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Optimal Size of Public Expenditure and Agricultural Growth in Togo: Evidence from Armey Curve

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ABSTRACT: This paper examines, using the Armey curve approach, the possibility of the existence of an optimal size of agricultural public expenditure in Togo. Using annual data from 1987 to 2019, the results show that the actual size of public agricultural expenditure is much below the optimal size, which is 34% of agricultural GDP for total agricultural expenditure and 27% for agricultural investment. In the light of these results, it appears that the Togolese government can pursue the expansionary fiscal policy by increasing agricultural expenditure to the optimal level. The gap is very deep and requires a significant qualitative jump.

KEYWORDS: Optimal size, Public expenditures; Agricultural growth; Armey curve

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INTRODUCTION

The role of the size of the public expenditure, as a factor of full employment and growth is a subject of economic debate and the economic literature reveals the existence of a non-linear relationship between public expenditure and economic growth (Adepoh, 2019). Some economists (Armey, 1995; Barro, 1990) consider that, like a company, there is an optimal size of government representing the equilibrium point of the economy. This equilibrium level is nothing more than the level of government expenditure that maximizes the production of goods and services (Vedder and Gallaway, 1998). For Armey (1995), the State must intervene to encourage investment by private agents. But the more the State increases its expenditure, the more the phenomenon of diminishing returns becomes operative. In short, for Armey, moderate State intervention is essential to economic activity, whereas excessive State intervention is harmful. However, Armey failed to demonstrate this thesis for agricultural sector on which Sub-Saharan Africa depends largely (OECD and FAO, 2016). In particular, agricultural expenditure appears as one of the direct and effective tools to enable sustainable economic growth in developing countries (Weibigue, 2021). The underlying premise is that through large-scale structural transformation led by smallholders, Africa can achieve poverty-reducing growth (Gninigue and Tchalim, 2021).

The influence of the macroeconomic environment on the performance of the agricultural sector is well known in the economic literature (Weibigue, 2021). Thus, any instabilities in the major macroeconomic equilibrium naturally affect the agricultural sector. Macroeconomic policies such as budgetary policies can have a major impact on the agricultural sector. Generally, and in line with endogenous growth theories, it is widely accepted that public expenditures one key public goods such as agricultural facilities are necessary to revitalize agricultural development (Aghion and Howitt, 1998). Consequently, state intervention is necessary for any take-off and an optimal investment in agriculture.

In Togo, public expenditure for agriculture has grown rapidly and faster than overall budget expenditures. From 2005 to 2019, public expenditures used in agriculture increased from $6.408 million to $63.662 million while overall public expenditure increased from $439.6 million to $1,506.446 million (MEF, 2020). The government public expenditure has increased by 2.42 points compared to 8.93 points for public expenditure for agriculture. However, this increase in public expenditure for agriculture has not translated into robust agricultural growth, which is expected to reach at least 6% in 2019. This raises the question of whether the Togolese government should increase or reduce the current level of public expenditure in order to better impact growth. In other words, what is the optimal level of public expenditure in Togolese agriculture? Otherwise, does Armey Curve exist for agricultural sector? To answer these questions, this paper aims firstly to determine the optimal size of public expenditure required for agricultural sector in Togo; secondly, to compare the actual size of public expenditure for agriculture to the optimal size.

The interest of this research is to contribute to the economic debate on the existence of an optimal size of public expenditure for agricultural sector. Indeed, Armey (1995) shows that public expenditure is growth-enhancing up to a given threshold, beyond which

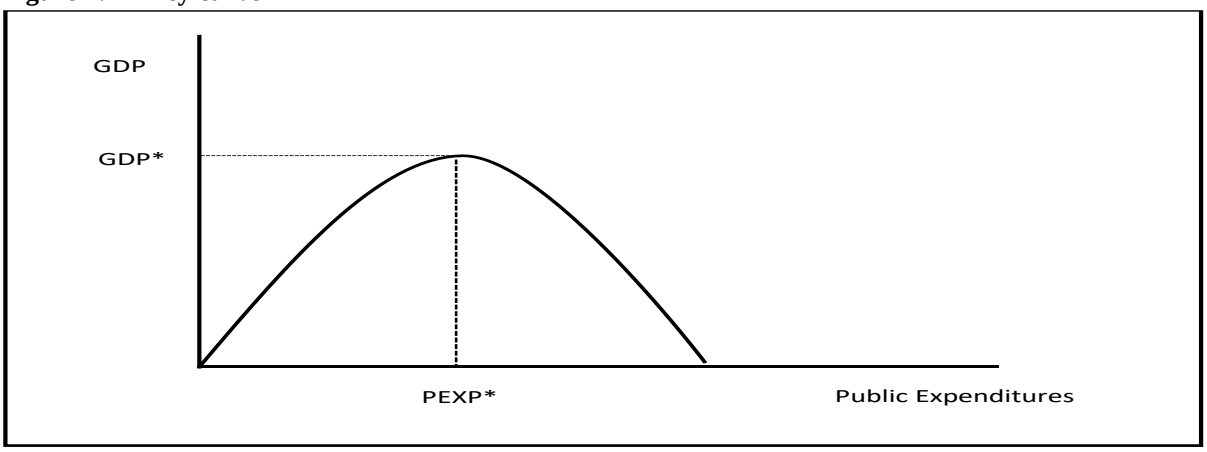
its effect on growth becomes negative. Following Armey, other authors such as Vedder and Gallaway (1998) have empirically verified the existence of an optimal level of public expenditures. Thus, the study enables us to understand the relationship between public expenditure and agricultural growth by emphasizing the existence of a public expenditure threshold beyond which its effect on growth becomes negative. In addition, the results of the research will help guide agricultural fiscal policy. Following this background, the rest of the article is structured as follows: the next section deals with the materials and methods; the third section provides results and discussion. Finally, fourth section concludes the article.

MATERIALS AND METHODS

Methodology

Economists and practitioners in both developed and developing countries have long sought to understand the nature, intensity, and direction of the effects of public expenditure on economic activity and more specifically on economic growth. Barro's (1990) study was one of the first studies to address the relationship between the optimal level of investment and growth. Thus the non-linear relationship between the size of government and growth, illustrated by an inverted U-curve, emerged and was popularized by Armey. Armey (1995) assumes that in a country with anarchy, no government with public expenditure close to 0% of economic activity, the output per capita is likely to be very low. Similarly, in countries where all production and investment decisions are made by the government, with government expenditure close to 100 percent of economic activity, the GDP per capita is likely to be very low (Vedder and Gallaway, 1998). On the other hand, as long as economic decisions are shared by the public and private sectors, then the output may be very high (Figure 1).

Figure 1: Armey curve



Source: Armey (1995)

On the empirical level, Vedder and Gallaway (1998) highlight Armey's theoretical approach. Their study focuses on American data from 1947 to 1997. They find an optimal level of public expenditure in relation to a GDP of 17.45%. They deduce that the American government should reduce its public expenditures, which was close to 20 to 22% of the GDP, to maximize growth. As far as they are concerned, Iyidogan and Turan (2017) examined the relationship between government size and economic growth using a threshold regression model and quarterly data over the period of 1998-2015 for Turkey. The results strongly show evidence of a nonlinear relationship with thresholds. They found 16.5% of GDP for total government expenditures; 12.6% for consumption expenditure and 3.9% for investment expenditures. According to Dione (2016), the optimal size of the government budget is an increasing function of countries' per capita income level. Based on a study of developed and developing countries, he shows that, developed countries spend on average more than their optimal level in contrast to emerging and developing countries that spend less than the optimal level.

Model specifications

Inspired by the approach developed by Vedder and Gallaway (1998), our model to be estimated can be written as follows:

$$AGDP_t = \alpha_0 + \alpha_1 PEXPA_t + \alpha_2 PEXPA_t^2 + \alpha_3 Labor_t + \alpha_4 Land_t + \alpha_5 HICP_t + \alpha_6 TT_t + \varepsilon_t \quad (1)$$

The one-period lagged *AGDP* is included in the model to improve forecast quality. As a result, we have:

$$AGDP_t = \beta_0 + \beta_1 AGDP_{t-1} + \beta_2 PEXPA_t + \beta_3 PEXPA_t^2 + \beta_4 Labor_t + \beta_5 Land_t + \beta_6 HICP_t + \beta_7 TT_t + \varepsilon_t \quad (2)$$

The variable $AGDP_t$ of dimension (n×1) is the agricultural gross domestic product at time t, $PEXPA_t$ of dimension (n×1) represents the Public expenditures in Agriculture. According to Barro (1990), the quadratic form is introduced in the linear model to take the nonlinear form. The variables $Labor_t$, $Land_t$, $HICP_t$, and TT_t are control variables. $Labor_t$ is agricultural labor, $Land_t$ is total agricultural land, $HICP_t$ is the harmonized consumer price index, and TT_t represents terms of trade. ε_t is the error term. β_0, the constant term, represents the unexplained growth in AGDP. Taking support from the economic literature and mainly from the work on the determinants of economic growth (Forte and Magazzino, 2010), we particularly expect β_2 to be positive and β_3 to be negative. The public expenditure in agriculture as a share of AGDP, which maximizes the growth of $AGDP_t$ in the quadratic function (3) is obtained by differentiating $AGDP_t$ with respect to $PEXPA_t$.

$$\boldsymbol{PEXPA_t^* = \frac{\partial AGDP_t}{\partial PEXPA_t} = 0} \qquad (\mathbf{3})$$

We have the following expression stating the public agricultural expenditure that maximizes the AGDP.

$$\boldsymbol{PEXPA_t^* = \frac{\beta_2}{2\beta_3}} \qquad (\mathbf{4})$$

Considering the composition of public expenditure and through the decomposition of total public expenditure for agriculture into public investment ($PINVA_t$) and consumption expenditure ($CEXP_t$) we have from (2) the following equations (5) and (6):

$$\boldsymbol{AGDP_t = \theta_0 + \theta_1 AGDP_{t-1} + \theta_2 PINVA_t + \theta_3 CEXP_t + \theta_4 PINVA_t^2 + \theta_5 Labor_t + \theta_6 Land_t + \theta_7 HICP_t + \theta_8 TT_t + \varepsilon_t} \qquad (\mathbf{5})$$

$$\boldsymbol{AGDP_t = \gamma_0 + \gamma_1 AGDP_{t-1} + \gamma_2 PINVA_t + \gamma_3 CEXP_t + \gamma_4 CEXP_t^2 + \gamma_5 Labor_t + \gamma_6 Land_t + \gamma_7 HICP_t + \gamma_8 TT_t + \varepsilon_t} \qquad (\mathbf{6})$$

Study Data

To achieve the main objective, i.e. the estimation of the size of public expenditure that maximizes agricultural growth in Togo, this study considers time series over the period 1987-2019. The data and their sources are presented in the table (1).

Table 1: Variables of the study

Variables	Definitions	Unit of measure	Sources
$LnAGDP_t$	Agricultural Gross Domestic Product	% Annual	World Bank (2020)
$LnPEXPA_t$	Public expenditures for Agriculture	% Agricultural GDP	MEF (2020)
$LnPINVA_t$	Public investment for agriculture	% Agricultural GDP	MEF (2020)
$LnCEXP_t$	Consumption expenditures	% Agricultural GDP	MEF (2020)
$LnLabor_t$	Agricultural labour	% Active Population	World Bank (2020)
$LnLand_t$	Agricultural Land	% Total land	World Bank (2020)
$LnHICP_t$	Harmonized Index of Consumer Prices	% Annual	World Bank (2020)
$LnTT_t$	Terms of Trade	Reference year 2000	World Bank (2020)

Source: MEF (2020); World Bank (2020)

RESULTS AND DISCUSSION

Stationarity Tests

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are used to test the hypothesis of stationary (table 2). Time series variables being integrated, we can study the long term behaviour and then assess the optimal size of public expenditures that maximizes agricultural growth.

Table2: Results of the Stationarity Tests

Variables	ADF Test			PP Test		
	Level	Difference	I (.)	Level	Difference	I(.)
LnAGDP	0.00	_	I (0)	0.00	_	I(0)
LnPEXPA	0.41	0.000	I(1)	0.15	0.000	I(I)

LnPINVA	0.34	0.000	I(1)	0.04	_	I(0)
LnCEXP	0.00	_	I(0)	0.00	_	I(0)
LnLabor	0.75	0.003	I(1)	0.99	0.033	I(1)
LnLand	0.31	0.000	I(1)	0.30	0.000	I(1)
LnHICP	0.00	_	I(0)	0.00	_	I(0)
LnTT	0.31	0.000	I(1)	0.30	0.000	I(1)

Source: MEF (2020); World Bank (2020). Note: The values in the table are P-values.

Model Estimation Results

The coefficient of determination R^2 is respectively 0.48 for model (2); 0.61 for model (5) and 0.58 for model (6) while the adjusted R^2 is 0.26 for model (2), 0.41 for model (5) and 0.45 for model (6). Furthermore, the specification tests of the models are conclusive and satisfactory in the sense that the coefficients of the error correction term are significantly negative (Table 4). All in all, the hypothesis of non-linearity in the relationship between public expenditure and agricultural growth is validated.

The results of model (2) show that the coefficient of PEXPA is positive and significant (0.8073) while the coefficient of $PEXPA^2$ is negative and significant (-1.1900). In model (5) taking into account public investment in agriculture, the coefficients of PINVA and $PINVA^2$ are significant and equal to 0.0759 and -0.1390 respectively. In model (6) the coefficient of CEXP and the squared term are not significant. The positive signs of the coefficients of total government expenditure and investment in the growth of AGDP and the negative signs of the quadratic terms of these variables confirm the existence of an inverted U-shaped Armey curve. From equation (4), $PEXPA_t^* = \beta_2/2\beta_3$ **,** the size of public expenditure for agriculture is 33.92% of agricultural gross domestic product (AGDP), that of investment expenditure is 27.30% of AGDP.

Table 4 : Model estimation results

Variables	Model (2)	Model (5)	Model (6)
$AGDP_{t-1}$	**-0.306*** (11.785)**	**-0.030*** (15.302)**	**0.0135*** (5.331)**
PEXPA	**0.807*** (-9.381)**	–	–
$PEXPA^2$	**-1.190*** (8.601)**	–	–
PINVA	–	**0.076*** (-19.199)**	**0.056*** (5.122)**
CEXP	–	0.0003 (-0.578)	0.0003 (-0.652)
$PINVA^2$	–	**-0.139*** (20.343)**	–
$CEXP^2$	–	–	0.0022 (0.5904)
Labor	**0.764*** (-3.061)**	**0.106*** (6.285)**	**0.1059*** (3.285)**
Land	**-2.529** (2.020)**	0.017 (-0.285)	**0.016*** (5.201)**
HICP	-0.005 (1.581)	**0.001*** (-5.085)**	0.008 (0.037)
TT	0.545 (0.117)	–	0.605 (0.721)
C	-24.170	-4.653	-0.256
Observations	31	31	31
R^2	0.485	0.606	0.586
Ajusted R^2	0.264	0.409	0.458
F Statistic	2.194	3.012	3.712
D. W	2.631	2.051	2.121

Note: The values in parenthesis are the t-student. *** $p<0.01$, ** $p<0.05$

Source: MAEP (2012); MEF (2020); World Bank (2020).

Analysis of table 5 shows that the optimal size of government is 34%, while the effective size during the study period is 4% of agricultural gross domestic product.

Table 5: Effective and optimal size of the government

Government size	Public Expenditure for Agriculture	Public Investment for Agriculture
Effective Size	4% of AGDP	3% of AGDP
Optimal Size	34% of AGDP	27% of AGDP

Source: MEF (2020); World Bank (2020)

Discussion of the Estimation Results

Public expenditure and agricultural growth are positively correlated, while an excess of public expenditure significantly and negatively influences agricultural growth. The change in signs simply reflects the existence of a double-phase curve: an ascending phase and a descending phase, thus confirming the possibility of the construction of an inverted U-shaped Armey curve for agricultural expenditure in Togo. Considering model (3), the function reaches its maximum when the ratio of public expenditure to agricultural GDP is about 34%. This is the maximum level beyond which public expenditure becomes harmful to agricultural growth. Indeed, the effective size of public expenditure for agriculture in Togo is on average 4% of agricultural gross domestic product. In line with economic theory, Barro (1990) considers that when the size of government is small, an increase in public expenditure has a positive effect on growth, and when the size of government is large enough to exceed a threshold, an increase in public expenditure is likely to cause damage to the economy.

Like the work of Adepoh (2019) and Dione (2016) in developing countries, this study shows that there is an Armey curve for the agricultural sector in Togo. Although the sizes obtained are specific to the agricultural sector, they are close to those obtained in developing countries for the whole economy. Similarly, the relationship between investment expenditure and agricultural growth is initially positive but beyond a threshold, an increase in public investment expenditure negatively affects agricultural growth. This threshold effect of public investment expenditure, about 27.30% of agricultural GDP, is close to the finding of Chen *et al.* (2017) for the whole economy. They showed that at some level, the effect of public investment on economic growth decreases as the level of public expenditures increases and when the ratio of public investment to GDP a given threshold, the effect of public investment becomes negative. Thus, beyond some threshold, investing public funds in infrastructure becomes counterproductive, mainly in developing countries, where it is generally recognized that corruption plagues public institutions and exerts negative effect on growth (Sawadogo, 2021).

The various results seem to plead for an increase in public expenditures for agriculture. This increase can be achieved through the development of infrastructure and the promotion of agricultural processing to increase agricultural value added. In addition, agricultural research and training could be strengthened to improve agricultural performance.

CONCLUSION

Given the importance of the agriculture in the Togolese economy, it sounds necessary to thoroughly examine the conditions for better agricultural growth in Togo. Thus, addressing the issues of financing agriculture in Togo, this study was intended to determine the optimal level of public expenditures that maximizes agricultural growth. By performing an empirical time series analysis from 1987 to 2019, the results reveal an inverted U-shaped curve and confirm that the effects exerted by the level of public expenditures on agricultural growth are non-linear. Indeed, the results suggest that the share of the public sector that would maximize agricultural growth in Togo is 34% of GDP.

Furthermore, the study reveals that the optimal level of growth-maximizing public investment in agriculture is 27%. These empirical results may have significant effects on public expenditures planning and policies because the current share of public expenditure for agriculture is well below the optimal point. It should be noted that the Togolese government can therefore pursue an expansionary fiscal policy by increasing its share of agricultural expenditure to an optimal level of 34% of GDP as compared to the actual level of 4%. The gap is very deep and requires a significant qualitative jump.

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