The Dynamic Synergies between Agricultural Financing and Economic Growth of Tanzania

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Abstract
We apply the recently developed asymmetric ARDL cointegration methodology of Shin *et al*. (2011) to analyse the relationship between agricultural financing and economic growth of Tanzania. In this approach, short run and long run asymmetries are introduced via positive and negative partial sum decompositions of exogenous variables, and the model is estimable by standard OLS. Our findings reveal supporting evidence of asymmetric interactions among the examined variables in the short run and long run. The findings further reveal that endogenous variables react differently to positive and negative shocks of exogenous variables. Positive shocks of agricultural financing have considerably larger positive impacts on economic growth compared to negative shocks, while any unfavourable economic conditions would clobber agricultural financing. In light of our findings, we conclude that the existing asymmetric relationship between agricultural financing and economic growth should be taken into account and the government should increase its financing of the agriculture sector.

Keywords: Agricultural financing, Economic growth, Asymmetric ARDL model, Tanzania

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1.0 Introduction

Tanzania like other developing countries has put poverty reduction as the primary objective in its public policies for many years. Agriculture was and is still considered to be the main vehicle in achieving poverty reduction objective since it employs the majority of the population and it contributes substantially to the formation of national income. This sector contributed about 15.7% in 2009 and 13.2% in 2015 of the total gross domestic product (GDP and employs more than 65% of the total population (FAO, 2017). Despite its immense contributions, it suffers from underinvestment by the public and private sectors, and this is its major impediment. Statistics indicate that developing countries spent 3.7% in 2001 while in 2015 they spent only 1.9% of their total spending in agriculture and 2.9% of total credit to agriculture from their domestic banks. Consequently, in recent years, the percentage share of agricultural sector in total GDP has been declining in spite of the fact that the sector still employs the majority of the population. In Malawi, for example, the share has declined from 36.2% in 2003 to 29.9% in 2008 while in Madagascar and Tanzania the share dwindled from 26.7% in 2003 to 22.3% in 2008 and from 46.7% in 2003 to 24% in 2008 respectively (The Regional Strategic Analysis and Knowledge Support System (RESAKSS), 2017; BoT, 2016)

To curb the preceding problem, African leaders begun to mobilize local resources to support agricultural sector in order to reverse the declining trend of the sector's contribution to GDP. In 2003 a powerful initiative was introduced to support smallholder farmers through what was known as the Comprehensive Africa Agriculture Development Programme (CAADP). This initiative was endorsed by African countries in the Maputo Declaration in which African leaders pledged to allot 10% of their national budgets to agriculture (Alabi, 2014). Some countries immediately begun to implement this declaration and changes in their budget allocations were observed. For instance, Malawi increased its budget allocation to agriculture from 4% in 2003 to 20% in 2008, Madagascar increased from 3% in 2003 to 16% in 2008, and Mali increased from 9% in 2002 to 12% in 2008 (RESAKSS, 2017). This increase in budget allocations by these countries implied more resources committed to agriculture. The Maputo declaration aimed at improving agriculture to meet the demand of Africa's growing population that is estimated to reach 2.4 billion people come 2050.

Tanzania's agriculture sector contributes about 25% of the GDP and over 65% of employment in the country and as the case for other African countries it suffers from underinvestment due to lack of reliable sources of finance (Ndulu, 2014; Thapa, 2012). Tanzania like other African countries committed itself to the Maputo and Malabo declarations on agriculture to set 10% of its public expenditure for agriculture. Despite the commitment it has not reached the 10% budgetary allocation to agriculture since 2003. The highest budgetary allocation for agriculture in Tanzania was 7.8% for the financial year 2010/2011 (ANSAF, 2012). Total public spending on agriculture for Tanzania averaged 5.4 % during 1995-2003, 5.3% during 2004-2008 and 4.8% during 2008-2014 (RESAKSS, 2017). Contrary to the expectation that allocation to agriculture would increase after the 2003 Maputo declaration, Tanzania's average spending on agriculture experienced a decreasing trend. Moreover, development expenditure to agriculture has been decreasing while recurrent expenditure has been increasing which deters capitalisation and modernisation of the agricultural sector. For instance recurrent expenditure was 39.5% in 2001/01, 82.4% in 2008/09, and 59.0% in 2011/12, while development expenditure was 60.5% in 2000/01, 17.6% in 2008/09, and 41% in 2011/12 (ANSAF, 2012).

In terms of commercial banks' credit to agriculture, Tanzania has experienced most of its commercial banks' credit being allocated to personal activities, trade and manufacturing with agriculture enjoying a small share of this credit. Credit to agriculture accounted to 7.4% of total domestic credit from commercial banks in 2015/16 compared to 10.7% in 2011/2012 (BoT, 2016). Comparing with other sectors of the economy like personal activities, trade and manufacturing which received 20.1%, 18.8% and 9.9 % respectively, agriculture received a smaller share of credit from commercial banks. It is estimated that about 91 % of total credit to agriculture is allocated to agricultural trading and only 9% is allocated to agricultural production (Shamte, 2014). Higher credit risk and transaction cost of lending to agriculture production affects commercial banks' willingness to extend credit to agriculture (Thapa, 2012). As a result, lenders provide credit to activities associated with agricultural trading than production because of their lower credit risk and transaction cost.

The remainder of this study is organized as follows. Section 2 reviews the empirical literature. While section 3 presents the methodology, section 4 gives empirical findings and discusses the results. Section 5 concludes.

2.0 Empirical Literature Review

A number of studies have investigated the relationship among credit to agriculture, public expenditure on agriculture and economic growth of different countries in different periods. Some studies revealed that credit to agriculture and public expenditure on agriculture have significant influence on the economic growth of a country. Such studies include Chandio et al. (2016) who used Johansen cointegration test and found long run relationship between government expenditure on agriculture, agricultural output and economic growth in Pakistan. Wangusi and Muturi (2015) for Kenya, Ebere and Osundina (2014), and Udoh (2011) for Nigeria revealed significant relationships between expenditure on agriculture and economic growth. Yet again, Jatuporn et al. (2011) reported a long run relationship between agriculture and economic growth for Thailand and therefore purporting that financing agriculture promotes economic growth of a country. Ayeomoni and Aladejana (2016) for Nigeria, Hartarska et al. (2015) for United States confirmed positive associations between agricultural credit and economic growth. Obansa and Maduekwe (2013) for Nigeria and Katircioglu (2006) for Cyprus found bidirectional causality between agricultural financing and economic growth of their respective countries. Şimşir (2012) ascertained that agricultural credit has a direct effect on agricultural income and employment in Turkey. Similarly, Alabi (2014) substantiated that foreign agriculutral aid has a positive and significant impact on agricultural GDP and agricultural productivity in Sub Saharan African.

On the contrary, Matahir and Tuyon (2013) reported no evidence of causality between agriculture and economic growth in the short run but in the long run for Malaysia. Chebbi (2010) investigated the relationship between agriculture and economic growth in Tunisia and the study confirmed a very limited role of agriculture in promoting economic growth compared to other sectors. Matthew and Mordecai (2016) study results depicted negative impact of agricultural expenditure on agricultural output and positive impact of agricultural credit on agricultural output in Nigeria. Correspondingly, Kareem et al. (2015) revealed a negative relationship between public spending on agriculture, agricultural output and economic growth of Nigeria. The findings from these empirical studies yield mixed and conflicting results which suggest a need to study the relationship among the variables in Tanzania, where empirical evidences *a propos* this relationship remain conspicuously few.

Recent studies that investigated the relationship between different components of expenditure and economic growth in Tanzania include Kyissima et al. (2017); Paul and Furahisha (2017); Kapunda and Topera (2013); Kweka and Morrissey (2000). These studies did not consider issues of asymmetry in their analyses, they employed standard cointegration techniques which implicitly assume that the adjustment process of the variables is precisely symmetric and the adjustment speed remains the same despite a positive or negative equilibrium error (Keho, 2017). This assumption of symmetry ignores the fact that positive and negative changes of a macroeconomic variable do not necessarily have the same impacts on other macroeconomic variables. The impact of a negative shock or change in an exogenous variable could be different from the impact of a positive shock or change both in size and magnitude. We cannot deny the fact that, for example, increase (positive change) and decrease (negative change) in government expenditure have different impacts on individual and national incomes. If income is influenced differently by the increase and decrease in government expenditure, then we need a methodology/technique that could capture the impacts of these positive and negative changes. Therefore, standard cointegration techniques may be insufficiently rich in typifying the true relationship between agricultural financing and economic growth of Tanzania. The reason is that, estimating a relationship among variables which are possibly asymmetric with standard cointegration techniques may lead to serious inappropriate conclusions (Keho, 2017 and Enders, 2015). Hence, we use nonlinear cointegration technique, specifically the Nonlinear Autoregressive Distributed Lag (NARDL) model advanced by Shin et al. (2011) and Pesaran et al. (2001) which helps to overcome the shortcomings of the standard cointegration techniques by incorporating both short run and long run asymmetries via positive and negative partial sum decompositions of explanatory variables and concurrently capture asymmetries in the dynamic adjustment.

3.0 Methodology

The Nonlinear Autoregressive Distributed Lag model (NARDL) model advanced by Shin et al. (2011) is used to examine the nexus between agricultural financing and economic growth of Tanzania. According to Greenwood-Nimmo et al. (2010) the NARDL model is basically an asymmetric extension of the linear ARDL technique of modelling long run cointegrating relatioships developed by Pesaran and Shin (1999) and Pesaran et al. (2001). Following and emulating Shin et al. (2014), Athanasenas et al. (2014) and Greenwood-Nimmo et al. (2010), we consider the following nonlinear asymmetric cointegrating regression:

$$y_t = \beta^+ x_t^+ + \beta^- x_t^- + u_t \qquad (1)$$

Where β^+ and β^- are the associated asymmetric long run parameters and x_t is a k x 1 vector of regressors decomposed as $x_t = x_0 + x_t^+ + x_t^-$ where x_t^+ and x_t^- are partial sum processes of positive and negative changes in x_t. The formulation of the partial sums of positive and negative changes is given as:

$$x_t^+ = \sum_{i=1}^{t} \Delta x_i^+ = \sum_{i=1}^{t} \max\left(\Delta x_i, 0\right) \text{ and } x_i^- = \sum_{i=1}^{t} \Delta x_i^- = \sum_{i=1}^{t} \min\left(\Delta x_i, 0\right) \qquad (2)$$

Accounting for the partial sum processes of positive and negative changes in x_t, Shin *et al.* (2011) revealed that we can associate equation (1) with the linear ARDL (p,q) model (see, Athanasenas et al., 2014); Greenwood-Nimmo et al., 2010 and Pesaran et al., 2001) and straightforwardly extend it to yield the following asymmetric NARDL (p,q) model:

$$\Delta y_t = \alpha_0 + \rho y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \sum_{i=1}^{p-1} \varphi_i \Delta y_{t-i} + \sum_{i=0}^{q} \left(\pi_i^+ \Delta x_{t-i}^+ + \pi_i^- \Delta x_{t-i}^- \right) + \varepsilon_t \qquad (3)$$

The superscripts (+) and (–) in equation (3) represent the positive and negative partial sum decompositions defined in equation (2), p and q stand for the lag order of the endogenous and exogenous variables respectively in the distributed part. Equation (3) is the NARDL model and our first step of the empirical analysis requires that, once the regressors x_t, are decomposed into x_t^+ and x_t^-, the model can simply be estimated by standard OLS. Subsequently, asymmetric cointegration between the levels of variables is tested using the bounds-testing procedure developed by Pesaran et al. (2001) and Shin et al. (2011) which remains valid even if the variables are *I(0)*, *I(1)* or both *I(0)* and *I(1)*. The joint null hypothesis of $\rho = \theta_1^+ = \theta_1^- = \theta_2^+ = \theta_2^- = 0$ is tested by the F-test of Pesaran et al. (2001) which is denoted by F_{PSS} and uses two critical value bounds, the upper bound and lower bound critical values. If the computed F-statistic exceeds the upper bound critical value, then there is evidence of contegration. If the computed F-statistic falls below the lower bound critical value, there is no contegration. If, however, the computed F-statistic falls between the lower and upper bound critical values, then the test is inconclusive. Lastly, we test for long and short run symmtries using the standard Wald test. For long run symmetry we test the null hypothesis $\theta^+ = \theta^- = 0$, while for short run symmetry, the null hypothesis is $\pi_i^+ = \pi_i^-$ for all $i = 0,...,q-1$ or $\sum_{i=0}^{q} \pi_i^+ = \sum_{i=0}^{q} \pi_i^-$ (see, Greenwood-Nimmo, et al. 2010; Shin at al. 2011; Atil, et al. 2014).

From equation (3) we develop the the general form for the NARDL (p,q) model of government expenditure on agriculture *(gea)*, credit to agriculture *(c2a)* and output *(gdp)* as follows:

$$\Delta gdp_t = \alpha_0 + \rho gdp_{t-1} + \theta_1^+ gea_{t-1}^+ + \theta_1^- gea_{t-1}^- + \theta_2^+ c2a_{t-1}^+ + \theta_2^- c2a_{t-1}^- + \sum_{i=1}^{p-1} \phi \Delta gdp_{t-i} + \sum_{i=0}^{q} \pi_{1i}^+ \Delta gea_{t-i}^+$$
$$+ \sum_{i=0}^{q} \pi_{1i}^- \Delta gea_{t-i}^- + \sum_{i=0}^{q} \pi_{2i}^+ \Delta c2a_{t-i}^+ + \sum_{i=0}^{q} \pi_{2i}^- \Delta c2a_{t-i}^- + \varepsilon_t \quad (4)$$

$$\Delta gea_t = \alpha_0 + \rho gea_{t-1} + \theta_1^+ gdp_{t-1}^+ + \theta_1^- gdp_{t-1}^- + \theta_2^+ c2a_{t-1}^+ + \theta_2^- c2a_{t-1}^- + \sum_{i=1}^{p-1} \phi \Delta gea_{t-i} + \sum_{i=0}^{q} \pi_{1i}^+ \Delta gdp_{t-i}^+$$
$$+ \sum_{i=0}^{q} \pi_{1i}^- \Delta gdp_{t-i}^- + \sum_{i=0}^{q} \pi_{2i}^+ \Delta c2a_{t-i}^+ + \sum_{i=0}^{q} \pi_{2i}^- \Delta c2a_{t-i}^- + \varepsilon_t \quad (5)$$

$$\Delta c2a_t = \alpha_0 + \rho c2a_{t-1} + \theta_1^+ gea_{t-1}^+ + \theta_1^- gea_{t-1}^- + \theta_2^+ gdp_{t-1}^+ + \theta_2^- dgp_{t-1}^- + \sum_{i=1}^{p-1} \phi \Delta c2a_{t-i} + \sum_{i=0}^{q} \pi_{1i}^+ \Delta gea_{t-i}^+$$
$$+ \sum_{i=0}^{q} \pi_{1i}^- \Delta gea_{t-i}^- + \sum_{i=0}^{q} \pi_{2i}^+ \Delta gdp_{t-i}^+ + \sum_{i=0}^{q} \pi_{2i}^- \Delta gdp_{t-i}^- + \varepsilon_t \quad (6)$$

After estimating models (4), (5) and (6) using OLS, we proceed with the cointegration tests, and in particular, we test the joint null hypothesis of no cointegration $\rho = \theta_1^+ = \theta_1^- = \theta_2^+ = \theta_2^- = 0$ in all models. Besides, the short run impact of positive and negative shocks of the first independent variable on the dependent variable is captured by π_{1i}^+ and π_{1i}^- respectively, while the short run impact of positive and negative shocks of the second independent variable is captured by π_{2i}^+ and π_{2i}^- respectively. The long run impact of positive and negative shocks of the first independent variable is captured by $-\theta_1^+/\rho$ and $-\theta_1^-/\rho$ respectively, while the long run impact of positive and negative shocks of the second independent variable is captured by $-\theta_2^+/\rho$ and $-\theta_2^-/\rho$ respectively.

4.0 Data, Empirical Results and Discussion

This study uses logarithm of annual time series data for Tanzania covering the period from 1990 to 2016, and due problems of data availability the time series data were taken from different sources. The time series data for government expenditure on agriculture were collected from the International Food Policy Research Institute (IFPRI) database. Time series data for commercial bank credit to agriculture were collected from Food and Agriculture Organizanition (FAO) database, and gross domestic product data were collected from IMF database.

We start our analysis by conducting unit root tests to determine the order of integration of the variables. Although the NARDL cointegration methodology does not require that all variables must be integrated of the same order, the presence of variables integrated of order two *I(2)* turns the computed F-statistics invalid. The reason is given by Pesaran et al. (2001) that the lower bound critical values assume that the variables are purely *I(0),* and the upper bound critical values assume that the variables are purely *I(1),* so there is no way we can include variables that are purely *I(2)*. Therefore, we conduct unit root tests to exclude from our analysis any variable that is integrated of order two *I(2).* The Phillips-Perron (PP) unit root test and Kwiatkowski-Phillips-Schmidt-Schin (KPSS) test are used. The KPSS test results reported in Table 1 reveal that all the variables are integrated of order zero *I(0)* and the PP test results indicate that all the variables expect GDP are integrated of order one *I(1)*. Therefore, all variabes meet the conditions of the ARDL cointegration method as none of them is purely *I(2)*.

Table 1: Unit Root Tests Results

Variables	Level		First Difference	
	PP	KPSS	PP	KPSS
lngdp	-0.6731	0.7563***	-2.9345	0.0888
lngea	-1.9934	0.5456**	-4.9736***	0.1157
lnc2a	-0.3381	0.7127**	-4.4599***	0.1270

Notes: The optimal lag structure of the PP and KPSS tests was selected based on the Newey- West Bandwidth. *** and ** denote significance at the 1% and 5% levels respectively. The respective 1%, 5% and 10% critical values for the PP test are -3.7115, -2.9810 and -2.6299 at level, and -3.7241, -2.9862 and -2.6326 at first difference. The respective 1%, 5% and 10% critical values for the KPSS test are 0.7390, 0.4630 and 0.3470 at level and at first difference.

After confirming the order of integration of the variables, we proceed to test for nonlinear cointegration by firstly estimating the NARDL (p, q) models by OLS. The optimal lag order is selected using Schwarz Bayesian Criterion (SBC) and the NARDL specifications are based on the specific to general approach for all models (4), (5) and (6). Based on the OLS estimation results reported in Table 2, the asymmetric cointegration test is conducted using the F-test of Pesaran et al. (2001) specifically to test the joint null hypothesis of no cointegration $\rho = \theta_1^+ = \theta_1^- = \theta_2^+ = \theta_2^- = 0$ for all three models. The results clearly reveal statistically siginificant and sturdy evidence in favor of the existance of long run cointegration among the variables. The computed values of the F_{PSS} statistics are 12.94, 38.27, and 9.48 for models (4), (5), and (6) respectively. Since the 5% lower and upper bound critical values are 3.79 and 4.85 respectively for $k = 2$, and all the computed F_{PSS} statistics exceed the upper bound critical value, we therefore conclude that there is long run cointegration among the variables.

We proceed to test for symmerty and apply the standard Wald tests to examine both the long run and short run symmetries among the variables. The results for short run and long run Wald tests are also reported in Table 2. The Wald test results for long run symmetry reveal that the null hypothesis of long run symmetry between positive and negative shocks of exogenous variables in all models is rejected. The test results for model (4) reveal that W_{LR}^{gea} is 119.321 (p-value = 0.000) and W_{LR}^{c2a} is 11.106 (p-value = 0.007); for model (5) W_{LR}^{gdp} is 15.679 (p-value = 0.005) and W_{LR}^{c2a} is 48.119 (p-value = 0.000), and for model (6) results W_{LR}^{gea} is 27.318 (p-value = 0.003) and W_{LR}^{gdp} is 22.5 (p-value = 0.005). Therefore, we conclude in favour of long rung asymmetries between positive and negative shocks of exogenous variables for all the three models. Similarly, the Wald test results for short run symmetry also reject the null hypothesis of short run symmetry in some cases. The test results for model (4) reveal that W_{SR}^{gea} is 14.224 (p-value = 0.004) implying short run asymmetry from government expenditure on agriculture towards GDP, but rejects any short run asymmetric relations between credit to agriculture and GDP as W_{SR}^{c2a} is 1.544

(p-value = 0.242). Short run asymmetry is confirmed in model (5) where W_{SR}^{gdp} is 10.589 (p-value = 0.014) and W_{SR}^{c2a} is 86.865 (p-value = 0.000) suggesting the rejection of the null hypothesis of additive short run symmetry for GDP and credit to agriculture. The Wald test results for model (6) report that W_{SR}^{gdp} is 10.736 (p-value = 0.022) implying short run asymmetry from GDP to credit to agriculture. However, the test results fails to reject the null hypothesis of additive short run symmetry for government expenditure on agriculture and credit to agriculture because W_{SR}^{gea} is 0.603 (p-value = 0.473).

Having confirmed that both positive and negative changes in the exogenous variables have different impacts on endogenous variables, we proceed to analyse the short run and long run asymmetric dynamics based on the results reported in Table 2. The estimated asymmetric model (4) reports that both positive and negative long run coefficients of government expenditure on agriculture are statistically significant, with proper signs as reflected in literatures. The results reveal that in the long run, a 1% increase in government expenditure on agriculture leads to a 0.5% increase in the country's GDP, while a 1% decrease in government expenditure on agriculture leads to a 0.1% decrease in GDP. The long run results simply reveal that positive changes of government expenditure on agriculture have considerably larger positive impacts on the country's GDP compared to negative changes. The positive long run coefficient of credit to agriculture is statistically insignificant but the negative coefficient is statisticaly significant, implying that the long run impact of reducing credit to agriculture by 1%, is a 0.4% decrease in the country's GDP. In the short run, the impact of government expenditure on agriculture is asymmetric and the sum of its estimated positive and negative coefficients are 0.305 and -0.148 respectively. This implies that in the short run, a 1% increase in expenditure on agriculture leads to a 0.3% increase in GDP, and a 1% decrease would bring about 0.1% deasese in GDP. The short run impact of both positive and negative coefficients of credit to agriculture on GDP are statistically insignificant and symmetric.

Considering model (5), the results show that there is a direct long run relationship between government exenditure on agriculture and GDP. Both the positive and negative long run GDP coefficients are statistically significant. A 1% increase in GDP leads to a 2.1% increase in the portion of government expenditure allocated to agriculture, while a 1% decrease in GDP results in 18.5% decrease in government expenditure on agriculture. The preceding results portray a true picture of the economies of countries like Tanzania which in the past decade has on average covered about 75% of its total annual budget using internal sources and relied on other external sources for the remaining average of 25% of the budget (Wuyts et al. 2016). Therefore, any unfavourable economic conditions that cause the country's GDP to decrease would instantly make the agricultural sector receive less share of total government expenditure. On the other hand, the positive long run coefficient of credit to agriculture is statistically insignificant, but its negative coefficient is positive and statistically significant. This implies that in the long run, a 1% decrease in credit to agriculture causes a 5.1% increase in government expenditure on agricuture. The short run sum of estimated positive and negative coefficients of GDP are statistically significant and equal to 2.931 and -9.131 respectively. The short run results depict that a 1% increase in GDP leads to 2.9% increase in government expenditure on agriculture while a 1% decrease leads to 9% decrease in expenditure on agriculture.

The asymmetric model (6) reveals an inverse long run relationship between credit to agriculture and GDP whereas both the positive and negative long run GDP coefficients are statistically significant. The results report that a 1% increase in GDP leads to a 3.2% decrease in credit to agriculture, while a 1% decrease in GDP leads to a 82% increase in credit to agriculture. This is an interesting piece of findings which corroborates the findings of model (5). Comparing the findings from the two models, it is now evident that when GDP increases just by 1% government increases its expenditure on agriculture by 2.1% and consequently credit to agriculture falls by 3.2% as farmers demand less of the latter from commercial banks. Similarly, when GDP goes down just by 1% government reduces its expenditure on agriculture by 18.5%. This is a big change that impels farmers to look for alternative sources of financing and therefore put more pressure on credit to agriculture from commercial banks which then respond by 82% increase. Similarly, the short run sum of estimated positive and negative coefficients are statistically significant and reveal that in the short run, a 1% increase in GDP leads to a 5.6% decrease in credit to agriculture, and a 1% decrease in GDP results to 17.5% increase in credit to agriculture. The short run results are consistent with the long run results for this model and just confirms the inverse asymmetric relationship between GDP and credit to agriculture.

Table 2: Dynamic Asymmetric Estimation of the Nonlinear ARDL Models

Dependent Variable: Δgdp			Dependent Variable: Δgea			Dependent Variable: Δc2a		
Regressors	Coeff.	Std. Er	Regressors	Coeff.	Std. Er	Regressors	Coeff.	Std. Er
Const.	9.637***	1.359	*Const.*	0.583	0.723	*Const.*	12.624***	2.793
gdp_{t-1}	-1.175***	0.166	gea_{t-1}	-0.946***	0.083	$c2a_{t-1}$	-0.773***	0.213
gea^{+}_{t-1}	0.589***	0.127	gdp^{+}_{t-1}	1.961***	0.283	gea^{+}_{t-1}	-0.242	0.438
gea^{-}_{t-1}	-0.121**	0.046	gdp^{-}_{t-1}	-17.472***	4.282	gea^{-}_{t-1}	-4.149**	1.283
$c2a^{+}_{t-1}$	-0.070	0.047	$c2a^{+}_{t-1}$	0.177	0.082	gdp^{+}_{t-1}	-2.445	1.275
$c2a^{-}_{t-1}$	-0.463***	0.088	$c2a^{-}_{t-1}$	4.777***	0.554	gdp^{-}_{t-1}	63.498***	13.792
Δgdp_{t-1}	0.873***	0.122	Δgdp^{+}_{t-1}	-0.956	0.489	Δgdp^{+}_{t}	2.944	1.396
Δgea^{+}_{t-1}	0.419***	0.062	Δgdp^{-}_{t-1}	-9.131**	3.117	Δgdp^{-}_{t}	27.130***	5.796
Δgea^{-}_{t-1}	-0.148***	0.044	Δgdp^{+}_{t-2}	3.887***	0.468	Δgdp^{+}_{t-1}	-8.577***	1.217
Δgea^{+}_{t-2}	0.205***	0.051	$\Delta c2a^{+}_{t}$	0.715***	0.153	Δgdp^{-}_{t-2}	-9.680	3.928
Δgea^{+}_{t}	-0.319***	0.083	$\Delta c2a^{-}_{t}$	1.453	0.759	Δgea^{+}_{t}	0.490	0.417
$\Delta c2a^{-}_{t-1}$	-0.163	0.110	$\Delta c2a^{+}_{t-1}$	1.344***	0.139	Δgea^{-}_{t}	-1.655***	0.440
$\Delta c2a^{+}_{t-2}$	-0.111	0.066	$\Delta c2a^{+}_{t-2}$	2.453***	0.172	Δgea^{+}_{t-1}	1.806***	0.437
$\Delta c2a^{-}_{t-2}$	0.376**	0.167	$\Delta c2a^{-}_{t-2}$	-4.995***	0.452	Δgea^{-}_{t-1}	1.559	0.736
			$\Delta c2a^{+}_{t-3}$	1.446***	0.214	Δgea^{-}_{t-2}	2.441**	0.867
			$\Delta c2a^{-}_{t-3}$	-2.956***	0.512	Δgea^{-}_{t-3}	-0.535	0.363
						Δgea^{+}_{t-3}	0.884**	0.235
						$\Delta c2a_{t-1}$	0.605	0.283
F_{PSS}	12.944		F_{PSS}	38.269		F_{PSS}	9.477	
LR^{+}_{gea}	0.501***		LR^{+}_{gdp}	2.073***		LR^{+}_{gea}	-0.313	
LR^{-}_{gea}	-0.103**		LR^{-}_{gdp}	-18.469***		LR^{-}_{gea}	-5.367***	

LR^{+}_{c2a}	-0.059	LR^{+}_{c2a}	0.187	LR^{+}_{gdp}	-3.163**
LR^{-}_{c2a}	-0.394***	LR^{-}_{c2a}	5.049***	LR^{-}_{gdp}	82.145***
W^{gea}_{LR}	119.321 (0.000)	W^{gdp}_{LR}	15.679 (0.005)	W^{gea}_{LR}	27.318 (0.003)
W^{c2a}_{LR}	11.106 (0.007)	W^{c2a}_{LR}	48.119 (0.000)	W^{gdp}_{LR}	22.5 (0.005)
W^{gea}_{SR}	14.224 (0.004)	W^{gdp}_{SR}	10.589 (0.014)	W^{gea}_{SR}	0.603 (0.473)
W^{c2a}_{SR}	1.544 (0.242)	W^{c2a}_{SR}	86.865 (0.000)	W^{gdp}_{SR}	10.736 (0.022)
$\overline{R}^2$	0.897	$\overline{R}^2$	0.942	$\overline{R}^2$	0.829
χ^2_{SC}	3.102 (0.146)	χ^2_{SC}	1.774 (0.262)	χ^2_{SC}	5.259 (0.105)
χ^2_{HET}	0.705 (0.727)	χ^2_{HET}	0.438 (0.915)	χ^2_{HET}	0.435 (0.909)
χ^2_{FF}	0.764 (0.396)	χ^2_{FF}	1.248 (0.307)	χ^2_{FF}	0.686 (0.568)
χ^2_{NORM}	1.549 (0.461)	χ^2_{NORM}	19.958 (0.000)	χ^2_{NORM}	0.997 (0.607)

Notes: The superscripts "+" and "–" denote the positive and negative partial sums respectively. F_{PSS} denote the F-statistic of Pesaran et al. (2001), and for $k = 2$ at the 5 percent level of significance, the lower bound and upper bound critical values of Pesaran et al. (2001) are 3.79 and 4.85 respectively. *LR* is the estimated long run coefficient captured by $-\theta^{+}/\rho$ and $-\theta^{-}/\rho$ respective for positive and negative shocks of the variables. W_{LR} and W_{SR} indicate the Wald tests of long run and short run symmetries respectively, *** denote significance at the 1% level and ** denote significance at the 5% level. $\chi^2_{SC}, \chi^2_{HT}, \chi^2_{FF}$ and χ^2_{NORM} denote *LM* test for serial correlation, heteroscedasticity, functional form and normality tests respectively.

Lastly, various diagnostic tests were carried out to assess the adequacy and stability of the dynamic models. The diagnostic tests include serial correlation LM test, heteroscedasticity test, functional form test and normality test. The tests results reported in Table 2 reveal that the regressions for models (4), (5) and (6) fit reasonably well and pass the diagnostic tests against functional form misspecification, serial correlation, non normal errors and heteroscedasticity. This is because the diagnostic tests failed to reject the respective null hypotheses in these models except for model (5) where the null hypothesis of non normal errors is rejected, however this model is in general adequate as it passes all other tests. Therefore, we conclude that in general, the specified models were adequate and the error terms are free from serial correlation problems, normally distributed and no heteroscedasticity. The stability diagnostic test results also reveal that the estimated models have correct functional forms.

5.0 Summary and Conclusion

This study adopted the newly developed nonlinear ARDL methodology to examine the nexus between agricultural financing and economic growth of Tanzania. In doing so, we estimated three macroeconomic models for the nexus between agricultural financing and economic growth under asymmetric structure that involved the positive and negative partial sum decompositions of exogenous variables. This approach, according to Shin et al. (2011), has recently assumed a prominent role in econometric research consequently reflecting an apparent realization by econometric researchers that asymmetry is ubiquitous within social sciences and inherent in modern economies. After the estimation we tested for asymmetric cointegration to check if there is long run cointegration relationship among the variables, and finally we tested for both the short run and long run symmetry to confirm whether the existing relationship among the variables is symmetric or asymmetric.

Our findings clearly support the existence of long run asymmetric cointegration relationship among the variables examined in all three models. The findings reveal that endogenous variables react differently to positive and negative shocks of exogenous variables in the respective models. Specifically, both short run and long run positive shocks of government expenditure on agriculture have considerably larger positive impacts on the country's GDP compared to the negative shocks. On the other hand, negative shocks of GDP have greater negative effects on government expenditure on agriculture compared to positive shocks both in the short run and long run. The findings further reveal an interesting relationship among the three variables where as the country's GDP decreases due to any unfavourable economic conditions, the government reduces its expenditure on agriculture forcing farmers to look for alternative sources of financing, therefore causing credit to agriculture from commercial banks to increase. Similarly, when GDP increases, the government also increases its expenditure on agriculture and therefore credit to agriculture falls because farmers demand less credits from commercial banks. Generally, our findings support the recent theoretical and methodological appeals to investigate the short and long run relationships among macroeconomic variables by using asymmetric cointegration techniques.

The policy implications that we derive from the findings of this study suggest that economic policies geared to achieving fiscal discipline through government expenditure reduction should be implemented wisely. The expenditure pattern of Tanzania reveals that in 2012/13 only 30% of total government expenditure was allocated to developments and the remaining 70% was recurrent expenditure. In 2016/17, 62.4% of the total government expenditure was set as recurrent expenditure and 37.6% as development expenditure (BoT, 2017). Therefore, a good balance between capital and recurrent expenditure is needed to capitalize the agriculture sector which is till today the backbone of Tanzanian economy. Government resources should be appropriately allocated to sectors with higher multiplier effects in the economy, and tax reforms and improved tax administration should be made to increase revenue collections. The government should also work hard to correct all institutional weaknesses, restore fiscal discipline and remove all possibilities of unnecessary and uncontrolled public spending.

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