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Comparative Impact of Public Expenditure on Agricultural Growth: Error Correction Model for South Africa and Zimbabwe

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ABSTRACT The aim of this study was to compare the impact of public expenditure on agricultural growth in South Africa and Zimbabwe based on the error correction model approach. The study found that both governments have higher current expenditure at the expense of capital goods and services, a practice, which is considered to be counterproductive and growth retarding. Furthermore, non-agricultural expenditure showed both negative and positive impact on agricultural growth, depending on the state of the country's economy. For economies with strong backwards linkages like South Africa, it was recommended to increase overall total expenditure. However, an increase in non-agricultural expenditure, especially for lower income countries with smaller expenditure envelops such as Zimbabwe, policymakers were advised not to overly fund their non-agricultural sectors at the expense of the agricultural sector, since diverting resources from agriculture to other sectors could result in higher opportunity costs.

INTRODUCTION

As noted by Devendra (2014), the agricultural sector needs to be regenerated if the quest for increased economic development and food security is to be met. Governments in developing countries are often faced with expenditure needs that often outstrip their resource endowments (Senoga and Matovu 2010) despite public spending being one of the most effective instruments, not only for boosting economic growth but also in reducing mass poverty. Fan et al. (2008) assert to the calls that have been made in both regional and international summits to increase and redirect resources towards the achievement of various development goals. However, efforts towards achieving this objective by many African governments have been negatively affected by lack of information on the type of public investments that would impact agricultural growth and food security (Cabral 2007). A review of literature has revealed massive neglect facing many African countries including focused investment in their agricultural sectors, food crises that have continued to negatively impact developmental and humanitarian imperatives. Examples of such neglects were reported by Ani et al. (2014), in their Nigerian study.

This study, therefore, sought to shed light on the impact of public expenditure targeting agricultural growth and thus, poverty alleviation. With increased population pressure, food insecurity and poverty remain major challenges especially in sub-Saharan African countries. Research shows that the number of poor countries in sub-Saharan Africa has doubled during the past few decades (Birner and Palaniswamy 2006). It is also common knowledge that the Millennium Developmental Goal Number 1 (targeted for year 2015) of halving poverty is still far off from realization. Moreover, the food security situation has worsened over the past years with African countries leading in receiving the dwindling food aid. The question that then becomes the focus of this paper is, "why is food security and agricultural growth in most African countries, particularly in the SADC region, still low given substantial calls and various summits prioritizing the agricultural sector?"The answer to this question necessitates an in depth impact analysis of public expenditure on agricultural growth in selected SADC countries. Specific study objectives include an analysis of the impact of capital and recurrent and non-agricultural expenditure on agricultural GDP for Zimbabwe and South Africa.

To contextualize the study, a brief outline of critical related theoretical underpinnings becomes imperative, commencing with a generalized understanding of public expenditure. A

study by the World Bank (2011), defines the latter as spending in agricultural extension and training, research and development, marketing, supply and subsidization of inputs, crop development, irrigation, livestock development and food security. Government expenditure on agriculture can be considered either as an input of the production function or as affecting the relationship of the other inputs with agricultural output (Odhiambo et al. 2004). Greedy et al. (2011) identified culture as a critical factor for differences in the composition of government expenditure amongst democratic countries.

For the purpose of this study, agriculture expenditure will encompass capital and recurrent annual budget allocations to the agricultural sector as suggested by the IMF's Internationally Recognized Classification of Functions of Government. In the context of this study, agricultural growth will be considered as an increase in the amount of agricultural goods and services produced within the boundaries of a given country over time (Blanco et al. 2010; Anakoya et al. 2013; Nasiru 2012; Loto 2011). In accordance with the latter and due to econometric challenges used for analyzing appropriate data, the methodology in this study takes agricultural GDP as a proxy for growth of the sector as applied in various public expenditure impact studies. In line with FAO (2011), food security will be defined as a state that exists when citizens of a particular country have physical and economic access to sufficient, safe and nutritious food for an active and healthy lifestyle

Study Objective

The main aim of the study was to compare the impact of public expenditure on agricultural growth using the Error Correction Model for South Africa and Zimbabwe. The following sections present the methodology for data collection, study findings, conclusions and recommendations.

METHODOLOGY

Fourteen (14) Southern African Development Countries (SADC) were initially selected as the overall population of the study, that is, eight (8) low-income countries (Democratic Republic of Congo, Mozambique, Lesotho, Madagascar, Malawi, Zambia, Tanzania, and Zimbabwe) and six (6) middle-income countries (Namibia, Angola, Swaziland, Mauritius, Botswana, and South Africa). Two (2) countries, that is, Zimbabwe and South Africa, were purposefully selected as target study countries to represent each of the two income level categories. While Zimbabwe was chosen due to the importance of agriculture (providing more than fifteen percent to the total GDP as compared to three percent in middle income countries), South Africa was selected amongst the middle-income countries due to availability of reliable statistical data covering the study objectives. Time series data on public spending for Zimbabwe was obtained from the Reserve Bank of Zimbabwe, the Department of Finance and the Department of Agriculture, while that for South Africa was obtained from the Treasury, South African Reserve Bank and the Department of Agriculture, Fisheries and Forestry. In both countries, the data were supplemented with published and unpublished estimates from the Zimbabwe Statistics, and Statistics South Africa (StatsSA) respectively.

Collected data included, Agricultural GDP, consumer price index, annual recurrent and capital expenditure on the two agriculture sectors and exchange rates. Prices were first deflated from current local currency expenditure to a set of 2005 base year prices using the consumer price index. Exchange rates measured in purchasing power parity, as reported by the World Development Indicators, were used to convert local currency expenditure (measured in terms of constant prices into a value aggregate expressed in terms of constant million United States International Dollars).

To set the stage for Co-integration and Error correction modeling, the first step was to determine the order of integration of all model variables before determining their levels of Stationarity through the process of differencing. The Stationarity test is critical in avoiding spurious results in cases where variables are integrated of different orders (Asteriou and Hall 2007; Gujarati 2003). It is critical to note that Co-integration, when testing for stationarity, is influenced by the number of observations available for the time series under consideration (Kristian 2011). According to Dang (2013), the error correction framework model changes in target leverage and past deviations. This study also employed the Augmented Dickey Fuller (ADF) test, resulting in the following equation that was calculated as t-ratios of the coefficient of $X_{t-1:}$

$$\ddot{A}X_t = \alpha_0 + \acute{a}_1 X_{t-1} + \sum_{i=1}^{n} \beta\iota\Delta X_{t-i} + \mu_t \quad (1)$$

Where X_i represents the series, t_i the trend factor, α_0 a constant term, μ the stochastic error term and β_1 the lag length. For confirmatory test the Philips Perron test was performed to correct the t-statistic of the coefficient. Also, to estimate the impact of recurrent and capital expenditure impacts on agriculture growth for each country, the endogenous growth model was employed. Time series data from 1981 to 2006 was used for Zimbabwe to avoid the negative effect of hyperinflation that took place thereafter, while data from 1983 to 2011 was used for South Africa. Agricultural recurrent and non-agricultural capital expenditure were regressed against agricultural Gross Domestic Product (AGDP). Taking into consideration that endogenous growth models are non-linear, variables had to be transformed into logs to linearize the model as specified below:

$$InRAGDPS_t = a_0 + \Sigma_{t=1}^{ki} \beta_1 InRACES_t + \Sigma_{t=1}^{ki} \beta_2 InRARES_t + \sum_{t=1}^{ki} \beta_3 InRNAES_t + \varepsilon_\tau \quad (2)$$

The model followed the general-to-specific modeling approach to determine appropriate lag length for each variable. The above variables can be expressed as follows,

- *RAGDP(ZIM$/SARand)* = agricultural gross domestic product per year;
- *RNAE$(ZIM$/SARand)*= non-agricultural expenditure [(a dummy of regime changes (for SA: 0 prior to 1994 and 1 thereafter, Zim: 0 prior to 1980 and 1 thereafter)];
- $RAGDP(ZIM\$/SARand)_{t-1}$=one year lagged agricultural gross domestic product per year;
- *RARE(ZIM$/SARand)*= annual recurrent expenditure; *RACE(ZIM$/SARand* - annual capital expenditure and μ being the stochastic error term.

Gujarati (2003) maintains that a linear combination stationary variable I(0) is required for a long run relationship to exist. Assuming that all variables used in the model were integrated of the same order I(1), residuals from the equation in question were obtained. The following model was applied to mitigate co-integration:

$$\Delta \hat{e}_t = \alpha_1 \hat{e}_{t-1} + \Sigma_{i=1}^{n} \delta\Delta \hat{e}_{t-1} + \varepsilon_t$$

The general Error Correction Model was finally determined as:

$$\Delta ln\frac{RAGDP\$}{R}_t = \alpha_0 + \sum_{t=1}^{ki} \beta_1 \Delta\pi nlnRACE\$_t + \sum_{t=1}^{ki} \beta_2 \Delta\psi ln\frac{RARE\$}{R}_t + \sum_{t=1}^{ki} \beta_3 \Delta\eta ln\frac{RNAE\$}{R}_t + \lambda\hat{\mu}_{t-1} + \varepsilon_t (4)$$

It should be noted that:

- "Δ is the first difference operator and all the differences are lagged k_i number of times, including the dependent variable (*"lnAGDP$/$R_t$*).
- These differences represent the short run dynamics of output (the dependent variable).
- The parameters β_1 and β_3 represent changes in the explanatory variables leading to changes in agriculture GDP.
- The fitted error correction term (μ_{t-1}) shows the speed of adjustment to the equilibrium.
- To arrive at a parsimonious ECM, the study followed the general-to-specific modeling approach for selecting appropriate lags.

RESULTS

Table 1 reflects diagnostic results of the model, especially to ascertain the presence of heteroskedasticity, misspecification, serial correlation, structural break and normality of distribution based on the E-views statistical package. Econometrically, the model passed all diagnostic tests. At five percent significance level all null hypothesis failed to be rejected. Using the Ramsey Regression Specification Error Test (RESET), the model proved to be well specified. Secondly, there was absence of serial correlation as evidenced by the Breusch-Godfrey Serial Correlation tests of 0.979265 and 0.8111 for South Africa and Zimbabwe respectively. Thirdly, residuals were normally distributed as shown by the Jacque-Bera Normality test. More so, the model shows the absence of heteroskedasticity. The Chow-break point test shows that the model is structurally stable, and thus justifying the use of a single equation for both countries.

Table 1: Diagnostic tests for the econometric models used in the study

Econometric Test	*Prob. Chi-square*	
	SA	*ZIM*
Ramsey RESET++	0.7593	0.4669
Breusch-Godfrey serial Correlation LM test	0.0914	0.8111
Chow Break Point test	0.1373	0.6877
Jacque-Berra Normality test	0.394303	0.394823
White Heteroskedasticity Test:	0.8179	0.5090

SA= South Africa, ZIM = Zimbabwe
Source: calculations from study results

As mentioned in the methodology section, this study has employed agricultural GDP as a proxy for growth of the agricultural sector for both South Africa and Zimbabwe. The econometric model adopted for this study follows the Stationarity, Co-integration and Error Correction procedure. All the variables were integrated of order one I (1), which is a desirable outcome for Co-integration as it avoids spurious results, which could occur if the variables were integrated of different order (Asteriou and Hall 2007; Gujarati 2003). With all the important variables integrated at the same order, the series validates the formulation of the selected econometric models for both countries' agriculture sectors.

With coefficients of 0.08 and 0.41, respectively for South Africa and Zimbabwe, (see Table 2) real capital expenditure (LRACEZIM$/SARand) (-1) on agriculture had positive relationships with agricultural GDP for both countries. In essence, these results mean that a one percent increase in real capital expenditure on agriculture could be accompanied by 0.08 percent and 0.4 percent increases in real agricultural GDP respectively. The finding is consistent with the expectation and economic theory as noted by Anakoya et al. (2013) and Purokayo and Umaru (2012) who unearthed similar findings as a result of crowd-in-effect which takes place when provision of public resources create an environment conducive for private sector investment. While for South Africa non-agricultural expenditure (LRNAE$) was positively related to real agricultural gross domestic product, the opposite was found to be true for Zimbabwe, that is,a one percent increase on non-agricultural expenditure could have been accompanied by 0.4 percent increase and a 0.16 percent decrease in real agricultural GDP for South Africa and Zimbabwe respectively. For South Africa, this relationship may be connected with the linkages of agricultural sector with other non-agricultural sectors such as transport services had multiplier effects on general economic growth.

Ironically the finding that recurrent expenditure (LRARE$/R)(-1) for both countries had negative coefficients (that is a 1 percent increase in real recurrent expenditure on agriculture had 0.23 percent and 0.24 percent decreases in real agri-

Table 2: Long run impact of public expenditure on agricultural growth. For South Africa (SA) and Zimbabwe (Zim) Dependent Variable: LRAGDP(ZIM$/SARand)

Variable	*Coefficient*		*Std. Error*		*t-Statistic*		*Prob.*	
	SA	*ZIM*	*SA*	*ZIM*	*SA*	*ZIM*	*SA*	*ZIM*
LRACE*(ZIM$/SARand)*(-1)	0.08	0.41	0.05	0.18	1.54	2.29	0.05	0.03
LRNAE*(ZIM$/SARand)*	0.4	-0.16	0.13	0.07	2.99	-2.34	0.01	0.03
LRARE*(ZIM$/SARand)*(-1)	-0.23	-0.24	0.12	0.11	-1.95	-2.09	0.08	0.05
LRAGDP*(ZIM$/SARand)*(-1)	0.68	0.45	0.13	0.17	5.13	2.62	0.00	0.02
DRC	-0.29		0.13		-2.27		0.04	
C	-0.47	7.59	0.79	0.11	-0.6	1.24	0.56	0.23

Source: calculations from study results
SA: R-squared = 0.95; Adjusted R-squared =0.93; Durbin-Watson stat= 1.79; F-statistic =49.77 (0.000000)
ZIM: R-Squared = 0.71; Adjusted R-squared= 0.62; Durbin Watson stat = 2.07; F Stat = 7.72 (0.000263.
(ZIM$/SARand) = US$ or SA Rand for Zimbabwe and South Africa respectively.

Table 3: The Parsimonious Error Correction Regression Estimate for South Africa (SA) and Zimbabwe (Zim)
Dependent Variable: "LRAGDP (SA RAND, ZIM DOLLAR)

Variable	*Coefficient*		*Std. Error*		*t-Statistic*		*Prob.*	
	SA	*ZIM*	*SA*	*ZIM*	*SA*	*ZIM*	*SA*	*ZIM*
Δ LRACE$	0.09	0.54	0.04	0.18	2.21	3.02	0.04**	0.01***
Δ LRNAE$	0.6	-0.18	0.14	0.08	4.47	-2.17	0.00***	0.04**
Δ LRARE$	-	-0.25	-	0.1	-	-2.42		0.03**
U(-1)	-0.52	-0.69	0.13	0.3	-4.03	-2.28	0.01***	0.04**

*, ** and *** denotes level of significance at 10%, 5% and 1% respectively
Source: Calculations from study results

cultural GDP respectively for South Africa and Zimbabwe) was inconsistent with economic theory. For South Africa in particular this finding could be evident that most programs that have been financed by the government were not productive or in their early stages of reflecting impacts as postulated by Liebenberg and Pardey (2010) and Vink and Van Rooyen (2009). However, with positive coefficients, the previous levels of GDP [LAGDP$/R (-1)] had the effect that a one percent increase in that variable increased the next agricultural GDP by 0.68 percent and 0.45 percent respectively for the two countries.

Parsimonious short-run Error Correction Regression Estimates for South Africa and Zimbabwe are reported in Table 3.The error term measures the speed of adjustment to the equilibrium. It can be observed from Table 3 that the system reports a negative and significant term with a coefficient of -0.52 and 0.69 for South Africa and Zimbabwe respectively showing that the system corrects its previous disequilibrium at the speed of fifty-two percent and sixty-nine percent respectively, per annum. For policymaking purposes, these magnitudes and directions of the error terms show that it takes about 2 years for a fiscal policy launched now to manifest in agricultural growth.

Capital expenditure (ΔLRACE$/R) on agriculture shows a positive relationship with agricultural gross domestic product in the short-run for both countries. Coefficients of 0.09 and 0.54 are statistically significant with t-statistics of 3.02 and 2.21 that are greater than 2, that is, above the rule of thumb. This finding is consistent with economic theory that purports that capital expenditure should crowd-in private investment and thus, increase both economic activity and agricultural growth (Barro 1990). Non-agricultural expenditure (ΔLRNAE$/R) had apositive relationship with agricultural gross domestic product in the short-run for South Africa but negative for Zimbabwe. The positive relationship for South Africa may be connected to linkages of the agricultural sector with the other non-agricultural sectors mentioned above. Short-run real recurrent agricultural expenditure (ΔLRARE$/R) was found to be negatively related to real agricultural gross domestic product. This finding is supported by previous studies in Africa which show that most governments allocate more than half of their resources to non-productive functions such as salaries and wages, with higher opportunity cost to development (World Bank 2011). For Zimbabwe, this finding may be due to periods of high inflation when the government had to increase the budget to cope with economic hardships.

DISCUSSION

The study estimated the short and long run effects of agricultural public expenditure for Zimbabwe and South Africa using Stationarity, Co-integration and Error Correction Methodology. Disaggregated public expenditure time series data for Zimbabwe (1981-2006) and South Africa (1983-2011) was used.

For both, Zimbabwe and South Africa, capital expenditure was found to be positively related to agricultural growth, a finding that asserts the importance of investing in capital expenditure for growing the agricultural sector. Regrettably in some years both countries allocated more on recurrent expenditure. However, the study showed that agricultural capital expenditure had positive impacts on short-run agricultural growths rates. Anakoya et al. (2013) and Purokayo and Umaru (2012) found similar results for the Nigerian agricultural sector. Also, as attested by He and Bao (2015), productive expenditure, as opposed to its social counterpart, is positively associated with capital budgetary allocation. The finding is also in line with that of Jagannath (2013) who asserted that capital expenditure, with its productive component, has the ability to contribute positively to state income. The present finding asserted that increased capital expenditure on the agricultural sector had multiplier effects on the growth of the agricultural sector for both countries, with positive economic implication for other Southern African countries especially in mitigating against food insecurity (SADC 2011).

Secondly, recurrent expenditure has been found to be negatively associated with agricultural gross domestic product in the long run for both Zimbabwe and South Africa. This confirms World Bank (2011) findings, that current expenditure such as salaries and subsidies are non-productive despite their more than eighty percent budgetary contribution in most developing countries (Belgrave and Craigwell 1995; Bose et al. 2003). As noted by Devarajan et al. (1996), capital expenditure in most developing countries fails to achieve anticipated production levels.

Thirdly, non-agricultural expenditure had different impacts on the two economies. For Zim-

babwe, the latter were negatively related to agricultural growth whilst for South Africa the effect was positive for both the short and long run. Zimbabwe's finding is in conflict with that of Fan et al. (2006) wherein, non-agricultural expenditure was found to contribute positively to agricultural growth through its distribution effects. As a country that relies heavily on its agricultural sector the negative impact of non-agricultural to the agricultural growth, the major driver of the economy (Kanyenze 2006) could have negative consequences for general economic growth.

The finding for the South African situation was consistent with that by Fan and Rao (2006), in which lower agricultural expenditure was found to be positively associated with agricultural growth. As noted by AgriSETA (2010), growth in non-agricultural expenditure was critical for increasing agricultural gross domestic product due to its backward and forward linkage effects.

In line with findings of the study by Nurudeen and Usman (2010) for the Nigerian agricultural sector, the present study also confirmed a period of close to two years for both economies to benefit from expenditure reforms.

CONCLUSION

As stated above, the overall aim of the study was to compare the impact of public expenditure on agricultural growth for both South Africa and Zimbabwe. Time series data covering the periods 1981 to 2006 for Zimbabwe and 1983 to 2011 for South Africa was analyzed using Stationarity, Co-integration and Error Correction techniques. The year 2006 was selected for Zimbabwe to avoid the effects of hyperinflation that ensued thereafter.

The finding that capital expenditure was positively associated with agricultural growth for both countries asserted the importance of this variable for growing the agricultural sector. The second major finding of the study was the realization that as in many developing countries, South Africa and Zimbabwe allocated massive budgetary commitments to recurrent as against capital expenditure. The last major finding related to the unexpected negative impact of non-agricultural expenditure on growing the agricultural sector for Zimbabwe as against the latter's positive influence in growing its South African counterpart.

RECOMMENDATIONS

The positive association between agricultural growth and non-agricultural expenditure reflects a positive outcome and interdependence between the two economic variables. In the long run, increased budgetary allocation should be accorded to the two countries' non-agricultural sectors especially to develop their secondary counterparts. Increased budgetary allocation to non-recurrent expenditure, especially towards employee salaries sends inappropriate signals that government employment is more lucrative than that emanating from the private sector. The latter has the effect of not only slowing down economic growth but also removing essential assets from productive use. It is thus recommended that budgetary allocations within the agricultural sectors of the two economies be increasingly directed towards capital expenditure. However, implementation of this policy should be more gradual for Zimbabwe than for South Africa due to its high dependence on the sector and for attraction of appropriate skills.

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