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Localized Public Investment and Agricultural Performance in Malawi

An Econometric Approach

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ABSTRACT

Using panel data econometric techniques, this paper evaluates how public expenditure influences agricultural performance at the district level in Malawi by empirically estimating localized expenditure multipliers for the districts. The results of the analysis show that public expenditures in agriculture have generally positive but variable impacts on agricultural growth at the district level. The paper also finds that there are substantial differences in terms of fiscal multipliers among the districts: most of these multipliers lie below one, although some are above one, while a few are negative. These results confirm that increasing public expenditures in agriculture can yield modest but positive impacts on agricultural productivity. The realization of improved impacts partly depends on both enhancing the quality of public spending and improving the health of public finances across the districts of Malawi.

Keywords: Malawi, agricultural performance, fiscal multipliers, public expenditure

JEL Classification: Q14, H72

1. INTRODUCTION

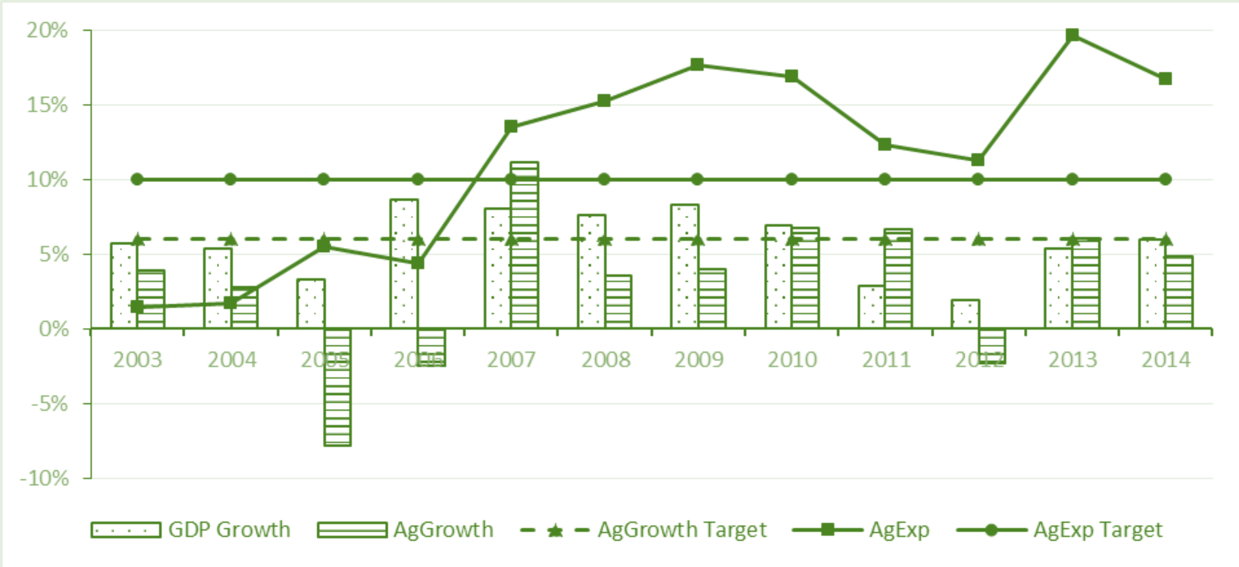
The contribution of public investment to agricultural productivity is well recognized in the economic growth literature. Public investment has been identified not only as a key determinant of agricultural growth but also critical for overall economic growth and poverty reduction (Mogues et al. 2008; Benin et al. 2009; Mogues et al. 2012; Ogino et al. 2013). The emerging focus on national commitments to the sector under the Comprehensive Africa Agriculture Development Program (CAADP) similarly expresses the importance of public investment in agriculture as a means to increase agricultural growth and, hence, overall economic growth and poverty reduction in Africa.

In line with CAADP commitments, Malawi is one of the African countries which has committed to spending at least 10 percent of the national budget on agriculture with the aim of achieving 6 percent annual average growth in the agricultural sector in order to significantly reduce poverty and spur economic growth. Hence, more so than before, policy makers and other stakeholders within the agricultural sector need to better understand agricultural expenditure levels and their composition and how public expenditures in the sector result in significant positive effects on agricultural growth. This necessitates an expenditure analysis to establish a clear link between public agricultural expenditures levels and their corresponding impact on agricultural growth in Malawi.

Accordingly, public policy continues to play a vital role in the determination of the agricultural growth required to meet the country's strategic commitments, including those under CAADP and the global Sustainable Development Goals. Although Mwase (1998) argues that agriculture is "public" in terms of policy and program needs and "private" in terms of production, marketing, and consumption decisions, the public sector in Malawi plays a dominant role in providing the agricultural services necessary to enhance agricultural productivity and to foster food security at household and national level. Moreover, it also is commonly observed that most governments in developing countries directly or indirectly supply farm inputs, are involved in agro-production, facilitate marketing, provide storage facilities, engage in processing and trading, and provide transport to smallholder farmers to varying degrees. However, analysis of the contribution of these public resources to agriculture growth in developing countries has been limited. The lack of significant research on this issue can be explained by two main factors, namely insufficient data and the greater emphasis placed upon the role of price policy as a stimulus to agricultural growth.

The 2013 Malawi Public Expenditure Review (PER) by the World Bank highlights that Malawi is one of the few countries on the continent that has surpassed the CAADP commitment of spending at least 10 percent of its national budget on agriculture. Agricultural expenditures accounted for 19 percent of total national expenditures on average between 2010 and 2013. However, despite agriculture being the main driver of economic growth in the country, agricultural sector growth between 2011 and 2014 only averaged 3.8 percent, significantly below the CAADP target of 6 percent. As a consequence of the poor economic performance of the agricultural sector, the country recorded low GDP growth of only about 4.0 percent over this period (Government of Malawi 2013). Generally, the growth patterns in GDP and the agricultural sector parallel each other in Malawi. Hence, analyzing whether public expenditures in agriculture accelerates or slows agricultural growth will be of great interest to public policy makers.

Figure 1—Malawi – Agriculture growth and expenditure commitments against CAADP targets



Note: Data from Annual Economic Reports (2013, 2014) and Annual Statistical Bulletins (2011, 2012, and 2015) from the National Statistical Office. GDP Growth denotes gross domestic product growth, AgGrowth denotes growth in value-added by the agriculture sector in constant prices (2009), AgExp is public agriculture expenditure, AgGrowth Target and AgExp Target are the Comprehensive Africa Agriculture Development Programme (CAADP) targets.

Agriculture remains the backbone of the Malawian economy – crop production accounts for 74 percent of rural incomes and agriculture provides employment for 71 percent of the rural population (Chirwa 2009). Crop production accounts for 75 percent of all economic production in Malawi, with cereals, particularly maize, being dominant. Tobacco is the main cash crop for most Malawians and is the principal source of foreign exchange earnings for the country. Initially grown on large estates, since the mid-1990s, it has increasingly been grown by smallholder farmers, boosting their incomes. Livestock and fisheries are also important sources of agricultural income.

With reference to Figure 1, a positive relationship between agriculture sector growth and overall economic growth can be seen, with the principal exception of the 2006 financial year. Despite a contraction in agriculture that year due to the lagged effects of drought and subsequent food crisis, the Malawian economy benefitted significantly from a well-managed humanitarian response to the food crisis, as well as from the inflow of significant High Indebted Poor Country (HIPC) resources that more than compensated for the contraction in agriculture. Nonetheless, most years the decisions by the government for investment in the agricultural sector are crucial in improving the livelihoods of most Malawians.

Over the past two decades, there has been some recognition of the need to diversify the Malawian economy, generally through increasing output from non-traditional productive sectors, such as mining and, in particular, services. This has resulted in a gradual reduction in the significance of the agriculture sector in driving national economic output. The rise of these non-traditional sectors in part reflects that Malawi's agro-production, which is largely rain-fed, carries with it huge risks due to weather-related shocks on production. These non-traditional sectors are viewed as less volatile contributors to national economic output than is the agriculture sector.

This paper seeks to provide an integrated assessment of the role of localized public investments in promoting agricultural growth in Malawi. In particular, the effects of government expenditure on agricultural productivity are estimated quantitatively across the districts of Malawi. The analysis focuses on how public investments affect levels of agricultural output – particularly crop production and some key crop yields. To do so, we empirically estimate and evaluate localized public expenditure multipliers for the districts. Building upon earlier studies, estimated fiscal multipliers are used to analyses whether government expenditure policies have slowed or accelerated growth in the agricultural sector. Given the relatively large share of government expenditure in investment in the agriculture sector in Malawi, public expenditure policies may play an important role in agriculture output dynamics. The empirical estimates are based on a panel dataset covering 28 districts in Malawi from 2005 to 2015.

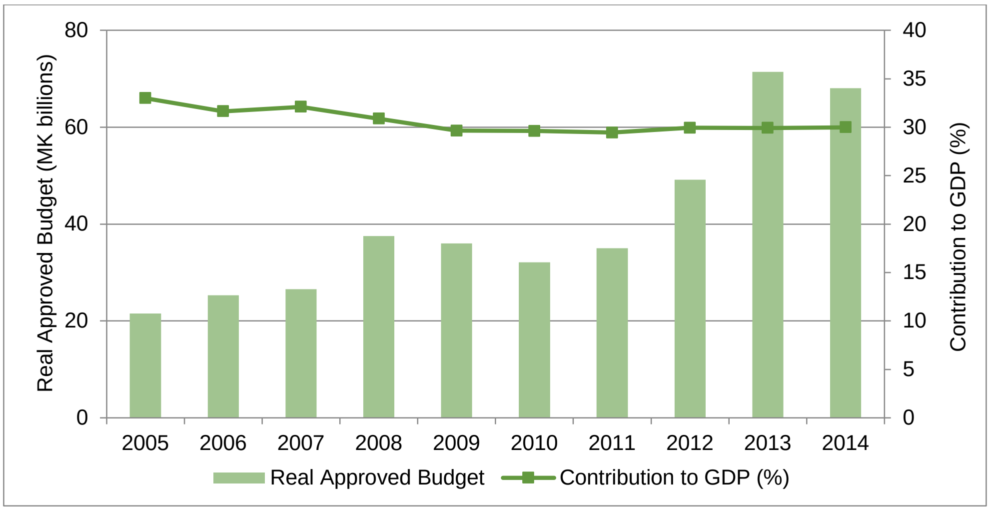
The remainder of the paper is structured as follows: section 2 provides a brief discussion on public spending in agriculture in Malawi. A review of the research literature on public investment and how it influences agricultural growth performance is presented in section 3. The paper describes the econometric methodology and data used in section 4, with the empirical results being provided in section 5. Section 6 concludes and provides policy recommendations.

2. PUBLIC SPENDING IN THE AGRICULTURAL SECTOR IN MALAWI

This section presents a brief overview of public spending in the agricultural sector in Malawi. As noted, Malawi was one of the first countries in sub-Saharan Africa to surpass the target of a 10 percent share of the total national budget allocated to the agricultural sector set by the 2003 Maputo declaration that launched CAADP. However, agricultural sector growth has been erratic in Malawi, leading to a failure to attain the 6 percent agricultural sector growth target in some years.

Figure 2 shows trends in the total budget allocation to the sector (in real Malawi Kwacha) and the annual percentage contribution of the agriculture sector to national economic output between 2005 and 2014. While the budget for the sector has increased substantially over this period, the contribution of the sector to GDP fell from 33 percent in 2005 to 30 percent in 2014. Several factors contribute to this decline in sector contribution to GDP.

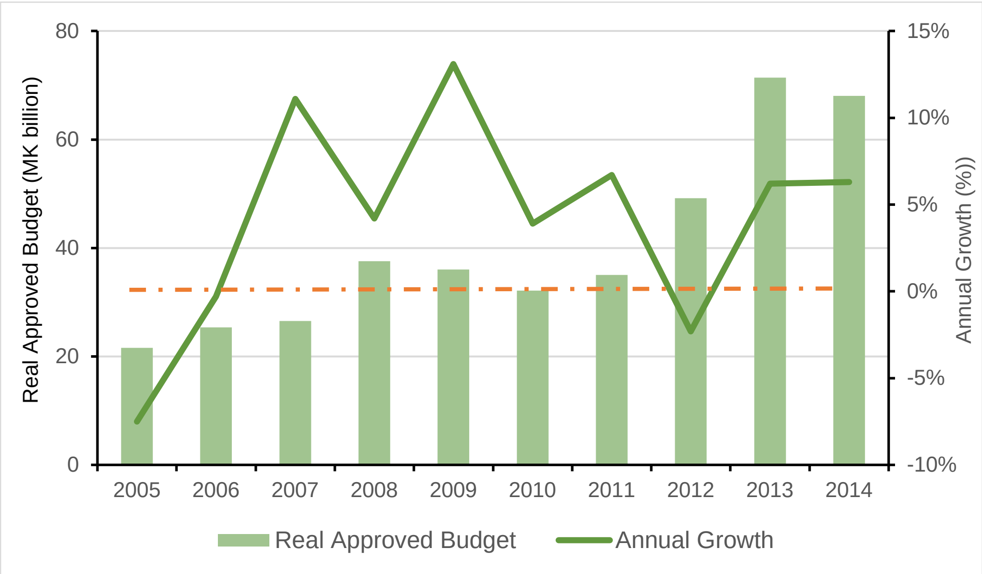
Figure 2—Budgetary allocation to agriculture and contribution of agricultural sector to total GDP, Malawi, 2005 to 2014



Source: Contribution to GDP data obtained from National Accounts reports by NSO and the Ministry of Finance and Economic Development. Real Approved Budget allocations data obtained from Ministry of Finance and Economic Development. The figures have been deflated using CPI from the World Development Indicators Database of the World Bank.

At the sectoral level, the increased budgetary allocations seem not to have consistently had the intended impact. Figure 3 shows that annual agricultural sector growth has been mostly low and volatile over this period, despite the rise in annual budget allocations to the sector. For example, between 2011 and 2014, while the sector growth rate averaged 3.3 percent per annum, 2012 registered a 2.7 percent contraction of the sector.

Figure 3—Budgetary allocation to agriculture and agricultural sector growth, Malawi, 2005 to 2014



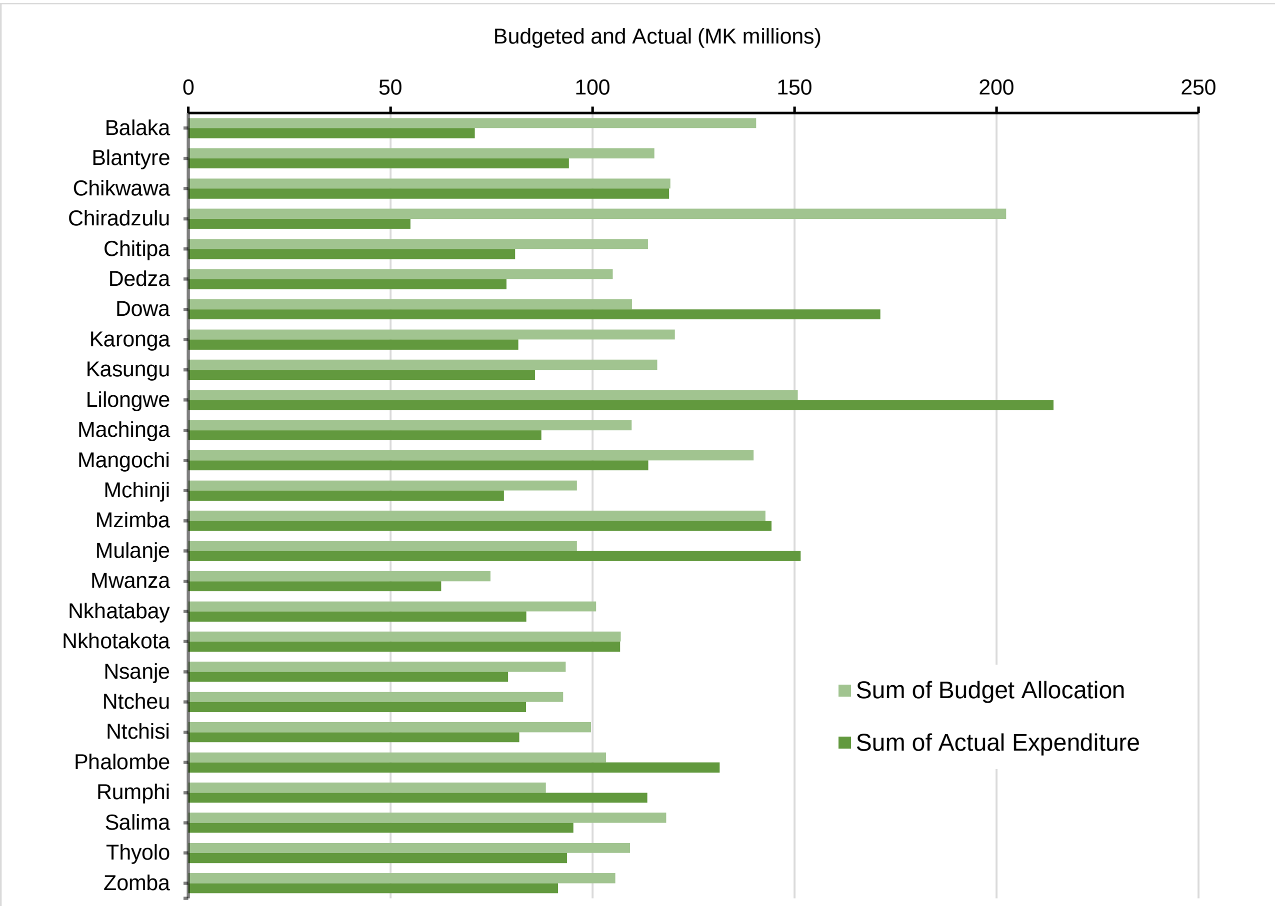
Source: Agricultural sector growth data obtained from National Accounts reports by NSO and Ministry of Finance and Economic Development. Real Approved Budget allocations data obtained from Ministry of Finance Budget documents and deflated using CPI (at 2009 prices) from World Development Indicators Database of the World Bank.

The Agriculture Public Expenditure Review for Malawi (World Bank 2013) found that the agriculture development budget contains substantial amounts of recurrent expenditures, such as salaries. Over the 2007/08 to 2011/12 period, the study estimated that non-capital elements in the agricultural development budget accounted for 63 percent of actual expenditures, 4 percent of which were salaries and 59 percent other recurrent expenditures. This left only 37 percent of the development budget for actual capital expenditures. As a result, actual capital expenditures by the Ministry of Agriculture was very low over this period, rarely exceeding 5 percent of actual expenditures by the Ministry. These limited capital expenditures account for much of the poor agricultural growth performance over this period. Investments made out of the development budget build capital and positively contribute to agricultural output growth. Recurrent expenditure is non-investment in nature and does not contribute to sector growth. Limited development spending in the agriculture sector today results in restricted agricultural sector growth in the future.

In addition, budget execution rates in the Ministry are low, particularly for the development budget. The World Bank (2013) study found budget execution rates to have been highly variable for all categories of expenditure throughout the 2007/08 to 2011/12 period. However, no clear patterns on budget execution are apparent, except that execution rates for donor-funded development activities appear to be consistently lower than those of the other categories of expenditures, all of which are financed using local resources. This was attributed to deficiencies of communication between the donors and the national administration and difficulties for the latter to master the myriad disbursement procedures of the development partners. This finding suggests that more domestically-sourced resources should be budgeted and spent by government.

Of particular interest to the analysis here, despite the commitment of the national government to devolve fiscal functions to districts and other local government bodies, total spending by local governments has remained relatively low, both in absolute terms and as a share of total public spending in Malawi. While the Local Government Act mandates that 5 percent of government discretionary spending should be directed through local councils, in the 2013/14 budget presented to parliament, local governments were budgeted to receive only 3.9 percent of the total budget (O'Neil and Cammack 2014). In terms of implementation of the budgeting processes, it is common that approved budgeted transfers and grants are not actually disbursed to the local authorities as planned or if disbursed, the funds are not provided according to the criteria of need, equity, and timeliness (Figure 4). This has been particularly challenging in recent years due to the poor macroeconomic and financial position of Malawi government arising from restricted budgetary support from Malawi's development partners and external weather shocks. Consequently, there have been delays and general reductions in the level of government subventions to district assemblies.

Figure 4—Sum of district agriculture budgets and expenditures, 2012/13 to 2014/15, by district



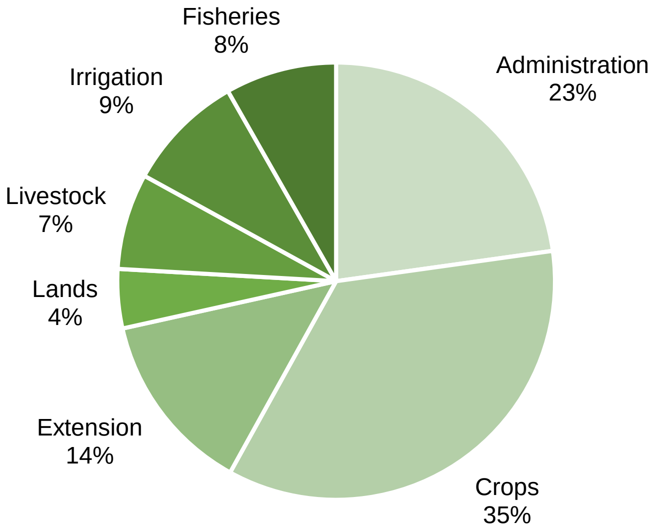
Source: Computed from district agriculture expenditure figures obtained from National Local Government Finance Committee

Agriculture, including irrigation and fisheries, are included in the public sector functions devolved to the districts. The total of budgeted allocations to all districts for the period 2012/13 to 2014/15 was MK 3.11 billion (US$ 4.35 million). Of this budgeted amount, MK 2.74 billion (US$ 3.84 million) was spent.[1] This represents an 88.3 percent utilization rate of financial resources. Figure 4 shows that 20 out of the 28 districts of Malawi spent less than their total budgeted allocations. Chiradzulu and Balaka had the highest underutilization rates – 27.1 and 50.5 percent, respectively – for the period under review. This supports the findings by World Bank (2013) that budget execution rates within the sector are very low. Eight districts spent more than their total budgeted allocations. Lilongwe, Dowa, and Mulanje districts had the highest over-expenditures over the three budget years between 2012/13 and 2014/15.

Though absorption of public financial resources is low in the districts, weak Public Financial Management (PFM) controls allow for spending over and above the approved budgets in some districts. This was confirmed by the European Union (EU) review of local government's Integrated Financial Management Information System (IFMIS)[2]. The review identified weak internal controls, such as execution of budgets not following rules and regulations configured in the Local Government IFMIS, that allows districts to make unauthorized transfers of funds from one part of their budget to another, but also allows for unbudgeted expenditures to be made. With a lack of strong oversight of district PFM functions, some districts exploit these weak financial controls to not only spend or commit more than their budgets allows but also to make unwarranted reallocations between budget lines. Extra-budgetary requests are thus used to accommodate such over-expenditures, though this trend started reversing during the 2014/15 financial year.

While the levels of public spending are important in driving the growth of the agriculture sector, equally important is allocative efficiency. Allocative efficiency is reflected by the quality as well as the priority areas of spending in the sector as reflected by functional allocations to the various agricultural sub-sectors. Figure 5 indicates the share of budgetary allocation to various agricultural sub-sectors in all districts throughout Malawi for the period from 2012/13 to 2014/15.

Figure 5—Share of functional allocations to districts between 2012/13 and 2014/15



Source: Computed from data obtained from National Local Government Finance Committee

Figure 5 shows that the largest allocation for the period under review was to crops development which had a share of 35 percent. The fact that administration costs had the second highest share of allocation provides more evidence that a large share of resources within the sector are spent on non-investment recurrent activities at the expense of development investments. More importantly, the above results reflect a misalignment between sector policies and budgeting in that important sub-sectors, such as extension and livestock development, receive relatively less public funding, despite being key drivers of growth in the sector alongside crops development.

3. LITERATURE REVIEW

There are numerous studies that examine the nexus of government expenditure and economic growth. However, there is no consensus that government expenditures consistently contribute positively to economic growth. One group of scholars on the subject support the proposition of John Maynard Keynes that government expenditure has a positive impact

[1] Converted at the middle exchange rate of July 2016 as reported by the Reserve Bank of Malawi.

[2] EU Technical Assistance report entitled "Review of Selenic Navigator for Enterprise Resource Planning (ERP) Software's Functionality in the Local Authority IFMIS in Malawi".

on economic growth (Solow 1957; Devajaran et al. 1996; Irmen and Kuehnel 2009; Alexiou 2009; Dandan 2011; Oyinbo et al. 2013). As argued by Kelly (1997), public expenditure can provide desirable services which the price mechanism cannot provide or produce at all or would only do so at a high cost and with smaller social benefit. In contrast, another group supports the classical school of thought first expounded by Adam Smith and does not agree that government intervention in the affairs of the economy is uniformly beneficial (Landau 1986; Barro 1990; Loto 2011). Studies from this perspective suggest that increases in government expenditure are correlated with slowdowns in economic growth.

Mogues et al. (2008) examined the effect on household welfare in Ethiopia of public expenditures at the sectoral level, finding that these effects varied considerably across sectors. Specifically, the researchers found that the impact of public investment in agriculture, relative to public investment in other sectors, is low in magnitude and statistical significance. Loto (2011) also investigated the impact of government expenditure on economic growth with a particular focus on sectoral allocations in Nigeria. The impact on economic growth varied from sector to sector. Of particular note, this research showed expenditure in agriculture in the short run to be negatively related to economic growth. Okezie et al. (2013) also investigated the relationship between Nigerian government expenditure in the agriculture sector and the sector's contribution to economic growth. In contrast to Loto (2011), this later study found that any reduction in public agriculture expenditures had negative repercussion on economic growth. A Malawi study by Musaba et al. (2013) on the impact of government sectoral expenditure on economic growth found insignificant short run effects of sectoral expenditures, but positive long-run effects of public expenditure in agriculture, in particular. In general, the studies finding insignificant or very weak linkages between public investment and agricultural growth attribute these results to the poor links between public expenditures in agriculture and productivity in the sector.

In contrast, other studies have found that government expenditure is an important determinant of agricultural productivity. For instance, Elias (1985), Diakosavvas (1990), and Iganiga and Unembilin (2011) have found empirical evidence of this sort for Latin America, a broad set of developing countries, and Nigeria, respectively. These authors conclude that government expenditure policies are vital in influencing the performance of the agricultural sector. For instance, Iganiga and Unembilin (2011) agree with earlier suggestions by Nwosu (1995) that government budget allocations in Nigeria have become an important determinant of agricultural output. Similarly, Oyinbo at al. (2013) find a positive relationship between public spending on agriculture production and productivity in Nigeria.

The basic general agricultural productivity response model includes several production input variables, such as labour, capital, land, and fertilizer. As in Blanc et al. (2014), public expenditure can be introduced as a key determining factor in such productivity response models. It is assumed that through its investment in agriculture, the government can enhance productivity and production. In Malawi, higher growth in the agricultural sector has been key to attaining food security at household and national levels. Accordingly, a number of studies have been conducted to determine the factors that contribute to the higher performance of the agriculture sector. However, the analyses have concentrated on the responsiveness of smallholder agriculture in specific crops to price and other non-price factors like infrastructure, fertilizers, credit, seed, and rainfall, ignoring the impact of public expenditure on agricultural output. The only study that considered public expenditure is the study by Musaba et al. (2013) examining the impact of government sectoral expenditure on economic growth in Malawi. Surprisingly, despite the abundant analysis of policy reform issues, little attempt has been made in Malawi to establish the relationship between government expenditure in the agriculture sector and the performance of the sector.

4. METHODOLOGY AND DATA

The empirical estimation of the impact of public agriculture expenditure on agricultural productivity for the districts of Malawi is based on the estimation of a reduced form production function using panel data. Standard fixed or random effects models are used to estimate the relative effect of public expenditure on agriculture productivity. The fundamental advantage of a panel data set over a cross-sectional data set is that it permits greater flexibility in modelling differences in behavior across districts. In addition, using panel data allows the data of all districts to be combined, increasing the sample size considerably. Individual estimations for each district could be considered unreliable because of the limited number of observations available for each. The panel data estimation method is specified as follows:

$$Y_{it} = \alpha_i + X_{it}\beta + v_i + \gamma_t + \varepsilon_{it} \quad (1)$$

where *i* denotes cross-sections and *t* denotes time periods (years). α_i is a unit-specific constant and β is Kx1 vector coefficients. X_{it} is the i^{th} observation on the K explanatory variables. v_i and γ_t denote the district-specific effect and period (year)-specific effect, respectively. ε_{it} is the usual residual with the standard properties (zero mean, no serial correlation or heteroscedasticity, zero correlation with X and with v_i). If v_i are treated as the fixed parameters to be estimated, the model is referred to as a fixed effects model. If v_i are treated as random, then the model is referred to as a random effects model. Generally, the application of whether to use a fixed effects or a random effects model is mostly based on the results of the Hausman test on the respective models. In this test, the null hypothesis is that the preferred model is the random effects model against the alternate hypothesis of the fixed effects model. The rejection of the null hypothesis indicates that the fixed effects model will be selected. Attempts should also be made to test whether an Ordinary Least Square method is suitable instead of using the fixed effects or random effects model by using the Breusch-Pagan Lagrangian multiplier test.

We specify the measure of agriculture productivity (*Prod*)—the average composite yield (mt/ha) of all crops for the district in a given year—as the dependent variable as a function of public agriculture expenditure (*PAE*) per hectare of cropped area in the district at a given year. Other explanatory variables in the estimated model include rainfall (*Rain*), average fertilizer use per hectares planted to crops (*Fert*), and the number of farm households (*FH*) per hectare of cropped area. All variables are analyzed as logarithms (ln). The modified empirical estimated panel model is specified as follows:

$$\ln Prod_{it} = \alpha_i + b_{iG}\ln PAE_{it} + b_{iH}\ln Rain_{it} + b_{iL}\ln Fert_{it} + b_{iP}\ln FH_{it} + v_i + \gamma_t + \varepsilon_{it} \quad (2)$$

where the parameter b_{iG} measures the contemporaneous one-year public agriculture expenditure spending elasticity, while α_i and γ_t denote the district specific effect and period (year) specific effect, respectively. The district fixed effects are used to control for factors such as geography, district bylaws, basic economics, culture, and the demographic structure of each district that did not change over time, but varied across districts. The period trend fixed effects control for changes in the economy that affected all districts at the same time (e.g., monetary policy changes, changes in tax rates, and implementation of the decentralization policy). Failure to control for these factors would result in the estimated parameters being spurious, as argued in Woodford (2011).

In addition, the study computes public expenditure multipliers to provide a quantitative measure of the change in agricultural productivity resulting from an increase in government spending. The calculated multipliers are key to evaluating the effectiveness of fiscal policies in managing output fluctuations. Studies on fiscal multipliers received much attention during the global economic crisis of 2008-09, but estimation of the magnitude of fiscal multipliers for both advanced economies and emerging markets has proven challenging, and there is still uncertainty about their size (Blanchard and Leigh 2013). Moreover, there is limited literature on fiscal multipliers for less developed countries, such as Malawi.

It is worth noting from equation 2 that the reduced form production function includes capital as an independent variable in the form of public expenditures in the agricultural sector. The overall impact of public agriculture expenditure on agricultural productivity is expected to be positive because it is an injection in the economy. The magnitude and direction of the impact depends on government contributing to increased productivity by providing public goods and infrastructure for social services and targeted interventions. However, empirical investigations show that the relationship can either be positive, negative, or constant (Mapfumo et al. 2012). As shown in equation 3, the fiscal multipliers (M) are computed from estimates of the elasticity parameters, as done in Bruckner and Tuladhar (2010).

$$M_i = \frac{\Delta \Pr od}{\Delta PAE} = E * \frac{\Pr od}{PAE} \quad (3)$$ [3]

where: M_i represents the fiscal multipliers for each district denoted by ***i***. Δ represents change and *E* represents the elasticity parameter, while *Prod* and *PAE* represent agricultural productivity and total public agriculture expenditures in a district, respectively. The elasticities are obtained from the random effects model which is more general in that they allow each panel to have its own vector of slopes randomly drawn from the distribution common to all panels. In addition, the average productivity and average agriculture expenditures obtained over the nine fiscal year period (2005/06 to 2013/14) were used to compute the elasticities.

According to the literature, the size of fiscal multipliers can be positive, close to zero, and, in some instances, negative (Bose and Bhanumurthy 2013, Mapfumo et al., 2012)). A public spending multiplier greater than one indicates that public expenditure is able to stimulate economic activities (agriculture activity) and produce a final increase in agriculture productivity larger than the initial increase in public spending. A multiplier of less than one means that the initial increase in aggregate demand is eroded by effects that counteract the initial unitary increase in public spending. These counteracting effects are often due to the crowding out of productive private sector activities. As argued in Batini et al. (2014), one key reason why spending multipliers can either be small (and even negative) is due to fiscal inefficiencies which limit the impact of fiscal policy on productivity.

Data

Malawi is divided into 28 districts. However, the study leaves out Likoma and Neno districts because of inconsistencies noted in the data for these two districts. Data that have characteristics that render them as outliers in our analytical data

[3] Where the formula for elasticity is represented as: $E = \frac{\Delta Prod}{\Delta PAE} \times \frac{Prod}{PAE}$; and the formula for fiscal multipliers is represented as $\frac{\Delta Prod}{\Delta PAE}$.

receive close attention. This is an important consideration if we seek consistency in comparisons over time. Unless treated, outliers can affect the regression results we obtain. The paper presents econometric results with and without outliers as robustness checks. We, therefore, not only investigate these outliers but also suggest techniques for dealing with them.

As noted, the dependent variable for the analyses is the natural logarithm (ln) of agriculture productivity (*Prod*), defined as total crop production (in metric tons) divided by total land put to crop production (hectare) (Table 1). The explanatory variables include public agriculture expenditure (*PAE*), which in some of our models is split into recurrent expenditures (*Rexp*) and development expenditure (*Dexp*) which represents capital expenditures; annual rainfall (*Rain*); fertilizer (*Fert*), as a proxy for farm inputs used; and number of farm households (*FH*), as a proxy for farm labor. We also present in Table 1 descriptive statistics for *Hect*, which is the hectares put to crop production in each district each year, as this variable was used to construct our dependent variable and to standardize the explanatory variables.

Table 1—Descriptive statistics of (unstandardized) variables used in the analyses

Variable	Definition	Unit	Mean	Median	Std Dev	Min	Max
Prod	Average composite yield (mt/ha) of all crops for the district in a given year *(dependent variable)*	mt/ha	3.95	3.20	2.90	0.87	16.11
PAE	Total public agricultural expenditure	MK million	804	486	904	49	5,668
Rexp	Recurrent public agricultural expenditure	MK million	119	88	103	4	746
Dexp	Development-oriented public agricultural expenditure	MK million	679	396	840	32	5,107
Fert	Inorganic fertilizer used under Farm Input Subsidy Programme	metric tons	6,314	5,501	4,676	196	31,135
Rain	Annual rainfall	millimeter	1,027	993	324	334	2,117
FH	Farm households	number	135,322	116,365	77,504	23,512	443,670
Hect	Land put to crop production	hectare	131,829	115,508	73,957	34,309	380,008

Source: Author's analysis from data set for 26 districts over nine years = 234 observations.
Note: In the analysis, all explanatory variables were standardized by being expressed on a per hectare of cropped area basis.

Data on total crop production, the area put to crop production, rainfall, and number of farm households were obtained from the Agriculture Production Estimates Surveys (APES) compiled by the Ministry of Agriculture, Irrigation and Water Development. *Prod* was based on agriculture crop production data because crop output forms more than 75 percent of agriculture gross domestic product (Government of Malawi 2005). Surveys on crop production are conducted annually with information available at district level. The district recurrent expenditure data were obtained from the consolidated annual appropriation accounts compiled by the Ministry of Finance, Economic Planning and Development, while data on development expenditure flows was collected from the Malawi Development Cooperation Atlas compiled by the Ministry of Finance, Economic Planning and Development. The proxy for farm inputs, *Fert*, is the Farm Input Subsidy Program (FISP) fertilizer tonnage distributed to the districts obtained from annual reports produced by the FISP Logistic Unit.

Treatment of outliers and data inconsistencies

Here we provide a brief discussion of how outliers have been dealt with in these analyses. Figures A1 and A2 in the Appendix visually display the crop production data in graphical form. These graphs enable us to detect observations which are clear outliers. The box plots in Figure A2 reveal the presence of outliers in selected districts, namely Nsanje, Blantyre, Phalombe, Thyolo, Ntcheu, Mzimba and Nkhata Bay. The data set contains both upper and lower outliers. One approach is, therefore, to remove observations in the 1st and 100th percentile in each of the districts. This would require that we generate a variable containing percentiles of production figures or yield estimates. Using this approach, we would drop 3 observations in the 1st percentile and 2 observations in the 100th percentile[4].

Table 1 shows that the median value of average composite crop yield (3.20 mt/ha) is lower than the mean (3.95 mt/ha) suggesting a positive skew of the data distribution created by the presence of large crop production outliers. In linear regression analysis, outliers give large residuals. Therefore, the second approach is to detect and get rid of observations with excessively large residuals. This is done by running an OLS regression on the natural log of average composite crop yield on the explanatory variables, standardizing the residuals generated and dropping residuals with absolute values greater than two (see Figure A3 in the appendix). Using this approach, 15 observations were flagged as having crop production figures that were either too high or low for their characteristics.

[4] Of course, different percentile levels can be used as threshold as a criteria for dropping as long as the loss of observations is not deemed excessive.

The final approach to detecting and dealing with outliers is robust regression, which has been found to be a good alternative to Ordinary Least Squares regression. This approach flags outliers by assigning them zero weights and therefore dropping them from further analysis. However, our analysis shows that there are no observations which can be considered as outliers when robust regression is used. In this study, the second approach of standardizing residuals to identify outliers is preferred, although results from the first approach are presented as robustness checks (see Appendix Table A2).

5. ECONOMETRIC RESULTS AND DISCUSSIONS

This section presents the result of analyses to generate empirical evidence on the impact of government expenditures on agricultural performances across the districts of Malawi. A balanced panel data regression method is utilized as the estimation technique. In addition, district fiscal multipliers are computed using the estimated elasticities on the relationship between government expenditure and agricultural productivity among the districts in Malawi.

We begin our analysis with a pooled ordinary least squares regression where the model is built by successively adding explanatory variables. The addition of variables to the analysis of productivity improves the overall fit of the model when examined in terms of R-squared (R^2). Squared terms of rainfall and fertilizer are added to check if there is some nonlinearity with respect to productivity. As can be seen from the results (Table 2), the signs for the squared terms do not switch from the linear terms, indicating linearity, although the size of the coefficients drop. With respect to the base year (=2005), the productivity for successive years are significantly higher. The results based on the data set before removal of outliers are presented in Table A1. Although the results differ in terms of the magnitudes of the coefficients (hence the need to remove outliers), the direction of the coefficients remain stable. Overall, the results presented in Table 2 and Table A1 demonstrate that the removal of outliers not only improves the fit of the model but also reduces the size of the model coefficients.

Table 2—Pooled Ordinary Least Squares regression results of determinants of district-level agricultural productivity after removing outliers

Variable	Model A	Model B	Model C	Model D	Model E	Model F
Total expenditures, MK million	0.115***	0.099***	0.073**	0.057*	0.073**	-0.157***
Rainfall, annual, mm		0.212***	3.783***	3.704***	3.772***	4.882***
Rainfall-squared			0.373***	0.363***	0.368***	0.471***
Fertilizer use, mt			0.128**	-1.006***	-0.679*	-0.257
Fertilizer use-squared				-0.161***	-0.122***	-0.065
Farm households, no.					-0.299***	-0.247**
2006, 0/1						0.414***
2007, 0/1						0.325**
2008, 0/1						0.512***
2009, 0/1						0.605***
2010, 0/1						0.612***
2011, 0/1						0.780***
2012, 0/1						0.862***
2013, 0/1						0.988***
Constant	1.788***	2.708***	11.355***	9.217***	10.127***	11.956***
R-squared	0.061	0.155	0.320	0.380	0.414	0.525

Source: Analysis by author.
Note: Observations: 216 in 26 districts; * p<0.05; ** p<0.01; *** p<0.001.

Fixed and random effects results

Next, we present results for fixed and random effects before and after treatment of outliers in Table 3. Before controlling for year (models A and C both fixed and random), the results shows a positive effect for total expenditure. The results are stable with and without outliers. The effect, however, disappears once we control for year. Just like in Table 2, yields are significantly higher for the subsequent years compared to the base year 2005.

The results in Table 3 show that government expenditure is significantly positively correlated with agricultural productivity among districts across Malawi. The coefficient on the main analytical variable of interest of public agriculture expenditure (PAE) is positive and statistically significant. Increasing the level of expenditures across the districts in Malawi would increase agricultural productivity, ceteris paribus. The coefficients on rainfall (*Rain*) is also positive and statistically significant in the random model without outliers, suggesting that growth in agriculture is also driven by rainfall.

Table 3—Fixed and random effects results of determinants of district-level agricultural productivity before and after treatment of outliers

	With outliers		Without outliers		With outliers		Without outliers	
Variable	Fixed A	Fixed B	Fixed C	Fixed D	Random A	Random B	Random C	Random D
Total expenditures, MK million	0.144***	-0.010	0.136***	-0.013	0.152***	-0.010	0.148***	-0.024
Rainfall, annual, mm	0.030	0.292	0.248	0.546	0.412	0.658	1.124*	1.534**
Rainfall-squared	-0.004	0.006	0.025	0.039	0.028	0.038	0.103*	0.130**
Fertilizer use, mt	0.083	0.105	0.143	0.217	-0.011	0.045	-0.016	0.098
Fertilizer use-squared	0.012	0.019	0.015	0.026	-0.002	0.009	-0.009	0.007
Farm households, no.	0.126	0.119	0.065	0.041	0.018	0.038	-0.120	-0.114
2006, 0/1		0.223**		.205*		0.229**		0.232**
2007, 0/1		0.222**		0.171		0.231**		0.203*
2008, 0/1		0.378***		0.325**		0.385***		0.367***
2009, 0/1		0.338**		0.315**		0.351***		0.367***
2010, 0/1		0.426***		0.351**		0.447***		0.407***
2011, 0/1		0.420***		0.413***		0.438***		0.475***
2012, 0/1		0.495***		0.464***		0.514***		0.530***
2013, 0/1		0.579***		0.554***		0.602***		0.630***
Constant	2.357*	2.199	2.790*	2.881*	3.318**	3.084**	5.006***	5.233***
R-squared	0.312	0.417	0.318	0.428	0.304	0.412	0.289	0.404
Observations	234	234	216	216	234	234	216	216

Source: Analysis by author.
Note: Observations from 26 districts; * p<0.05; ** p<0.01; *** p<0.001

However, the coefficient on fertiliser (*Fert*), though with the expected positive sign in some cases, is statistically insignificant. The study used FISP fertiliser distributed in each district as a proxy for modern agricultural input use. It is possible the FISP beneficiaries received fewer bags of fertiliser than intended. Moreover, the fertiliser they received may have been thinly spread across their farms to ensure that all crops received fertiliser. Moreover, FISP beneficiaries often sell the fertiliser coupons they receive. Where that sold coupon is utilised might not necessarily be in the district of the original beneficiary. Hence, the low response of fertiliser can partly be explained by specific FISP implementation factors and how FISP fertiliser was distributed among farmers.

Table 4—Ordinary Least Squares Regression results of determinants of district-level agricultural productivity using recurrent and development expenditure and excluding outliers

Variable	Model A	Model B	Model C	Model D	Model E	Model F
Recurrent expenditures, MK million	0.176***	0.106*	0.034	0.052	0.056	-0.058
Development expenditures, MK million	-0.009	0.020	0.037	0.012	0.025	-0.126***
Rainfall, annual, mm		0.189***	3.752***	3.628***	3.688***	5.049***
Rainfall-squared			0.370***	0.356***	0.360***	0.487***
Fertilizer use, mt			0.126**	-1.049***	-0.728**	-0.243
Fertilizer use-squared				-0.166***	-0.128***	-0.062
Farm households, no.					-0.294***	-0.234**
2006, 0/1						0.452***
2007, 0/1						0.363**
2008, 0/1						0.547***
2009, 0/1						0.651***
2010, 0/1						0.655***
2011, 0/1						0.835***
2012, 0/1						0.920***
2013, 0/1						1.040***
Constant	2.373***	2.939***	11.327***	9.068***	9.963***	12.075***
R-squared	0.091	0.159	0.314	0.378	0.411	0.535

Source: Analysis by author.
Note: Observations: 216 in 26 districts; * p<0.05; ** p<0.01; *** p<0.001.

Table 4 provides results of estimations when total expenditures (*PAE*) by districts are split into recurrent (*Rexp*) and development (*Dexp*) expenditures. We also run a pooled ordinary least squares regression where the model is built by successfully adding explanatory variables. The addition of variables to the analysis of productivity improves the overall fit of the model when examined in terms of R^2. With respect to the base year 2005, the yields for successive years are significantly higher. Alternative results based on a data set before removal of outliers are presented in Table A3 in the appendix. Although the results differ slightly in terms of magnitudes of the coefficients (hence the need to remove outliers), the direction of the coefficients remain stable. Overall, the results presented in Tables 4 and Table A3 in the Appendix shows that the removal of outliers not only improves the model fit but also reduces the size of coefficients.

Table 5 presents results for fixed and random effects before and after treatment of outliers. Before controlling for year in Models A and C for both fixed and random, the results shows a positive effect for development expenditure. The coefficients for development expenditure are very significant and large when compared with the coefficients for recurrent expenditure. The effect however disappears once we control for year. Worth noting is that rainfall as a controlling factor in the random model without outliers is significant and positive.

Table 5—Fixed and random results of determinants of district-level agricultural productivity using recurrent and development expenditure before and after treatment of outliers

	With outliers		Without outliers		With outliers		Without outliers	
Variable	Fixed A	Fixed B	Fixed C	Fixed D	Random A	Random B	Random C	Random D
Recurrent exp., MK million	0.041	-0.031	0.022	-0.071	0.043	-0.033	0.022	-0.086
Development exp., MK million	0.110**	0.001	0.112***	0.006	0.115***	0.000	0.122***	-0.001
Rainfall, annual, mm	0.020	0.350	0.273	0.767	0.388	0.715	1.165*	1.914***
Rainfall-squared	-0.005	0.011	0.028	0.061	0.026	0.043	0.107*	0.166***
Fertilizer use, mt	0.093	0.111	0.157	0.239	-0.001	0.052	-0.007	0.113
Fertilizer use-squared	0.013	0.019	0.017	0.027	0.000	0.010	-0.009	0.006
Farm households, no.	0.113	0.125	0.053	0.041	0.008	0.045	-0.135	-0.123
2006, 0/1		0.242*		0.249**		0.251**		0.289***
2007, 0/1		0.240*		0.215*		0.252**		0.261**
2008, 0/1		0.398***		0.370***		0.407***		0.427***
2009, 0/1		0.367**		0.385***		0.384***		0.458***
2010, 0/1		0.447***		0.400***		0.471***		0.474***
2011, 0/1		0.449***		0.484***		0.470***		0.569***
2012, 0/1		0.526***		0.542***		0.549***		0.633***
2013, 0/1		0.605***		0.620***		0.632***		0.719***
Constant	2.476*	2.180	2.926*	3.045*	3.405**	3.048**	5.177***	5.695***
R-squared	0.313	0.419	0.320	0.440	0.305	0.414	0.289	0.412
Observations	234	234	216	216	234	234	216	216

Source: Analysis by author.
Note: Observations from 26 districts; * p<0.05; ** p<0.01; *** p<0.001

Evidence emanating from these results indicate that, while the coefficient of recurrent expenditure is positive in some cases, it is not consistently statistically significant across all the models. When running a pooled OLS estimate, the elasticity of development expenditure is found to be positive, statistically significant in Models B, C, and E, and higher than the elasticity of recurrent expenditures across all the models. On the other hand, all the elasticities in the fixed and random models without controlling year are statistically significant and large when compared with the elasticities of recurrent expenditure. Hence, the contribution of government expenditures to agricultural productivity growth in the districts mainly emanates from the development expenditures. In addition, the effects of the control variables are not clear.

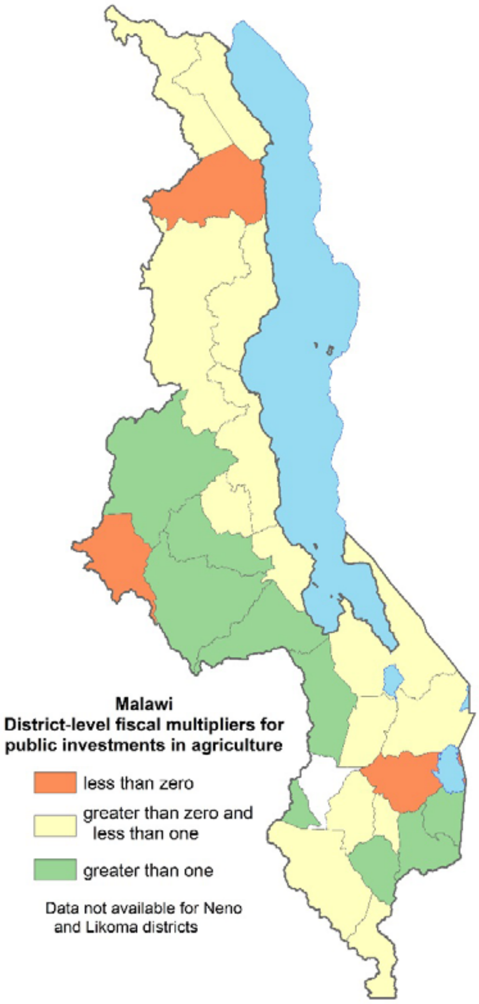
Analyzing fiscal multipliers

The fiscal multipliers presented in Table 6 and mapped there are calculated based on equation 3. We have used elasticities obtained from the random effects model because there is evidence of significant differences across districts in our estimation as seen in the Breusch and Pagan Lagrangian Multiplier Test results presented in Tables A4 in the Appendix. Most of the fiscal multipliers are positive and in agreement with the Keynesian framework, but most fall below 1.0. By implication, increasing agriculture expenditures increases agricultural productivity, but the increase is relatively small. Obtaining low fiscal multipliers implies that government spending is crowding out private investment and consumption that would have taken place without government spending.

Low multipliers can also be obtained where openness to trade exists among districts (Ilzetzki et al. 2012). It is believed that in open districts, part of the increase in aggregate demand (investment) would be met by a reduction in trade (net exports) rather than by an increase in district production. Thus, holding all other things constant, existing trade among districts can lead to smaller multipliers. For instance, the fiscal multiplier is very low in Mzimba district. This can partly be explained by the agricultural produce of Mzimba farmers being traded with other districts in Malawi and across the border into Zambia. The net trade (imports) is a leakage and, hence, reduces the increase in aggregate demand rather than the increase in production.

Table 6—Fiscal multipliers among districts in Malawi

Districts	Elasticity	Multiplier
Chitipa	0.018	0.085
Karonga	0.083	0.379
Rumphi	-0.040	-0.062
Mzimba	0.025	0.096
Nkhata Bay	0.006	0.071
Kasungu	0.240	1.366
Mchinji	-0.152	-2.347
Dowa	0.240	2.264
Ntchisi	0.132	0.712
Lilongwe	0.422	2.051
Dedza	0.194	1.484
Ntcheu	0.256	3.409
Nkhotakota	0.075	0.469
Salima	0.119	0.169
Balaka	0.186	0.312
Machinga	0.100	0.446
Mangochi	0.162	0.751
Zomba	-0.084	-0.793
Blantyre	0.134	0.845
Thyolo	0.276	2.609
Chiradzulu	0.077	0.401
Phalombe	0.289	2.803
Mulanje	0.267	4.443
Mwanza	0.254	2.073
Chikwawa	0.089	0.268
Nsanje	0.187	0.387



Source: Analysis by author.

On the other hand, we observe fiscal multipliers greater than 1.0 in most parts of the Central region (Kasungu, Dowa, Lilongwe, Dedza, and Ntcheu districts) and some parts of the Southern region (Thyolo, Phalombe, Mulanje, and Mwanza districts). Production in these areas is relatively high as indicated in most of the annual Agricultural Production Estimate Surveys (APES) produced by the Ministry of Agriculture. Theoretically, when spending multipliers are greater than 1.0, then the private components of agricultural productivity rise at a greater rate than government spending. Interestingly, however, some districts, e.g., Dowa, Phalombe, and Mulanje, with high fiscal multipliers, overspent their budgets for agriculture, contrary to the requirement of good expenditure management (see Figure 4).

Negative fiscal multipliers are observed in Rumphi, Mchinji, and Zomba. As indicated in Table 7 and graphs in Figure A4 in the Appendix, there is an inverse relationship between the average percent changes between productivity and agriculture expenditure in Rumphi and Mchinji and the positive relationship in Zomba is very low. On the other hand, Table 6 and Figure A4 in the Appendix reflects that there is significant positive relationship between agricultural productivity and public expenditure in districts with high positive fiscal multipliers.

Table 7—Average annual percentage changes in agricultural productivity and agriculture expenditures in selected districts with strongly negative or positive fiscal multipliers

Strongly Negative Fiscal Multipliers			Strongly Positive Fiscal Multipliers		
District	Avg. change agricultural production	Avg. change total agricultural expenditures	District	Avg. change agricultural production	Avg. change total agricultural expenditures
Rumphi	-3.59	83.70	Lilongwe	20.39	59.17
Mchinji	-1.98	54.68	Thyolo	10.50	62.75
Zomba	2.40	44.81	Mulanje	12.67	62.91

Source: Analysis by author.

As argued in Bose and Bhanumurthy (2013), negative fiscal impacts are feasible if Ricardo's theory of balanced budgets hold or the impact of crowding-out is large. Bose and Bhanumurthy (2013) argue that negative fiscal multipliers may arise when public finances are in bad shape and there is weak quality in the expenditures made. As highlighted in the World Bank Agriculture Public Expenditure Review of 2013, expenditure allocations to the agricultural sector have mainly been at central level, with very little (about 5 percent) allocated to the districts. Hence, the impact of district-level public investments would generally be small. The EU Technical Assistance report of 2015 on the financial management systems of local governments revealed that district councils tend to overspend their budgets. This reflects weak Public Financial Management controls that allow spending entities to spend more than their approved budgetary allocations. In addition, most of the districts identified in the EU report as having weak financial management systems are the same districts which have low fiscal multipliers as reflected in Table 6. These district include Blantyre, Ntchisi, Nkhotakota, Nsanje, Mzimba, Kasungu, Zomba, and Chitipa.

6. CONCLUSIONS AND POLICY IMPLICATIONS

This paper investigates the impact of government expenditure on agricultural growth in Malawi over the period 2005 to 2014. The causal effects were established using panel regression models in which pooled OLS, fixed effects, and random effects models were estimated. The results of the analysis indicate that government agriculture expenditures have a variable but generally positive impact on agricultural growth in the districts of Malawi. Most of the fiscal multipliers estimated are less than one and for three districts they are negative. In addition, individual district characteristics explain a substantial part of the within-country variation in agricultural productivity. However, the impact vanishes when year effects are accounted for in the models. Improving the quality of government expenditures and the health of public finances are key to realising more positive impacts from public expenditures on agriculture across the districts of Malawi.

A few policy recommendations from this analysis can be drawn:

- At the district level, the current levels of budgetary allocations to agriculture should be enhanced as the study provides evidence that government expenditures can influence agricultural growth in Malawi. However, the increase in allocations should also be buttressed by significant improvement in expenditure management to improve on expenditure efficiency at the district level.
- Fiscal impact at district level comes more from development expenditures than from recurrent expenditures. Hence, greater capital investments through the development budget should be provided to districts, supplemented by significant improvement in expenditure management to improve the efficiency of these expenditures.

Further studies are required to inform policy makers on the likely impact of expenditures within specific sub-sectoral programs, especially on specific agricultural products, such as crops, livestock and fisheries.[5] Such studies would assist with both the determination of expenditure allocations and the identification of districts that may produce particular products profitably.

[5] Apart from these agricultural products, the impact of expenditures on specific agricultural sub-sectors such as extension, irrigation, seeds, and research is also crucial.

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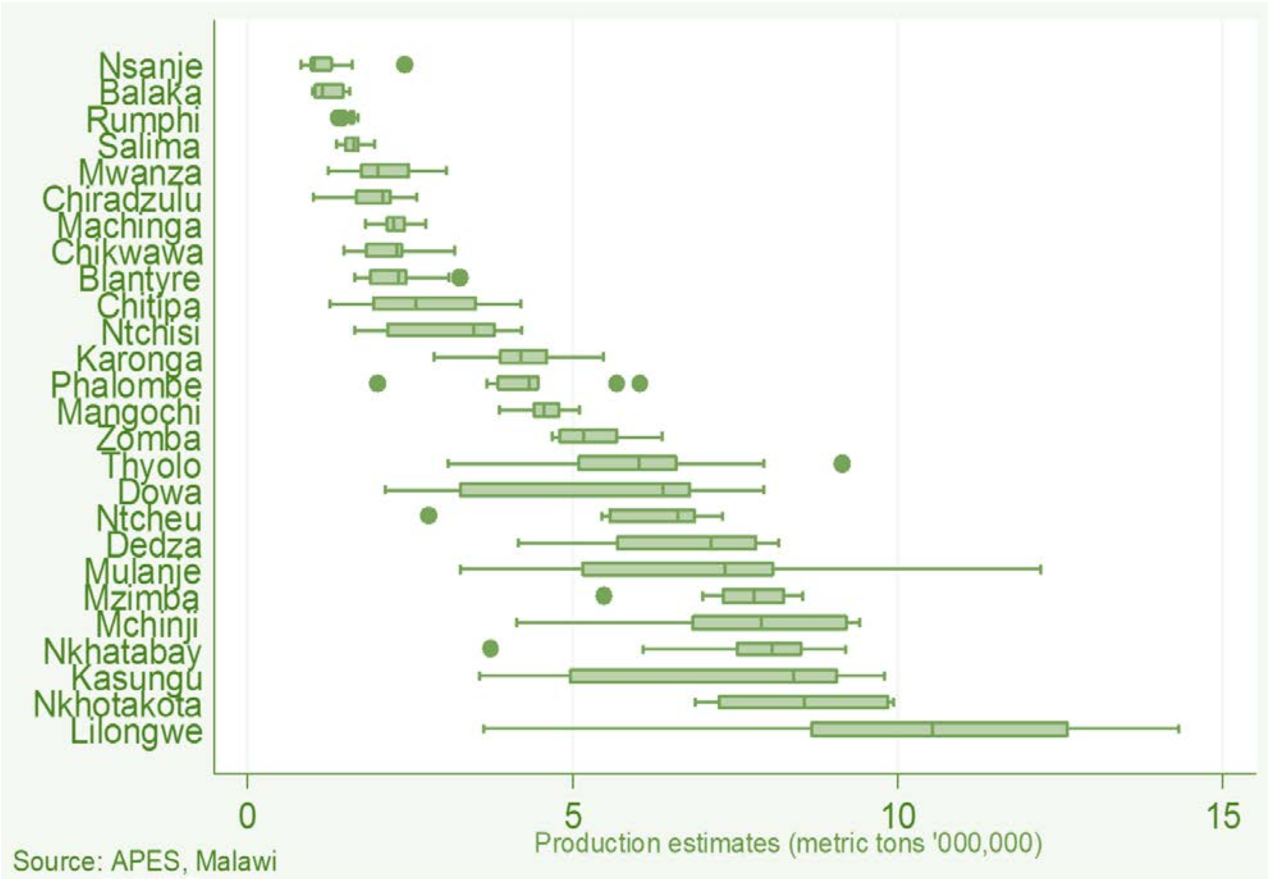
APPENDICES

Figure A1—Panel line graphs showing agricultural production estimates, by district

Source: Analysis by author.

Figure A2—Average annual agricultural production estimates by district, sorted box plots



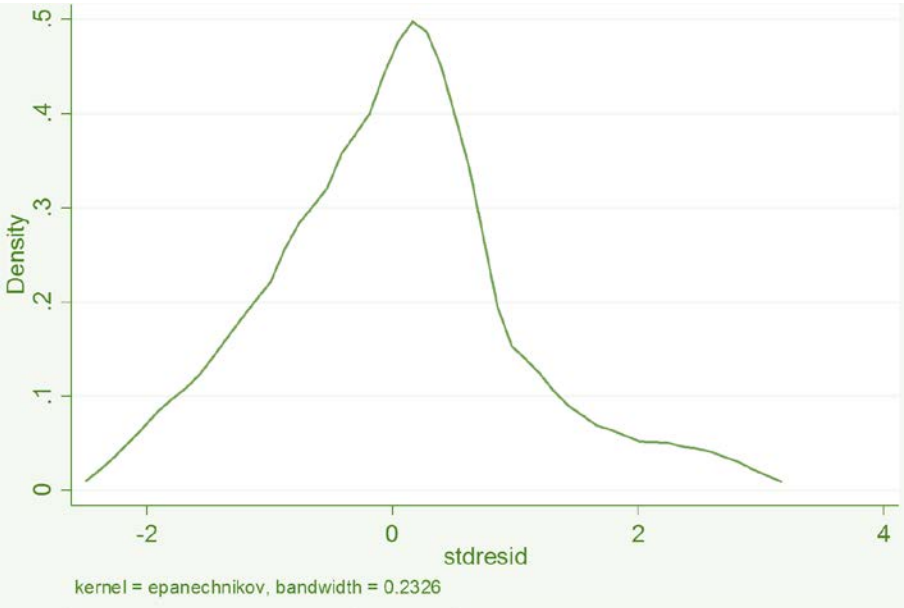
Source: Analysis by author.

Table A1—Ordinary Least Squares regression results of determinants of district-level agricultural productivity before removing outliers

Variable	Model A	Model B	Model C	Model D	Model E	Model F
Total expenditures, MK million	0.172***	0.137***	0.115***	0.093**	0.106***	-0.091
Rainfall, annual, mm		0.311***	3.599***	3.471***	3.552***	4.495***
Rainfall-squared			0.345***	0.330***	0.337***	0.424***
Fertilizer use, mt			0.089	-1.297***	-1.014**	-0.756*
Fertilizer use-squared				-0.197***	-0.164***	-0.126**
Farm households, no.					-0.269**	-0.202*
2006, 0/1						0.390**
2007, 0/1						0.342*
2008, 0/1						0.476***
2009, 0/1						0.506***
2010, 0/1						0.638***
2011, 0/1						0.640***
2012, 0/1						0.731***
2013, 0/1						0.868***
Constant	2.136***	3.424***	11.255***	8.531***	9.382***	10.705***
R-squared	0.099	0.246	0.349	0.408	0.426	0.479

Source: Analysis by author.
Note: Observations: 234 in 26 districts; * p<0.05; ** p<0.01; *** p<0.001.

Figure A3—Graph showing standardised residuals from OLS regression for identification of outlying cases as those with a standardised residual with an absolute value greater than 2.0



Source: Analysis by author.

Table A2—Ordinary Least Squares regression results of determinants of district-level agricultural productivity based on alternative treatment of outliers

	Percentiles		Residuals	
Variable	Model A	Model B	Model C	Model D
Total expenditures, MK million	0.102***	-0.083	0.073**	-0.157***
Rainfall, annual, mm	3.658***	4.606***	3.772***	4.882***
Rainfall-squared	0.351***	0.439***	0.368***	0.471***
Fertilizer use, mt	-0.902**	-0.612	-0.679*	-0.257
Fertilizer use-squared	-0.148***	-0.108*	-0.122***	-0.065
Farm households, no.	-0.271**	-0.217*	-0.299***	-0.247**
2006, 0/1		0.354**		0.414***
2007, 0/1		0.291*		0.325**
2008, 0/1		0.430**		0.512***
2009, 0/1		0.488**		0.605***
2010, 0/1		0.593***		0.612***
2011, 0/1		0.652***		0.780***
2012, 0/1		0.682***		0.862***
2013, 0/1		0.810***		0.988***
Constant	9.728***	11.238***	10.127***	11.956***
R-squared	0.388	0.444	0.414	0.525
Observations	229	229	216	216

Source: Analysis by author.
Note: Observations from 26 districts; * p<0.05; ** p<0.01; *** p<0.001

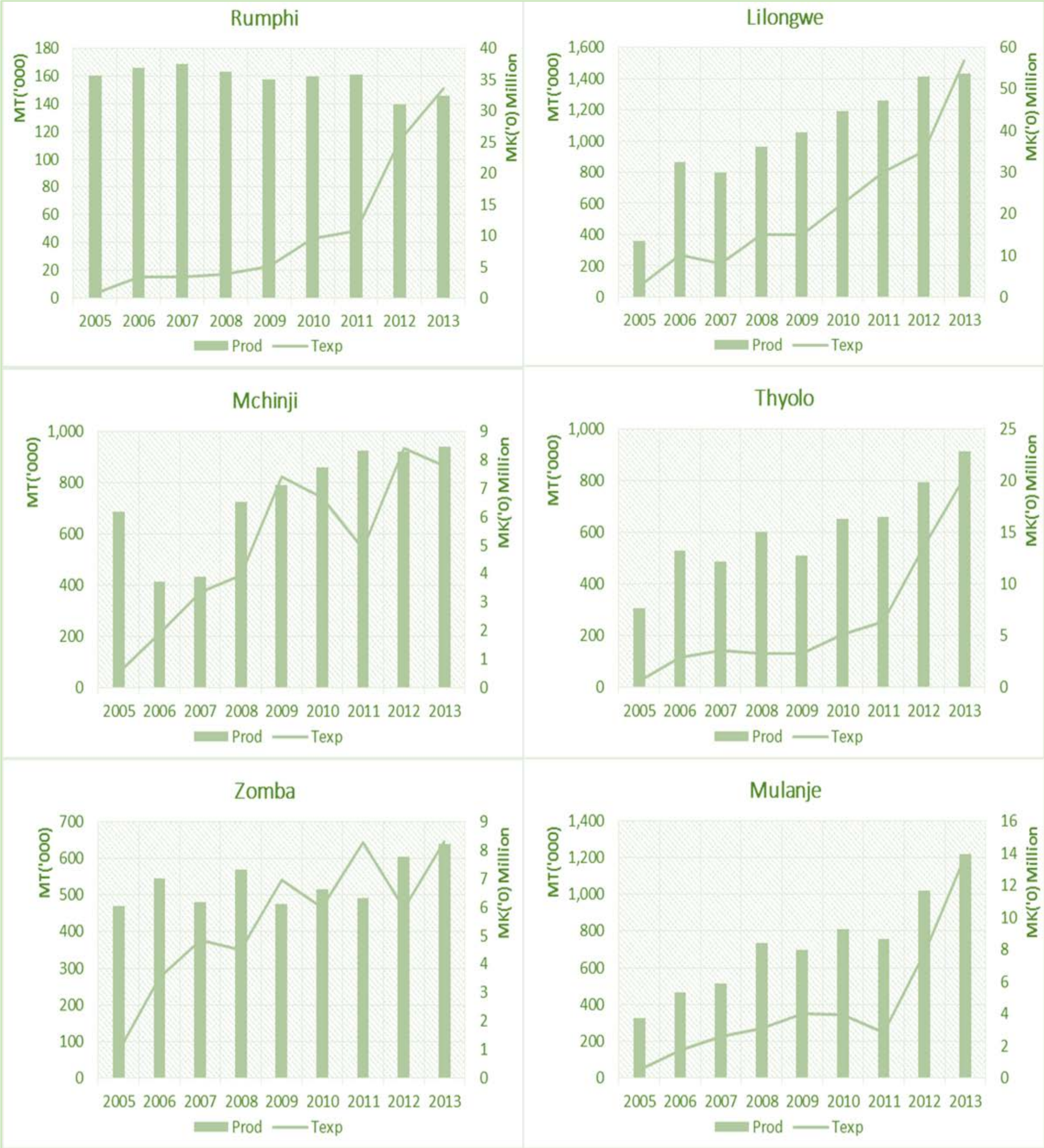
Table A3—Ordinary Least Squares regression results of determinants of district-level agricultural productivity based on recurrent and development expenditure before removing outliers

Variable	Model A	Model B	Model C	Model D	Model E	Model F
Recurrent expenditures, MK million	0.146*	0.039	-0.010	0.015	0.016	-0.084
Development expenditures, MK million	0.064	0.095*	0.099**	0.066	0.077*	-0.064
Rainfall, annual, mm		0.312***	3.646***	3.480***	3.558***	4.749***
Rainfall-squared			0.349***	0.330***	0.337***	0.448***
Fertilizer use, mt			0.095	-1.314***	-1.033**	-0.703*
Fertilizer use-squared				-0.200***	-0.166***	-0.119**
Farm households, no.					-0.266**	-0.183
2006, 0/1						0.453**
2007, 0/1						0.407**
2008, 0/1						0.544***
2009, 0/1						0.601***
2010, 0/1						0.716***
2011, 0/1						0.739***
2012, 0/1						0.838***
2013, 0/1						0.964***
Constant	2.610***	3.495***	11.281***	8.513***	9.356***	10.911***
R-squared	0.103	0.239	0.342	0.402	0.420	0.487

Source: Analysis by author.
Note: Observations: 234 in 26 districts; * p<0.05; ** p<0.01; *** p<0.001.

Figure A4—Trends of annual agricultural production and total expenditure in selected districts with high positive and negative fiscal multipliers

Strongly negative fiscal multipliers | *Strongly positive fiscal multipliers*



Source: Analysis by author.

Table A4—Breusch and Pagan Lagrangian Multiplier Test for random effects in the district models

Estimated Results		
	Variance	Standard Deviation
Yield	0.296	0.544
E	0.028	0.166
U	0.132	0.363

Test: Var(u) = 0
Chi^2 (01) = 437.42
Prob > Chi^2 = 0.0000

Source: Analysis by author.

About the Author

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