negatively to Food availability at the minimum and mean values of DMBs loans to MSMEs, but positively, at its maximum value. The adjusted R-Squared value of 0.89 show that the model explains 89% of the variation in Fav_t.

Model 2a: In Model 2a, $Ragr_t$, $Dmbl_t$, and $Agcs_t$ have negative effects on Food Access, Fac_t, similar to the effects on Fav_t. $Unem_t$ and $Dragr_t$ have positive effects. Also, based on the t-values, all the explanatory variables are significant at the 5% level except $Unem_t$ which is only significant at the 10% level and Agc_t which is not significant at any conventional level. Furthermore, the sizes of the coefficients on $Ragr_t$ and $Dmbl_t$, -0.88 and -10.58 respectively, show that when each increase by 1%, Fac_t decreases by 0.88% and 10.58%, respectively. In contrast, a 1% increase in $Unem_t$ and $Dragr_t$ cause respective increase in Fac_t of 0.40% and 0.44%. The positive effect of $unem_t$ contrasts with the theoretical expectation of the study.

The marginal effects of $Ragr_t$ on Fac_t at the minimum, mean and maximum values of $Dmbl_t$ are -1.562, -1.111, and -0.502, respectively. Based on the t-values, the effects are all statistically significant. These results show that agricultural output contributes negatively to Food access at the minimum, mean and maximum values of DMBs loans to MSMEs. The adjusted R-Squared of 0.80 indicate that the model explains 80% of the movements in Fac_t.

Model 2b: In Model 2b, $Ragr_t$, $Unem_t$ and $Dmbl_t$ are negatively signed, while $Dunem_t$ is positive. Furthermore, $Ragr_t$ and $Dmbl_t$ are significant at the 1% and 5% levels based on the t-values of -6.30 and -2.79, while $Unem_t$ and $Dragr_t$ are only significant at the 10% levels based on their respective the t-values of -1.85 and 1.98. The results show that Food access, Fac_t, decreases by 0.79% and 4.58%in response to a 1% increase in $Ragr_t$ and $Dmbl_t$ and a 1 unit increase in $Unem_t$. In contrast, the variable increases by 0.28% in response to a percentage increase in $Dunem_t$. The marginal effects of $Unem_t$ on Fac_t at the minimum, mean and maximum values of $Dmbl_t$ are -0.073, 0.210, and 0.591, respectively.

The effects are statistically insignificant with the exception of the marginal effect at the maximum value which is significant at the 5% level. The implication is that the DMBs loans to MSMEs reduces the negative effects of unemployment on Food access. The positive marginal effects at the higher levels of MSMEs financing contradict theoretical expectation. The adjusted R-Squared is 0.84 showing that the model explains 84% of the movements in Fac_t.

For each of models 1, 2a and 2b, the respective F-statistic values of 23.02, 17.11 and 21 are statistically significant at the 1% level indicating a rejection of the null that all estimated coefficients are zero for each model. Furthermore, the Durbin-Watson Statistics also show that the models are free of autocorrelation.

Key findings of the study are discussed as follows,

Effect of Real agricultural output and Unemployment on Food Security:

First, the study finds a negative co-movement between indicators of food security and agricultural output. This is in accord with Tackie et al., (2023), Thomas et al., (2023), but it contends Lv et al., (2022). It implies that the agricultural sector component of National Food and Nutrition security in Nigeria, which has over time involved several agricultural development policies has not had the capacity to resolve the problems of food availability and food access. Lack of crop diversification, poor processing, storage, and preservation may explain the adverse effect of agricultural output on food security, and therefore, suggest that these are priority areas for food security policy. The study also finds that unemployment affects negatively on food access, which accords with Amare et al. (2021), Etana & Tolossa (2017), Endris Mekonnen, & Kassegn Amede (2022).

Moderating Effects of DMBs Loan to MSMEs: The finding that the moderating variable, DMBs loans to MSMEs has a negative effect on both food security indicators accords with the spirit of Bizikova et al., (2020), and suggests the negative implications of stringent terms of DMBs loans to MSMEs in Nigeria (Ketley, 2012; Ogunmokun et al., 2024) for the economy's food security objective. The study, however, finds that the adverse effect of real agricultural output growth on food security is ameliorated as DMBs loans to MSMEs attains higher levels. In line with the view of about 30% post-harvest losses and associated food insecurity in food surplus countries (Tomlinson, 2011), this finding may point to improvement in storage, preservation, and processing facilities due to increase in financial resources from the loans.

The second key finding on the moderating role of DMBs Loans to MSMEs is that the negative effect of unemployment on access to food also appears to improve with higher levels of the loans. This finding suggests that the loans ameliorate the negative effects of unemployed household members on household income and hence food expenditure and access to food (Restrepo et al., 2021; Wudil, 2022). However, the further finding is that despite the mitigating influence of the loans, they do not succeed in generating a strong positive effect of real ag-

ricultural output on food security. The implication is that the positive influence of DMBs loans to MSMEs requires a certain threshold level which exceeds the amounts of the loans observed in the Nigerian economy.

The Performance of Private Versus Public Intervention in MSMEs Financing:

The main finding on this issue is that while DMBs loans to MSMEs have measurable direct and indirect effects on food security in Nigeria, the CBN owned ACGSF loans to small scale farmers has no effect on the indicators of food security. The implication is that intervention in the MSMEs sector designed as a public sector-based financing has not performed as well as the private sector-based intervention in influencing the factors that impact food security in Nigeria.

Model Diagnostics

The model diagnostics evaluate results for the estimated models in Table 5 support the validity of the estimated models. The Adjusted chi^2 Normality test statistics for Models 1, 2a and 2b have probability values equal 0.2889, 3.68, and 0.6891, respectively. They indicate support for the null of normally distributed regression residuals. Similarly, based on the probability values for the Breusch–Pagan/Cook–Weisberg Heteroskedasticity test-statistics, the models show absence of serial autocorrelation at the 1% level. The Durbin's Alternative Test for Autocorrelation in the residuals in turn, confirms that the null of no serial correlation can be accepted at the 1% level for each one of the models.

Table 5

Model Diagnostics

Test	Model 1		Model 2a		Model 2b	
	Test Stat	Prob.	Test Stat	Prob.	Test Stat	Prob.
Normality: (Adj chi^2)	2.48	0.2889	3.04	3.68	0.74	0.6891
Heterosckedasticity$^{(1)}$ (Chi^2)	0.35	0.5529	0.77	0.3809	1.15	0.2831
Durbin's Alternative Test for Autocorrelation ($H_{0:}$ no serial correlation)	1.80	0.1797	0.7055	0.3639	1.144	0.2849

Source: developed by the author. $^{(1)}$ = Breusch–Pagan/Cook–Weisberg Heteroskedasticity test: (H_0: Normal error terms).

Practical Implementation

MSMEs financing is one type of the interventions to pursue food security. The policy may be used to improve the adverse food security outcomes associated with growth in agricultural sector that is achieved from agricultural projects in the economy.

This study depends on the finding in extant studies of substantial problems in pre-and post-harvest handling of agricultural output, including crop diversification, storage, preservation, processing, and distribution to understand the adverse relation between agricultural output and food security and hence, the moderating effect of MSMES financing. An area for further study is explicating the effects of MSMEs financing on these activities.

Conclusions

The study employed regression analysis with interaction terms to analyse the direct and moderating effects of MSMEs financing on food security indicators in an economy with high agricultural surpluses and food insecurity. Results from the empirical analysis confirms a negative effect of agricultural output on food security indicators. They also show, possibly, representing harsh conditions of the loans, that MSMEs financing had negative direct effects on indicators of food security. The financing however, caused improvements in the adverse effects of both real agricultural output and unemployment on food availability and food access in Nigeria. The results also show that in contrast to the effects of loans from Deposit Money Banks, finance from the Central Bank of Nigeria owned ACGSF to small scale farm holdings had no effect on food security.

The study concludes that MSMEs financing in the form of Deposit Money bank Loans leads to improvement in the adverse effects of real agricultural output and unemployment on food security in Nigeria. However, the level of financing to the sector that has been observed is not large enough in comparison to the level that is required. The recommendations of the study are first, the current level of MSMEs financing is inadequate, achievement of an adequate level of financing for MSMEs will render it effective for the aim of improved food security in the country. Policymakers can reach this achievement by implementing clear rules on the level of credits that should be accessed by MSMEs. It is also recommended by this study that policymakers promote the effectiveness of MSMEs financing as a demand side policy for food security, by implementing rules on tenure and terms of the loans, which takes account of the effects of the loans on households' cashflows. Second, policymakers need to also promote the effectiveness of

MSMEs financing as a supply side policy for food security by giving priority to investments in MSMEs projects that yield outcomes in agricultural output processing, storage, and preservation.

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