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IS PUBLIC AGRICULTURAL EXPENDITURE EFFECTIVE ON AGRICULTURAL PRODUCTION IN SUB-SAHARAN AFRICA?

Yaya POUAKONE SECHOUTDI

PhD Student, Public Economic Laboratory, University of Abomey Calavi, Benin
pouakoneyaya@gmail.com

Foster Augustin CHABOSSOU

Professor at the Faculty of Economic and Management
Public Economic Laboratory, University of Abomey Calavi, Benin
achabossou@yahoo.fr

Abstract

This study examines the nexus between government agricultural expenditure and agricultural production in SSA while using panel data from 33 SSA countries from 2001 to 2018. Data are from several sources that is FAOSTAT, ASTI and IFPRI, and the empirical evidence is based on a system Generalized Method of Moments from Blundell and Bond (1998). This method controls for unobserved heterogeneity, potential endogeneity of the explanatory variables and correlated individual effects. Empirical findings reveal that government agricultural expenditure has a positive and significant relationship with agricultural production both in the short run as well in the long run. This study recommends that government should adhere to the Maputo Declaration by allocating at least 10% of their budgets to the agriculture sector for a higher agricultural production, to increase the level of socio-economic infrastructures so as to incite farmers to increase their production and finally to facilitate the attribution of land titles.

Keywords: Government agricultural expenditure, System GMM, SSA, Agriculture, Production

INTRODUCTION

Agriculture is one of the most important activities practiced ever since and it plays a pivotal role in developing countries in general and in Sub-Saharan Africa (SSA) in particular. Since the early 80s the agricultural sector has been progressively abandoned whereas it is one of the sectors which act as a major source of income, food, job opportunities and effective reduction of poverty (Afdb, 2014). Nowadays, over 60 percent of people in Africa live in rural areas and relied specifically on agriculture to earn a living (Afdb, 2016), and more than half of the labor force provided in agricultural production is made uniquely by women (Christiaensen, Demery, & Kuhl, 2010). In SSA, agriculture remains the main engine for economic growth, around 40% to their gross domestic product are from this sector and employing more than half of their total labor force. The gross domestic product (GDP) growth from agriculture is shown to raise incomes of the poor by 2 to 4 times more than GDP growth from non-agricultural activities (Afdb, 2014).

Governments in SSA are generally giving far less prominence to agriculture than its contribution to the economy. The World Bank (2015) reported that agriculture is an engine for development in Africa and has been neglected by governments reason for limited access to food by the local population. The agricultural sector has been facing great difficulties over the pass decades in SSA as a result of increase demand of food by it emerging population (Philip and al., 2011). Its production outcomes is considered as one of the lowest in the world in contrast with the demographic change. In early 2000, the urban population of Africa was estimated at 263 million people. From 2005 to 2015, there was a drastic shift of the population from 311 million to 446 million people which explains the increase in demand of agricultural products (African Development Bank, 2016). The role of governments is shifting towards fostering an enabling environment for responsible expenditure with the ambition of reducing the constraints faced by smallholder farmers. Government agricultural spending in SSA remains very low when compare with other developing regions (Asia and Latin America) in the world. For the past three decades Africa spent only 4 to 7 percent of its total national budget on agriculture compare to Asian countries where 6 to 15 percent of their public budget were oriented (Mogues & Benin, 2012).

The States in SSA need to increase public spending in agriculture which is one of the most direct and effective methods, secure property rights, develop rural infrastructure for it may promote agricultural production, food security and nutrition, poverty reduction and rural development. Achieving Sustainable Development Goals (SDG) will depend on the availability of long-term public spending to support agricultural initiatives (Fan, Omilola, & Lambert, 2009). Accessing long-term public spending will require a greater focus on the quality of spending on agricultural preparation and implementation, as well as policies and instruments that can lower risk and strengthen the confidence of small farmer. Financing a transformative agricultural development agenda requires resources to be used more effectively and strategically to catalyze an increase in agricultural production in SSA.

Sub-Saharan African countries are diverse and asymmetrical in terms of area, population, high labor force, endowment of natural resources such as; cultivable land, favorable climate, water, etc. The subsistent local farming system are under massive threats of less attention given to it by States, population growth, land scarcity and worsening ecological degradation and climate change episodes. The limited attention by governments in agricultural research, technology, irrigation systems, reinforcement of farmers' capacity in modern methods of cultivation and infrastructure development further aggravates the production decline rendering access to food difficult (Ssozi, Asongu, & Amavilah, 2017). SSA is known to be one of the regions in the world where a green revolution in agriculture has failed to materialize. (Philip et al., 2011). Despite the contribution of public agricultural expenditure to the agricultural sector, it has performed poorly relative to other developing countries due to limited attention given to it (Barrios, Ouattara & Strobl, 2008). Thus, this study aims to examine the effectiveness of public agricultural expenditure on agricultural production in SSA.

In an attempt to address the gap observed above and contribute to the current empirical literature, this study employs an up-to-date dataset on public agricultural expenditure, credit accorded to the agricultural sector, number of researchers, arable land and includes a wider coverage of SSA countries. The rest of the paper goes thus: Section 2 provides theoretical highlights and recent empirical reviews, research methodology is covered in Section 3, Section 4 analyses and interprets results while we conclude in section 5 with recommendations and future research directions.

BRIEF INSIGHTS FROM THE EXISTING LITERATURE

The usefulness of government expenditure in boosting economic activity has always been at the center of debates. This section presents the literature on theoretical and empirical debates on public expenditure. It is therefore necessary to provide a theoretical outline of the effectiveness of public expenditure following the interventionists of the Keynesian theory, then, the empirical literature.

The public expenditure theory according to the Keynesian

The notion of enhancing government expenditure with the aim of increasing agricultural production goes in straight line with the Keynesian thought which stipulates that the state can increase it expenditure to impact on economic activities. John Maynard Keynes revolutionized the 20th century with the "General Theory of Employment, Interest and Money" which later became the foundation of macroeconomics. He provided a solution to the 1929 crisis with this theory. According to him, public expenditure is an instrument which can be used to restrict or expand economic activities. Keynes further highlighted that an increase in public expenditure leads to an increase in production hence increase in income. Mogues & Benin (2012) considered public expenditure as one of the policy instruments governments in developing countries could use in improving agricultural growth and sustainable food production. Increased government expenditure in agriculture (irrigation, fertilizers, input subsidize, innovation, research and development, etc.) and other sectors like education, transport and health can therefore boost the productivity of all factors in agricultural sector leading to agricultural growth hence playing an important role in the economy, as part of the income from these activities are saved, part consumed and part taxed. The increase in consumption through the Keynes multiplier effect therefore rendered economic activities dynamic hence facilitating food accessibility to households. Keynes' thought changed the way states view public finances. Indeed, public finance management before 1929 consisted solely of financing collective services. State public spending was not used to influence the level of economic activity as to what we have nowadays. Public spending is an important instrument of economic policies for recovery or stabilization. The Keynesian theory shows that the State can take advantage of the positive and negative effects of the level of public spending to influence the demand of economic agents. On one hand, when the government increases taxation or reduces public spending in response to a situation in the economy, fiscal policies are considered restrictive. On the other hand, when the government increases public expenditure to stimulate demand in the event of high unemployment or as a result of a fall in economic activities, fiscal policies are considered expansionary. In the case of the need to revive production growth, the elements used focus on the precision of the existing quantitative relationships between public expenditure and the level of output and employment. Thus, for Keynes, public spending stimulates economic activity.

Empirical Literature

Researchers after several studies had controversial findings as far as public expenditure is concern. These controversial findings have greatly contributed in the literature.

With the aim of analyzing the impact of agricultural public spending on Chinese food economy, Xu, and al. (2011) developed a dynamic computable general equilibrium (DCGE) model to analyze economy wide impacts. They came out with results showing that public spending has significant impact on food production, price, and trade. Their evidence also proved that an increase in public spending on agricultural research and development (R&D), irrigation, and agricultural subsidy has a modest impact on other sectors such as industry, service, and GDP growth.

In a study carried out by disaggregating the total agricultural expenditure into spending on irrigation as well as spending on subsidies, a time series analysis (during the period 1976-2006) with both ordinary least squares and generalized method of moments econometric techniques were used by Armas and al. (2012) in Indonesia. They obtained results showing that there exist a positive relationship between infrastructure spending and agricultural growth. Also, public spending on agriculture and irrigation during the period 1976–2006 had a positive impact on agricultural growth while spending on input subsidies like fertilizer had a negative relationship with agricultural production hence render its realization difficult.

In a comparative impact analyses of public expenditure on agricultural growth in South Africa and Zimbabwe, Timothy et al. (2015) analyzed time series data from 1981 to 2006 for Zimbabwe and 1983 to 2011 for South Africa using stationarity, co-integration and error correction techniques. Findings here are similar to those of Adofu, Abula, & Agama (2012) which show that capital expenditure is positively associated with agricultural growth for both countries and asserts the importance of this variable for growing the agricultural sector. The results also show a negative impact of non-agricultural expenditure on the agricultural sector for Zimbabwe as against the positive influence in South African. Timothy et al. (2015) went on calling the attention of governments in both South Africa and Zimbabwe to shift their priorities and focus more on capital expenditures.

In the course of examining the empirical relationship between public agricultural spending and agricultural growth in India, time series data covering 17 major states in India from 1981 to 2014 were analyzed by (Bathla, 2017). He adopted the Ordinary least square (OLS) and the generalized methods of moments (GMM) techniques. His results reveal that low and inadequate public capital formation impinged upon farmers' investment and jeopardized technological change and agricultural growth. Empirical results are similar with those of Iganiga & Unemhilin (2011) which reveals a positive and significant impact of public expenditures on agriculture R&D and irrigation on agriculture income. Both OLS and GMM techniques show consistent results. However, GMM specification shows the estimated coefficient on public spending on agriculture R&D and irrigation to be much higher at 0.05 and 0.19 respectively, in impacting agricultural income.

Ogboru, Abdulmalik, & Park, (2018) examined government expenditure on agriculture and its impact on unemployment reduction in Nigeria from 1999 to 2015. They used time series data obtained from secondary sources on unemployment rate, government expenditure on agriculture and GDP from the Central Bank of Nigeria Statistical Bulletin, the National Bureau of

Statistics, and the World Bank Trading Economics for analysis. A simple linear regression model was used with the application of Ordinary Least Squares technique. Results obtained show that government recurrent expenditure and government capital expenditure both have positive effect but insignificant relationship between the variables and unemployment rate while the GDP shows a negative and significant relationship between economic growth and rate of unemployment in Nigeria. The government expenditure on agriculture does not amount to reducing unemployment significantly. Hence, there is no directional relationship between government expenditure on agriculture and unemployment.

Mustapha & Enilolobo (2019) in the course of highlighting the effects of public agriculture spending on agricultural performance, employs a system generalized method of moment to control for endogeneity, simultaneity, and reverse causality. Results show that on one hand, public expenditure on energy supply, research and development and railway line are positive and essential for the agricultural sector performance to feeding SSA, hence revealing a positive impact on to agriculture value added in SSA countries while on the other hand, public spending invested in credit given and fertilizer have a negative and insignificant relationship with agriculture value added.

Aragie & Balié (2019) carried out a study analyzing the influence of public spending on agricultural productivity. An economic wide general equilibrium model calibrated to a well disaggregated social accounting matrix representing the economic structure in 2010 was adopted. Their findings show that overall public spending have a positive and significant relationship with agricultural production. These benefits are substantially higher for rural households, revealing the positive role such spending play for food security and poverty reduction. A comparison of the relative efficiency of the policies shows that support to farmers in the form of input subsidy is the most effective and rewarding in terms of output and welfare, followed by irrigation development for it increases agricultural production.

To our knowledge, this study is one of the very studies that explore the relationship between government agricultural expenditure and agricultural production. It seemed necessary for us to deepen the analyzes by varying the components, modifying the sample of countries and trying to solve the different limits using the technique borrowed from Blundell and Bond (1998).

RESEARCH METHODOLOGY

Empirical model specification

The importance of public spending on agriculture follows a logic of the Keynesian theory which stipulates that public spending is vital and is a way in which economic activities can be boosted. Our model (public expenditure on agricultural production) is anchored on an augmented model of Ebi & Amaraihu (2018) initially developed by Charles Cobb and Paul Douglas (1928). Ebi & Amaraihu's (2018) in their model used agricultural output in tons as endogenous variable and as exogenous variables, they used agricultural government expenditure, adult literacy rate, labor force, rainfall, and lending rate. Their model permits us to bring about some modifications and extension in the function so as to bring in more variables in line with observed empirical phenomena. Therefore, to explore the relationship existing between government agricultural expenditure and agricultural production in SSA, the Ebi & Amaraihu model is augmented by extending the production function to include government agricultural expenditure as one of the variables affecting output. Some of the variables affecting agricultural production include arable land, number of researchers engaged in agriculture, credit allocated to farmers etc. We can therefore conveniently express government agricultural expenditure on agricultural output as:

$$Aproin_{it}=A_{it}\ \text{Aproin}_{it-1}^{\alpha1}\ \text{Gagrex}_{it}^{\alpha2}\ \text{Gagrex}_{it}^{\alpha3}\ Kap_{it}^{\alpha4}\ Lan_{it}^{\alpha5}\ Lab_{it}^{\alpha6}\ Agricre_{it}^{\alpha7}\ Nmsearcher_{it}^{\alpha8}$$

(1)

Where, Aproin means Agricultural production index[1] used as a proxy for agricultural production; Gagrex represents government agricultural expenditure in US dollars; Kap is the amount of money invested by private individuals in the agricultural sector expressed in US dollars; Lan stands for the percentage of arable land used for permanent crop cultivation and for permanent pastures; Lab refers to the number of workers engaged in agriculture; Agricre stands for the amount of loans granted by the private and commercial banking sector to producers in agriculture, forestry and fisheries, including household producers, cooperatives, and agro-businesses; Nmsearcher represents the number of researchers engaged in agriculture per thousand of agricultural farmers.

The agricultural production $(Aprod_{it-1})$: The lagged endogenous variable is integrated among explicative variables in order to test dynamic effects behavior of the model. Mustapha & Enilolobo (2019) applied this approach that brought into their model some level of dynamics in the course of analyzing the effect of public spending on food production and agriculture sector performance.

${Gagrex_{it}}^2$ is also introduced in the equation to take in account the possibility of non-linearity of the relation government agricultural spending and agricultural production. This goes in line with Apata, (2019) who analyze public spending mechanisms and gross domestic product growth in the agricultural sector in Nigeria. In order to estimate equation (1) above, we linearize it by integrating the logarithm transformation. Hence, the model becomes:

[1]Agricultural production index is considered as the endogenous or explained variable and for the exogenous or explicative variables, we have government agricultural expenditure or spending, Kap, Lan, Lab, Agricre and Nmsearcher.

$Log\ (Aproin_{it}) = \alpha_0\ Log(A_{it}) + \alpha_1 Log(Aprod_{it-1}) + \alpha_2\ Log(Gagrex_{it}) + 2\alpha_3\ Log(Gagrex_{it}) + \alpha_4 Log(Kap_{it}) + \alpha_5\ Log(Lan_{it}) + \alpha_6 Log(Lab_{it}) + \alpha_7 Log(Agricre) + \alpha_8 Log(Nmsearcher_{it}) + \varepsilon_{\ it}$

(2)

The empirical counterpart of the dynamic equation to be estimated is as follows:

$Log\ (Aproin) = \alpha_0 + \alpha_1 Log\ (Aprod_{it-1}) + \alpha_2 Log(Gagrex_{it}) + 2\alpha_3 Log(Gagrex_{it}) + \alpha_4 Log\ (Kap_{it}) + \alpha_5 Log(Lan_{it}) + \alpha_6 Log(Lab_{it}) + \alpha_7 Log(Agricre) + \alpha_8 Log(Nmsearcher_{it}) + \mu_i + \varepsilon_{\ it}$

(3)

μ_i is unobserved country specific (time invariant) effects of each country *i* and $\varepsilon_{\ it}$ is the error term. Aproin is considered as an endogenous variable of the model, while $\mathrm{Aprod_{it-1}}$, Gagrex, Kap, Lan, Lab, Agricre and Nmsearcher are exogenous variables. The choice made for the variables used in this study is justified by the fact that in literature those variables are often used to explain the influence of government agricultural expenditure on agricultural production.

Estimation technique

To estimate our dynamic equation (equation 3) above, we adopt a Generalized Method of Moment[2] condition (GMM) system approach of Blundell and Bond (1998) that was also used in studies realized by Bathla (2017), Sers & Mazhar (2018); Mustapha & Enilolobo (2019) and Gachili & Mongbet, (2020). The system GMM estimation approach enables in addressing endogeneity problem (that is a correlation between the explanatory variable and the error term in the model) by exploiting the time series variation in the data, controlling for unobserved group-specific effects, Omitted variables, simultaneity and allowing for the inclusion of a lagged dependent variable in the model. The GMM system of Blundell & Bond, (1998) is preferable to other estimation methods that is Ordinary least square method, first difference of Arellano & Bond (1991) and other estimation techniques because of its above advantages. Blundell & Bond (1998) shows with the help of Monte Carlo simulation that the system GMM estimator is more efficient than the first differenced because it performs and provides robust results. In the presence of heteroscedasticity and serial correlation, a two-step system GMM estimator is used by exploiting a weighted matrix using residuals from the first step. Following Arellano and Bond (1991), Arellano & Bover, (1995) and Blundell & Bond (1998), two tests are recommended that is the Sargan over identification test and the second order autocorrelation test to test the validity of delayed variables as instruments.

[2]GMM is a generic method of estimating parameters in a statistical model which used moment conditions that are functions of the model parameters and the data, such that their expectation is zero at the parameters' true value.

Before estimating our model, a stationarity test on the series to detect if there is presence of unit roots is necessary. It is well-documented in the literature that the most popular unit root tests (Augmented Dickey-Fuller and Phillips Perron tests) have low power against the stationary alternative test. The Augmented Dickey Fuller (ADF) test can no longer be used because if the number of delay is overestimated, its power is deteriorated. The problem is fundamental if the number of lag is undervalued. The use of Im Pesaran and Shin test is therefore appropriate. If after testing for unit root test the series are not stationary, the co-integration test of Pedroni (1999, 2004) shall be used to see the presence of co-intergration relationship existing between agricultural production and government agricultural expenditure.

Data and descriptive statistics

Our study is conducted on a dynamic panel of thirty-three SSA countries presented from 2001 to 2018. The main reason for the exclusion of other countries from the analysis is the unavailability of data. Data used for econometric analysis are from secondary sources that is FAOSTAT, ASTI and IFPRI. The chosen 33 countries are noted in an alphabetical order as follows; Angola, Benin, Botswana, Burkina Faso, Cameroon, Cape Verde, Congo, Cote D'ivoire, Democratic Republic of Congo, Ethiopia, Gabon, Gambia, Ghana, Guinea-Bissau, Kenya, Lesotho, Liberia, Malawi, Mali, Mauritius, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra-Leone, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

Table 1: Results of descriptive statistics

Variables	Observations	Mean	Standard deviation	Minimum	Maximum
Agricultural production	594	117.356	27.41352	49.93	265.21
Government agricultural expenditure	594	10166.77	24499.21	48.12	143099.7
Capital	561	395.4009	703.7048	2.324933	4875.112
Labor	594	3279.503	4772.342	34	38941
Cultivated land	594	41.58023	18.04804	11.27015	80.92054
Agricultural credit	594	4414.074	9080.638	1.08	81294.16
Number of researchers	590	9.702373	12.09002	1.2	76.1
Gagrex* Gagrex	590	20333.55	48998.42	96.24	286199.4

Source: Commuted by author with data from IFPRI, FAOSTAT and ASTI.

It is necessary to illustrate an overview of the panel analysis of variables in the assessment of public agricultural expenditure and agricultural production in SSA covering the period of review by showing the descriptive statistics (mean, standard deviation, minimum, and maximum statistical values).

A cursory look on the table above reveals that, the country with the lowest minimum of the aggregate volume of agricultural production is Serra Leone (49.93) which was in 2001, the maximum level was scored Benin (265.21) in 2018 and while the average level of the volume of aggregate volume of agricultural production is 117.356. For the government agricultural expenditure, some countries allocate the greater part of their budget to the agricultural sector while others do not. The maximum amount of money in US dollars attributed to agriculture was spend by South Africa in 2001 (with 143099.7 US dollars), while the minimum amount (48.12 US dollars) was recorded by Serra Leone in 2001. This interpretation goes the same for the remaining variables. We notice that our mean variable distributions are all positive and showing statistical closeness to both minimum and maximum values. All the positive mean and standard deviation values are located within the range of the minimum and maximum values, indicating that the panel data exhibit significant distributional consistency. Furthermore, the small standard deviation distribution shows the very little extent to which the panel data disperses from the mean values.

RESULTS

Result of the Stationarity test of the government agricultural expenditure – agricultural growth

Table 2: Panel Unit Root Test Im, Pesaran and Shin

	With constant		With constant and trend		Decision
Series	**t-stats**	**P-value**	**t-stats**	**P-value**	
Agroin	-0.193	0.4234	-5.307	0.0000***	Stationary
Gagrex	1.776	0.9622	-4.203	0.0000***	Stationary
Kap	-2.209	0.0136**	-6.405	0.0000***	Stationary
Lan	-12.05	0.0000***	-6.852	0.0000***	Stationary
Labor	-3.931	0.0000***	-7.320	0.0000***	Stationary
Agricre	-0.664	0.2533	1.442	0.9254	Not Stationary
Nmsearcher	1.567	0.9415	-3.614	0.0002***	Stationary
Gagrex*Gagrex	1.776	0.9622	-4.203	0.0000***	Stationary

Source: Computed by author with data from IFPRI, FAOSTAT and ASTI

Notes: The stationarity at *****1%, ****5% and ***10%.

The hypothesis test of Im Pesaran-Shin is given thus:

H_0: Absence of unit root test

H_1: Presence of unit root test

In line with the Im Pesaran-Shin hypothesis test, if the associate probability value of any series is inferior to the different critical threshold, being it at 1%, 5% or 10%, we say there exist an absence of unit root. Hence the hypothesis H_0 is accepted while H_1 which is the alternative hypothesis is rejected. We have effectuated a unit root test with constant, and another with constant and trend. From the test with constant alone, we notice that only three series are stationary (capital at 5%, labor and land at 1%). While effectuating the test with constant and trend, we observe that almost all the variables are stationary at 1% each except the series agricultural credit and their P-values are all greater than the t-stats values. To conclude, given that almost all the series are stationary it is not necessary effectuating Pedroni's co-intergration test. We therefore go directly to estimations.

Estimation results of Government agricultural expenditure and agricultural growth

The results from the dynamic model are presented in table 2. Column (1) represents an estimation of control variables on agricultural production, column (2) shows the results obtained from estimating both control variables and Government agricultural expenditure on agricultural production, in column (3), the square of government agricultural expenditure (Gagrex²) is included in the model and finally column (4) displays results obtained from the long run relationship between Aprion and variables that are statistically significant in the short run estimation.

Table 3: Estimation results of Government agricultural expenditure and agricultural growth

Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**
A GMM system method	**Estimation with control variable only**	**Estimation with both control and Gagrex variables**	**Introduction of Gagrex²**	**Long run estimation results**
Exogenous variables	**Coefficients and P-values**	**Coefficients and P-values**	**Coefficients and P-values**	**Coefficients and P-values**
Constant	-1.2208*** (0.000)	-1.0435*** (0.001)	-1.1176*** (0.002)	
Agricultural production (lagged 1)	0.7301*** (0.000)	0.6725*** (0.000)	0.6999*** (0.000)	
Capital	0.0335*** (0.000)	0.0321*** (0.000)	0.0349*** (0.000)	0.1165*** (0.000)
Labor	0.0553*** (0.001)	0.0449** (0.028)	0.0387* (0.052)	0.1291* (0.059)

Table 3…

Land cultivated	0.5048*** (0.000)	0.4847*** (0.000)	0.4440*** (0.000)	1.4799*** (0.000)
Agricultural credit	0.0211** (0.047)	0.0070 (0.531)	0.0050 (0.673)	
Number of researchers	0.0031 (0.818)	-0.0083 (0.444)	-0.0181* (0.075)	-0.0605* (0.059
Government agricultural expenditure		0.0457*** (0.002)	0.1160*** (0.003)	0.3867** (0.029)
Government agricultural expenditure Squared ($Gagrex^2$)			-0.0048* (0.072)	-0.0162 (0.155)
Number observations	491	491	491	
Group / Number of instruments	33/25	33/26	33/27	
Wald's statistics	6698.21 (0.0000)	9902.27 (0.0000)	10100.3 (0.000)	
Arellano and Bond Test AR(1)	-3.2305 (0.0012)	-3.2597 (0.0011)	-3.243 (0.0012)	
AR(2)	1.7908 (0.0733)	1.8446 (0.0651)	1.8452 (0.0650)	
Sargan Test	19.9669 (0.3347)	17.0790 (0.5177)	19.5935 (0.3562)	

Note: Probabilities of the coefficients or t-statistics in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ indicate significance at 1%, 5% and 10% respectively.

After effectuating the regression of control variables, results in column (2) reveal that only capital, land, lagged dependent variable (agricultural production) and agricultural credit are positive and statistically significant (1% for the first three and 5% for agricultural credit). Philip and al. (2018) and Dkhar & Kumar, (2018) both had similar results. The number of researchers engaged in the agricultural sector in SSA have a positive effect (0.0031) on the agricultural production though insignificant.

In column (3), Government agricultural expenditure is added in the estimation and results obtained have no great difference with those in column (2). The lagged dependent variable, capital, land and Government agricultural expenditure have positive coefficients (0.6725, 0.0321, 0.4847 and 0.0457) and are all statistically significant at 1%, while labor is positive and statistically significant at 5%. These results corroborate with those obtained by Wangusi & Muturi (2015) and Ebi & Amaraihu, (2018) in their study of agricultural expenditure and agricultural output in Nigeria.

The introduction of the squared of Government agricultural expenditure ($Gagrex^2$) in the estimate that is, column (4), brings about some changes in results obtained. The squared of

Government agricultural expenditure itself has a negative (-0.0048) coefficient though statistically significant at 10%. The lagged agricultural production is positively and statistically significant at 5%. We find that across our model specifications, the past agricultural production level is a strong predictor of its current level. This reveals that agricultural production tends to be partly dependent, which suggests that a country's production level in the present year has a strong influence in determining her level of production in the following year. Similar results were obtained by (Mose, Kibet, & Kiprop, 2019). Capital, land and government agricultural expenditure as in column (3) all have positive coefficients and are statistically significant at 1%. Evidences are consistent with those found by early scholars such as Iganiga & Unemhilin (2011). For the case of number of agricultural researchers, and labor, there are both significant at 10% each with varying effects that is negative for number of agricultural researchers and positive of labor.

After effectuating short run estimates, variables that have positive coefficients and are statistically significant are estimated once more in other to see their long run behavior on agricultural production as displayed in column (5). These variables are capital, the square of government agricultural expenditure, labor, cultivated arable land, number of researchers and government agricultural expenditure. Results show that, capital and cultivated land both influence agricultural production positively (0.0349 and 0.4440) in the short run as well as in the long run (0.1165 and 1.4799) and are all statistically significant at 1% in the short and long run. It therefore shows that these series are indispensable for agricultural production in SSA. These findings are consistent with those of Barro (1990) and Chauke et al. (2015) for whom the impact of capital on agriculture are positive in both South Africa and Zimbabwe. Labor on its part has positive coefficients both in the short and long run at a significant level of 5%, the number of researchers has contradictory effects to that of labor both in the short run and in the long run though statistically significant at 5%, for government agricultural expenditure, it has positive outcome on agricultural production both in the short and long run though at a significant level of 5% in the long run compared to 1% in the short run. Finally, the square of government agricultural expenditure though had a negatively and significant relationship in the short run, has a negative (-0.0162) and insignificant relationship in the long run with agricultural production. Results here corroborate to those obtained by Timothy et al., (2015) in a comparative impact analysis of public expenditure on agricultural growth.

The capital, labor and cultivated land variables are the only variables to be positive and statistically significant in the four regressions. So, these variables are unavoidable in the government agricultural expenditure--agricultural production relationship. This is the channel through which spending could positively and significantly affect agricultural production, that is, the volume of public spending by SSA countries should be guided in these domain. A few diagnostic tests are done to check the robustness of the estimates. The Sargan test for over identifying restrictions as well as the AR test for no second order serial correlation. Given the choice of one lag length, the specification test results of the AR(2) reveal that our models do not suffer from second-order serial correlation, and the Sargan test performed for over-identification of the equation and test results show it to be identified.

CONCLUSION

This study examines the relationship existing between government agricultural expenditure and agricultural production in SSA. Analyses are based on a dynamic panel data of 33 SSA countries from 2001-2018. While using a GMM system from Blundell and Bond (1998), empirical results show that there exist a positive and strong relationship both in the short and long run between government agricultural expenditure, capital, cultivated land and labor, and agricultural production. The number of researchers reports a negative coefficients both in the short as well as in the long run though significant. The squared of government agricultural expenditure on its part has a negative relationship with agricultural production both in the short and long term while being significant in in the short term (10%) and insignificant in the long term. This study recommends that government should adhere to the Maputo Declaration by allocating at least 10% of their budgets to the agriculture sector for a higher agricultural production, to increase the level of socio-economic infrastructures so as to incite farmers to increase their production and finally to facilitate the attribution of land titles to local farmers. In order to better identify the agricultural production where these strategies would be the most effective, it will be of great importance to examine the link between public agricultural spending and agricultural production within a more desegregated approach. Although comprehensive, there are further research questions relating to both public expenditure and agricultural production that remain to be answered. Data limitations restrict the ability to test a range of hypotheses. It is important to disaggregated data on public agricultural expenditure and analyze their consequences on agricultural production with respects to sub-regions in SSA.

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