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Fiscal Dividend from Saving, Investment and Per Capita Income Growth in Sub-Saharan Africa: Panel Data Analysis

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Abstract

Most of sub-Saharan Africa countries (SSA) have recorded impressive rates of growth and remained resilient to shocks especially during the recent past. Nevertheless, the status of social welfare has remained low as manifested by poor quality of standard of living and short longevity of life. In cognisance of the role of public sector to wellbeing through the fiscal arrangement, the objective of this study was to unearth the extent to which SSA have taken advantage of the achieved saving, investment and growth performance to enhance fiscal gains. Panel data analysis of 40 countries was done and results indicated that per capita income growth, total investment and gross national saving bolstered governments' revenue and thus reduced budget deficits in SSA, except in the global economic crisis during which, only saving yielded significant fiscal dividend in terms of cushioning the revenue. In view of this, enhancing national savings (both public and private) in SSA can appropriate surpassing return to fiscal stance.

Keywords: government revenue, deficit, growth, saving, investment

1. Introduction

Over the past one decade many sub-Sahara African (SSA) countries, particularly the low income economies (excluding fragile (Note 1) ones) realized remarkable increases in investment rate and economic growth, however, with a modest rise in domestic savings. On one hand, governments' total revenues as proportion of GDP have been increasing concurrently with investment and output growth, while on the other hand national budget deficits relative to GDP, which were declining during 2002–2007, turned around to an increasing trend starting 2008, partly exacerbated by the global economic crisis. In SSA countries budget deficits have recently kept on rising and this is a challenge as these economies continue to reshape their economic landscapes after the economic crisis. With increasing budget deficit, fiscal space is reduced and so financing choices for all governments at every stage of development in the region become limited.

To cope with the budget constraints in developing countries, SSA countries inclusive, a number of solutions have been recommended including *inter alia*: expanding tax bases; undertaking tax system reforms; improving quality of tax administration; and rationalizing public expenditure in the manner that amplifies fiscal discipline (World Bank, 2012; Oyejide, 1999). Even so, for SSA economies which have been foreign dependent for a long time now in terms of direct investment, portfolio flows, and public finance through budget supports, trade, and so forth (Note 2), these solutions are but a window dressing measures, while seeking for the lasting resort that originates from within the sub-continent.

Among the lingering concerns in the global economy is that SSA countries remain behind the rest of the world, especially regarding wellbeing – which is largely manifested by poor quality of living standard and short longevity of life – despite its huge development potential (UNDP, 2011; IMF, 2000, 2014). The fact that SSA economies are generally resources rich, for both natural and human (but of course in need of capacity development) is indisputable. Nonetheless, one of the ever spinning questions is about how to speedily start and sustain transformation of these resources into welfare. Several stakeholders must play their respective roles (some of which mutually exclusive) to accomplish the required transformation, but suitable and competent management/administration should be in the forefront of this undertaking. Sociology and political science aspects of mind-setting and good governance of the leadership characters are of paramount importance in this view. However, this article is specifically focused on economic aspects of SSA governments' revenues and deficits. Without financial resources at the disposal of public administration, a noble (development) role of the government cannot be well pursued regardless of how serious and innovative the government is. This study is hinged on one key question; do the SSA governments accrue potential resources from the improving macroeconomic conditions? This is asked in cognisance of high demand for public goods and services, notably health, education and infrastructure, among others, in developing economies at the present. The approach we take to craft answers to this question is a kind of inward looking exploratory research, attempting to find out the significance of the benefit that SSA countries have made or can hoard from enhancing growth, saving and investments. Through analysis of developments in these deterministic macroeconomic variables, which together constitute the "national assets creating mechanism", we want to find out whether there have been substantive gains to SSA governments from prioritizing these variables, particularly in terms of the fiscal stance.

A panel data approach is employed to study 40 SSA countries for the period of 13 years (2000–2012), using data from IMF World Economic Outlook Database (IMF, 2013). The findings show that before the recent global economic crisis which hit the global economy from October 2007, "fiscal dividend" from national income growth, saving and investment performance significantly bolstered government revenue and also led to a remarkable improvement in terms of reduction of fiscal deficit in SSA. Nevertheless, during post crisis, these variables did not contribute significantly to safeguarding SSA economies from experiencing budget deficits; save for the national saving in particular, which remained an important factor underlying government revenue generation. While most developing countries have had on top of their agenda a proclamation for higher incomes, and that in their foreign ministries and embassies solicit for more FDIs; a missing link seems to be a big push to enhanced domestic saving behaviour (for both public and private sectors) since saving appears to entail the most significant fiscal dividend to the SSA countries in both dimensions of this study.

The rest of the paper is organized as follows, the next Section 2 describes income growth and fiscal status of SSA, Section 3 underscores the underlying conceptual framework and Section 4 presents the adopted methodology. Empirical results are presented and discussed in section 5 while Section 6 makes a conclusion.

2. Output Growth and Fiscal Status of Sub-Saharan Africa

There has been a wide spread argument in some SSA countries that the achieved GDP growth in the past couple of decades may be immiserizing to the general public since poverty has either increased or its reduction speed has remained too slow. Validation of this argument is out of the scope of this paper, but one of the ways we could convince others that growth has generally been good is by exhibiting the extent to which real per capital income has increased since that reflects a sort of achievement in terms of purchasing power. There are those who look at a shared growth in a different way, arguing that it may be as growth happens, public sector provision of goods and services from increase collected of government revenue entails a compensating welfare effect especially where private purchasing power does not seem to have gained much. In this context it means improvement in government revenue performance is a prerequisite for the public sector's capacity to amplify welfare gains from the realized growth.

Real GDP growth rate of SSA countries has generally been stable and was resilient to shocks of the last global economic crisis, with an average rise of 6.3% during 2004–2007, and 4.5% during 2008–2011. These figures exclude oil exporting economies which realized much higher average growth rates of 9.0% and 6.4% during the same periods; and fragile countries, which achieved lower rate of 2.6% and 3.7%, respectively. In spite of these high rates as compared to most other regions in the world, real income per capita growth rate has been decreasing over time. Regarding tax as a major source of government revenue, a fall in per capital income growth (Note 3) is a bad sign since it implies sluggish improvement in the tax payment ability of the majority of general public. Growth rate of real GDP per capita of SSA economies (excluding oil exporters and fragile countries) declined from 4.6% in 2004 to 4.4% in 2007 and then further down to 2.6% in 2012.

Regarding government revenue and expenditure of SSA economies, they were both increasing throughout the period 2004–2012. Government revenue as percent of GDP for SSA economies (excluding oil exporters and fragile countries) stood at an average of 22.1% during 2004–2007, and despite the financial crises it slightly scaled up to 22.5% during 2008–2012. On the other side, expenditure rose from 25.6% to 28.4%, respectively (Table 1). A concern that is relevant to the subject of this paper is the difference in the speed of increase in these two variables. Revenue as percent of GDP rose at an average change of 0.2 percentage points per annum for most of the periods while expenditure increased at an average change of 0.6 percentage points. While it is okay that the government revenue and expenditure have to increase as time goes especially if the economy is growing, the fear is on the discrepancy in their speeds of growth, i.e. expenditure adjustment to the higher side in the SSA countries leaves revenue adjustment behind. Many reasons can be given for this scenario, however, its negative effect on budget balance and overall fiscal stance will not have been offset though (Carneiro et al., 2005).

Table 1. Government revenue and expenditure

Government revenue (excluding grants) as percent of GDP	2004	2005	2006	2007	2008	2009	2010	2011	2012
Oil exporters	32.1	35.6	35.7	32	36.6	25	29.1	33.9	31.3
South Africa	25.3	26.8	27.7	29.6	29.7	27.8	27.8	27.5	27.3
Middle income excluding SA	23	23.7	23.9	23.5	22.1	22.1	22.1	22.4	23.5
Low income excluding fragile	15.1	15.3	15.5	16	16.2	15.9	17.2	17.5	17.8
Low income fragile	14.8	15.5	16.3	17.1	17.7	17.4	18.3	20.1	21.3
Average excluding oil exporters & SA	17.6	18.2	18.6	18.9	18.7	18.5	19.2	20.0	20.9
Government expenditure as percent of GDP									
Oil exporters	26.4	28.8	24.2	27.7	29.8	32.1	32	30.8	29.9
South Africa	26.5	26.8	26.9	28.1	30.2	33	33	32.1	32.3
Middle income excluding SA	27.5	26.5	26.3	26.9	28	29.4	29.3	28.6	29.5
Low income excluding fragile	22.4	22.9	23.1	23.5	22.9	23.6	24.6	24.5	25
Low income fragile	20.4	22.6	21.5	21.2	23.2	24.7	27	27.7	28.7
Average excluding oil exporters & SA	23.4	24.0	23.6	23.9	24.7	25.9	27.0	26.9	27.7

Note. SA abbreviates South Africa.

Source: Computed from IMF Regional Economic Outlook Statistical Tables, 2012.

Fiscal deficit is particularly considered with exclusion of grants in our analysis, and the reason is because domestic capacity and effort that SSA has attributed to revenue generation and public financing is the major focus of this paper. Except for the oil exporting economies whose budgets were largely affected by economic crisis, particularly in 2009 and 2010 (but now regaining), fiscal balances of all other countries in the sub-region have overall been at unrelenting "deficit status" for quite some time (Table 2).

Table 2. Overall fiscal balance (*excluding grants*) (*Percentage of GDP*)

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Oil exporters	*5.7*	*6.8*	*11.4*	*4.4*	*6.8*	*-7.1*	*-2.9*	3.1	1.4
South Africa	-1.2	0	0.8	*1.5*	*-0.5*	*-5.2*	*-5.1*	-4.6	-5
Middle income excluding SA	-4.5	-2.8	-2.4	-3.4	-5.9	-7.3	-8.4	-6.2	-6
Low income excluding fragile	-7.3	-7.6	-7.6	-7.5	-6.7	-7.7	-7.5	-7	-7.1
Low income fragile	-5.6	-7.1	-5.2	-4.1	-5.4	-7.3	-8.7	-7.6	-7.4
Average excluding oil exporters & SA	**-5.8**	**-5.8**	**-5.1**	**-5.0**	**-6.0**	**-7.4**	**-8.2**	**-6.9**	**-6.8**

Source: Computed from IMF Regional Economic Outlook Statistical Tables, 2012.

With revenue expansion by less than offsetting the increase in expenditure, it is likely that fiscal deficit will continue to persist, and in case of any severe economic shock, bailout fiscal actions will tend to aggravate deficit situation. As statistics indicate, fiscal balances worsened further in post economic crisis era, giving impression that the resilient growth of SSA countries did not among other, make as adequate fiscal dividend during post-crisis as it did in pre-crisis time.

3. Conceptual Framework

In most cases, macroeconomic variables depend on each other except that in the cycle of dependency, the time and extent of dependency differ. While a variable like income (increases) may have instant or shortly lagged *positive* effect on current tax revenue; over time, this rise in government revenue can further spur income and thereafter as a second round, sustain enhanced tax revenue. This section underscores the existing theoretical and empirical relationships among the main variables used in this study.

Normally the major source of government revenue is taxation. Tax revenue (and more so for the developing countries) leans on trade and income (Note 4) taxes as major sources. One has to note that direct taxes on income and wealth are important revenue bases in low income SSA countries. Direct taxes generate round 40% of total tax revenue, and of these, corporate income taxes are the most important, followed by pay-as-you-earn (PAYE) taxes on formal sector employees (Ndulu et al., 2007; Pfister, 2009; Cottarelli, 2011). This tells us that income growth has got remarkable bearing on government revenue in the sub-region. Theoretically there is endogeneity between tax revenue and economic growth. Atkinson and Stiglitz (1990) argue that tax policy has influence on growth, and long-run growth so much depends on saving of individuals and firms which are used for further investments in the real sector. The interdependence issue of Atkinson and Stiglitz focuses on expenditure taxes which enhance saving, investment and therefore further income leading to more government revenue and expenditure in turn (Cheng & Lai, 1997; Peacock & Wiseman, 1979; Ho & Huang, 2009).

3.1 Implications of Growth, Saving and Investment on Tax Revenue and Budget Balance

We can conceptualize income growth and tax revenue relationship from tax elasticity of income perspective. Regarding the national income identity, we can write the relationship between a change in disposable income on one hand and changes in national income, tax and transfers on the other. This simple relationship can be expressed as

$$\Delta Y_d = \Delta Y + \Delta R - \Delta T_i \tag{1}$$

Where Y represents national income; Y_d is disposable national income; R represents transfers while T_i denotes income tax. Δ stands for a change. Let us define tax revenue elasticity of income as $\varphi_{T_i} = \frac{\Delta T_i/T_i}{\Delta Y/Y}$ and also revenue elasticity of transfers as $\varphi_R = \frac{\Delta R/R}{\Delta Y/Y}$. We rearrange the elasticities to define ΔT_i and ΔR as $\Delta T_i = \Delta Y \varphi_{T_i}\left(\frac{T_i}{Y}\right)$ and $\Delta R = \Delta Y \varphi_R \left(\frac{R}{Y}\right)$. Substituting these changes in Equation (1) we can write,

$$\Delta Y_d = \Delta Y + \Delta Y \varphi_R \left(\frac{R}{Y}\right) - \Delta Y \varphi_{T_i}\left(\frac{T_i}{Y}\right) \tag{2}$$

Make income tax revenue the subject of this equation, to have

$$T_i = \left[\Delta Y - \Delta Y_d + \Delta Y \varphi_R \left(\frac{R}{Y}\right)\right] \frac{Y}{\Delta Y \varphi_{T_i}}.$$

Simplify to get,

$$T_i = \left[Y - \frac{Y \Delta Y_d}{\Delta Y} + \varphi_R R\right] \frac{1}{\varphi_{T_i}}.$$

From the second term in the parentheses (which is negative as income increases) we have reciprocal of growth rate of income (g), and so we can write Equation (3) as

$$T_i = \left[Y - \frac{\Delta Y_d}{g} + \varphi_R R\right] \frac{1}{\varphi_{T_i}} \tag{3}$$

Conceptually, this expression shows direct relationship between tax revenue and income; and between tax revenue and transfers if any, and if are taxed. Increasing g will thus enhance tax revenue.

Regarding tax revenue, savings and investment nexus, there is conceptual link implied by both theoretical and empirical existing studies. There is argument that many empirical studies have confirmed that the primary explanation of inter-country differences in economic growth is the share of gross national product (GNP) devoted to investment; and that despite the increasing integration of the world capital markets, the rates of investment in the major industrial countries especially, are closely related to their rates of saving (Feldstein & Bacchetta, 1991; Feldstein, 1995). Intuitively, if investment has positive impact on income and hence government revenue, then saving has the same positive influence, particularly if saving enhances investment (Baghestani & McNown, 1994; Zagler & Durnecker, 2003; Baghestani & McNown, 1994; Carneiro et al., 2005). This is indirect way saving can affect revenue but the other way is direct if there are taxes levied on savings, including contribution of financial institutions to government revenue. Because income is the key factor to tax revenue (as tax base), saving and investment are due to contribute largely to government revenue (Note 5) via their role on income generation (i.e., through deepening the tax base). We are using some insights of neoclassical Solow-Swan growth model to conceptualize this direct relationship between output and saving/investment. Neoclassical growth theory begins with the aggregate production function of two factors labour (L_t) and capital (K_t), where Y_t is output. Subscript t denotes time.

$$Y_t = F(K_t, L_t) \tag{4}$$

Three assumptions are made here: (i) well behaved production function of positive and diminishing marginal returns of inputs; (ii) constant returns to scale, $F(\lambda K_t, \lambda L_t) = \lambda F(K_t, L_t)$; and (iii) Inada conditions are satisfied, that means

$$\lim_{K_t \to 0}(MPK_t) = \lim_{K_t \to 0}(MPL_t) = \infty, \text{ and}$$

$$\lim_{K_t \to \infty}(MPK_t) = \lim_{K_t \to \infty}(MPL_t) = 0.$$

To satisfy all these conditions, an assumption can be made that we are dealing with a kind of Cobb-Douglas production function. In per capita terms, this production function is written as

$y_t = \frac{Y_t}{L_t} = F\left(\frac{K_t}{L_t}, 1\right) = f(k_t, 1)$, which reduces to

$$y_t = f(k_t) \tag{5}$$

Output per capita is here defined as a function of capital (i.e. which is a result of investment – i.e. the process of capital formation). We can then look at investment in terms of capital formation process in the same neoclassical perspective,

$$\dot{K} = I_t - \delta K_t \tag{6}$$

where I_t is investment, δ is the depreciation rate and $\dot{K} = dK_t/dt$. Investment funding is done by saving (S_t) and that at the balance is written as $I_t = S_t$; with $S_t = sY_t$. We can therefore rewrite Equation (6) as,

$$\dot{K} = sY_t - \delta K_t \tag{7}$$

If we write it in per capita terms we have,

$$\frac{\dot{K}}{L_t} = s\frac{Y_t}{L_t} - \delta\frac{K_t}{L_t} \rightarrow \frac{\dot{K}}{L_t} = sf(k_t) - \delta k_t$$

$$\dot{k} \equiv \frac{d\left(\frac{\dot{K}}{L_t}\right)}{dt} = \frac{L_t\frac{dK_t}{dt} + K_t\frac{dL_t}{dt}}{L_t^2} = \dot{k} = \frac{\dot{K}}{L_t} - k_t\frac{\dot{L}}{L_t}$$

$$\dot{k} = sf(k_t) - \left(\delta + \frac{\dot{L}}{L_t}\right)k_t$$

$$\dot{k} = sf(k_t) - (n + \delta)k_t \tag{8}$$

Equation (8) is a main differential equation for capital stock accumulation in the simple neoclassical Solow-Swan model; where $\frac{\dot{L}}{L_t} = n$, is a population growth rate. The simple intuition regarding Equations (5 & 8) is that saving derives investment and investment thereafter derives output. This argument has been quite debatable about which variable leads the other between investment and saving? Nevertheless, empirical findings are mixed on this debate (Feldstein & Bacchetta, 1991; Feldstein, 1995). But whichever the case, provided they are both positively related to income, we look back to our focus on influence of these variables (*saving and investment*) on government revenue. This theory postulates from the outset that the indirect impact of saving and investment on government revenue is essentially positive.

Regarding budget deficit, the implication which straightforwardly comes from the preceding discussion is that, increased economic growth, saving and investment have domestic revenue enhancing impact and hence a reducing effect on the budget deficit. A note has to be made, however, that for some of these variables notably investment and growth may impact on revenue with some lag, i.e. their revenue outcomes can be realized in the subsequent period(s).

4. Methodology

To harness advantages of the panel data for cross-country studies over the conventional cross section and time series we employ to panel data model in study. Panel data help control for unobserved heterogeneity across countries, provide large number of data points, increase degrees of freedom and reduce collinearity among explanatory variables, therefore increasing efficiency of econometric estimates.

Two panel data models are to be estimated one for the government domestic revenue and the other for the deficit excluding grants. The structure of these models is standard one (Baltagi, 2001; Hsiao, 1986; Wooldridge, 2002), and that can be presented as

$$y_{it} = f(x_{1it}, x_{2it}, \ldots, x_{1it}) \tag{9}$$

The dependent variable y_{it} in any case (like in the domestic revenue model) represents revenue (*variable*) of country *i* in time *t* from initial time wave 1 to the terminal time wave T, successively. Dependent variables (x'$_s$) are similarly representing observations of each variable for every included country from time 1 to time wave T, respectively. This is a simple formulation right from the structure of panel data. From Equation (9), we can formulate an error component model of the form

$$y_{it} = \beta_0 + \beta_1 x_{1it} + \beta_2 x_{2it} + \ldots + \beta_k x_{kit} + \varepsilon_{it} \quad (10)$$

As we see from this expression the error (ε_{it}) is over time in units (countries) perspective. Betas are parameters of the model. The error term is composite one with two components including: (i) (λ_i) which is constant across countries; and (ii) (u_{it}) which is assumed to be normally distributed, $u_{it} = N(0, \sigma_u^2)$. That means, $\varepsilon_{it} = \lambda_i + u_{it}$. This is a case of the one way error (where we have constant component only across countries but not over time). However, we don't rule out a case of two way error component of the form $\varepsilon_{it} = \lambda_i + \mu_t + u_{it}$, where μ_t represents time constant error component. Generally in panel data model we have possibility of country effect (λ_i), time effect (μ_t) and random effect (u_{it}) components in the composite error term.

Consideration of country effect can be done by assuming a restriction to one way error and so having two options for country effect, which are: (i) λ_i assumed constant – therefore fixed effects model. This assumption means there are unique attributes of individual countries in measured variables and they don't result from random variations, and also do not vary with time; (ii) λ_i drawn independently from some probability distribution – therefore random effects model. This assumption means there are unique attributes of individual countries in measured variables and these result from random variations, and they do not correlate with the individual regressors.

From the assumption of *fixed effects* model, λ_i becomes a part of constant but varies by the countries and this would make a panel data model of the form,

$$y_{it} = (\beta_0 + \lambda_i) + \beta_1 x_{1it} + \beta_2 x_{2it} + \ldots + \beta_k x_{kit} + u_{it} \quad (11)$$

This model therefore has different constants (intercepts) for each individual country. Because countries have unobservable heterogeneity, it should be that in modelling we have to eliminate such heterogeneity and one way this could be done is by lagging Equation (11) one period and then subtract it from the same (11). This undertaking can be easily shown as,

$$\begin{aligned} y_{it} - y_{it-1} &= [(\beta_0 + \lambda_i) + \beta_1 x_{1it} + \beta_2 x_{2it} + \ldots + \beta_k x_{kit} + u_{it}] \\ &\quad -[(\beta_0 + \lambda_i) + \beta_1 x_{1it-1} + \beta_2 x_{2it-1} + \ldots + \beta_k x_{kit-1} + u_{it-1}] \\ &= \beta_1(x_{1it} - x_{1it-1}) + \beta_2(x_{2it} - x_{2t-1}) + \ldots + \beta_k(x_{kit} - x_{kit-1}) + (u_{it} - u_{it-1}). \end{aligned}$$

The constant and country effects are eliminated altogether and that gives,

$$\Delta y_{it} = \beta_1 \Delta x_{1it} + \beta_2 \Delta x_{2it} + \cdots + \beta_k \Delta x_{kit} + \Delta u_{it} .$$

The other way we could eliminate fixed effects is by a more general approach of scrapping off the fixed effects when there are more than two time periods, i.e. through taking deviations from country means. Let x_{1i} denote the mean of variable x_1 for country i, that is averaged across all time periods. Calculating means for each variable (including y) and then subtracting them (*the means*) from their values we get,

$$y_{it} - \bar{y}_i = \beta_0 - \beta_0 + \lambda_i - \bar{\lambda}_i + \beta_1(x_{1it} - \bar{x}_{it}) + \cdots + \beta_k(x_{kit} - \bar{x}_{kt}) + u_{it}$$

$$y_{it} - \bar{y}_i = \beta_1(x_{1it} - \bar{x}_{it}) + \cdots + \beta_k(x_{kit} - \bar{x}_{kt}) + u_{it}$$

Similarly, the constant and country effects are eliminated by this transformation. Estimation of this equation will simply take deviations from individual means (as it is done) and apply least squares – fixed effects (LSDV) or "within" estimator. It is called the "within" estimator because it relies on variations within individuals/countries rather than between countries.

The second assumption of the *random effects* model, has equation of the form,

$$y_{it} = \beta_0 + \beta_1 x_{1it} + \beta_2 x_{2it} + \ldots + \beta_k x_{kit} + \lambda_i + u_{it}. \quad (12)$$

Where λ_i is now a part of error term. This approach might be more appropriate if observations were representative of a sample rather than the whole population. With random effect therefore, there is another estimator that uses only information on individual means, this is known as the "between" estimator. The random effects model is a combination of the fixed effects (*within*) estimator and the *between* estimator. The overall estimator is a weighted average of the within and between estimators. It will only be efficient if these weights are correct. The random effects estimator uses the correct weights, however. One of the most crucial assumptions in the random effects model is that unique time constant attributes of individuals due to random variations are uncorrelated with the individual regressors, that $E(x_{kit}, \lambda_i) = 0$ for all k, t, i. It is necessary for the consistency of the random effects model, but not for fixed effects model. This assumption can be tested by the Hausman test (Hausman, 1978). The variance structure of random effects assumes that λ_i is a part of the composite error term,

ε_{it}. If the estimator is efficient these assumptions have to hold:

$$E(u_{it}) = E(\lambda_i) = 0;\ E(u_{it}^2) = \sigma_u^2;$$
$$E(\lambda_i^2) = \sigma_\lambda^2;\ E(u_{it}\ \lambda_i) = o,\ \text{for all } i, t;$$
$$E(\varepsilon_{it}^2) = \sigma_u^2 + \sigma_\lambda^2,\ t = s; E(\varepsilon_{it}\ \varepsilon_{is}) = \sigma_\lambda^2;\ \text{for all } t \neq s; \text{ and}$$
$$E(x_{kit}^2 \lambda_i) = 0, \text{ for all } k, t, i.$$

The T by T matrix that describes the variance structure of the ε_{it} for the country i is expressed below, but note that because the randomly drawn λ_i is present in each period, there is a correlation between each pair of periods for the individual country.

$\varepsilon_i' = (\varepsilon_{i1}, \varepsilon_{i1}, \dots \varepsilon_{iT})$; and then,

$$E(\varepsilon_i \varepsilon_i') = \begin{bmatrix} \sigma_u^2 + \sigma_\lambda^2 & \sigma_\lambda^2 & \sigma_\lambda^2 & \sigma_\lambda^2 \\ \sigma_\lambda^2 & \sigma_u^2 + \sigma_\lambda^2 & & \sigma_\lambda^2 \\ \sigma_i^2 & & \dots & \dots \\ \sigma_\lambda^2 & \sigma_\lambda^2 & \dots & \sigma_u^2 + \sigma_\lambda^2 \end{bmatrix} = \sigma_u^2 I + \sigma_\lambda^2 ee' = \Omega \tag{13}$$

Where $e' = (1\ 1\ 1\ \dots\ 1)$ is a unit vector of size T. The Random Effects estimator has the standard *generalised least squares* (GLS) form, which is summed over all countries in the dataset as,

$$\hat{\beta}_{RE} = [\textstyle\sum_{i=1}^{N}(\mathrm{X}_i'\Omega^{-1}\mathrm{X}_i)]^{-1} \sum_{i=1}^{N}(\mathrm{X}_i'\Omega^{-1}\mathrm{y}_i) \tag{14}$$

Where given Ω in expression (13), it can be shown that:

$$\Omega^{-1/2} = \frac{1}{\sigma_u}\left(I_T - \frac{\theta}{T}ee'\right), \text{ with } = 1 - \frac{\sigma_u}{\sqrt{T\sigma_\lambda^2 + \sigma_u^2}}\ .$$

4.1 Estimation Model

Estimation model of either case (revenue or deficit) is supposed to be in the form of Equation (11 or 12) depending on whether the appropriate form is fixed effects or random effects, respectively. Empirical econometric presentation of these equations – in line with the argued relationships in this case – model "fiscal dividend in terms of revenue gains and narrowing of budget deficit" as functions of growth of national income per capita, gross saving and total investment, respectively. For scaling and relativity, these variables are all defined as ratios of GDP, save for the rate of growth of income per capita.

Whether the relevant estimation model (given the data) is fixed effects or random effects, is usually ascertained by the Hausmam test before making a firm decision to use either of these forms. Specifically, the test is H_0: $E(\lambda_i|x_{it}) = 0$ for the one-way model. And if there is no correlation between regressors and effects, then *fixed effects* and *random effects* are both consistent, but fixed effect is inefficient. The procedure is thus, $\hat{\beta}_{RE} - \hat{\beta}_{FE}$ and their covariance are calculated, if there is a correlation, *fixed effects* is consistent and random effects is inconsistent. Under the null hypothesis of no correlation, there should be no differences between the estimators.

A test for the independence of the λ_i and the x_{kit}, should be done, such that the covariance of an efficient estimator with its difference from an inefficient estimator should be zero. Therefore, under the null hypothesis we test:

$$W = (\beta_{\mathrm{RE}} - \beta_{FE})'\hat{\Sigma}^{-1}(\beta_{\mathrm{RE}} - \beta_{FE}) \sim \chi^2(k) \tag{15}$$

If W is significant, we should not use the random effects estimator (Equation, 12) but fixed effect estimator (Equation, 11) instead, and vice versa.

4.2 Data Source

To estimate empirical models, IMF statistics from World Economic Outlook database for the period, 2000–2012 are used. This is a recent period after substantial economic reforms were done in SSA economies with support of IMF and other development partners. Panel data of 40 SSA economies is employed, and a few countries are excluded owing to some reasons including those with too extensive data gaps and the extremely out-laying cases. Appendix 1 shows a list of included countries.

5. Empirical Analysis

Following differences that have been noted in the trend of performance of variables of interest in this study before and after the financial crisis, we are analysing developments in these particular periods separately. Estimations start with panels of 2000–2007 and then panels of 2008–2012. The first activity here is to determine the appropriate forms of models that fit the available revenue and deficit data, respectively. This means to choose between Equation 11 (fixed effects) and Equation 12 (random effects); and thereafter–if random effects is opted for – to confirm its appropriateness, i.e. whether we really need to apply it or just to use simple OLS technique. Hausman test (which states its null hypothesis as random effects is preferred to fixed effects model) is employed for the former decision while Breusch-Pagan test (which stated its null hypothesis as random effects model is not appropriate) is employed for the latter.

5.1 Prior to Financial Crisis, 2000–2007

Table 3 presents revenue equation results of Hausman test, while Table 4 shows the same for deficit equation.

Table 3. Hausman test results for revenue model (*pre-crisis*)

Hausman fixed-random (dependent variable is government revenue)				
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Coefficients			
	fixed	random	Difference	S.E.
GDP per capita growth	0.0056754	0.0096596	-0.0039842	0.0035754
Gross national saving	0.2395412	0.274504	-0.0349628	0.023088
Total investment	0.0736319	0.0983827	-0.0247508	0.0269947

Note. Test: Ho: difference in coefficients not systematic (Note 6). $chi^2(3)$ = (b-B)'[(V_b-V_B)^(-1)](b-B) = 3.77, Prob > chi^2 = 0.2873.

From this test we have, Prob > Chi^2 which is insignificant and so we accept the Ho to use random effect model for this equation. Regarding government revenue generation, unique attributes of SSA countries are a result of random variations and they do not correlate across countries.

Table 4. Hausman test results for deficit model (*pre-crisis*)

Hausman fixed-random (dependent variable is budget deficit)				
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Coefficients			
	fixed	random	Difference	S.E.
GDP per capita growth	-0.0333484	-0.0559307	0.0225823	0.0038789
Gross national saving	-0.1834401	-0.1993536	0.0159134	0.0329566
Total investment	0.1747488	0.0912152	0.0835336	0.0387234

Note. Test: Ho: difference in coefficients not systematic. $chi^2(3)$ = (b-B)'[(V_b-V_B)^(-1)](b-B) = 36.27, Prob > chi^2 = 0.0000.

This test we have, Prob > Chi^2 which is significant and so we reject the Ho to use fixed effect model for budget deficit equation. In SSA countries unique attributes of budget deficit are not due to random variations, implying that fiscal policy discretion is dominant, and there are no reasonable variations across time.

If differences across these countries regarding governments' revenue are not significant, we are supposed to use simple OLS model for the revenue case instead of the random effects model. We verify if there is need for use of random effects model by using Breusch and Pagan Lagrangian Multiplier (LM) test. The null hypothesis is no evidence of significant differences across countries. This test is specified as,

$$y[country, t] = Xb + u[country] + e[country, t] \quad (16)$$

Where y represents government revenue variable, X are dependent variables and their parameters (b), while the second and third terms on the right hand side denote cross country and within country differences, respectively. The results for this test are in Table 5.

Table 5. Breusch and Pagan Lagrangian multiplier test for random effects (*pre-crisis*)

Government revenue model Var sd = sqrt(Var)		
GDP per capita growth	118.6036	10.89053
e	38.74476	6.224529
u	58.51688	7.649633

Note. Test: Var(u) = 0. $chi^2(1) = 369.15$, Prob > $chi^2 = 0.0000$.

We can't use simple OLS model in this case since Prob > chi^2 is significant and this tells us that variations across countries are important, random effects model is therefore an appropriate choice.

Because the sample is not large, we are not worried much about cross sectional dependence in the panels and so we advance to stationarity test in panel data model by using the 1st generation unit root test procedure, and since length of this period is not too short for the panel data series, we opt for the restricted Levin-Lin-Chu (LLC) technique. Null hypothesis states as panels contain unit root, and the results are Table 6.

Table 6. Levin-Lin-Chu unit root test (*pre-crisis*)

	Unadjusted t	*Adjusted t*	*P-value*
Government revenue	-9.023	-5.9515	0.0000
Budget deficit	-8.9917	-2.2882	0.0111
GDP per capita growth	-22.646	-19.3783	0.0000
Gross national saving	-17.1367	-13.5761	0.0000
Total investment	-14.7992	-12.2812	0.0000

Estimations in the table indicate there is no unit root in any one of these panels, they are all stationary. With these diagnostic results overall, we estimate random effects panel data model of government revenue against its predetermined variables. The approach we use begins with determination of the parsimonious model by testing the number of lags required through observation of improvements in Wald test as we move from levels to the first and the second lags especially. While saving is effective within the reference year, GDP and investment affect revenue with one lag. Table 7 contains estimation results. This is because income generated this period is likely to be taxed in the next period, and investment will usually have some gestation period to start contributing to government revenue, particularly through taxation.

Table 7. Government revenue model – random-effects GLS regression results (*pre-crisis*)

Random-effects GLS regression. Number of obs = 280

Group variable: country. Number of groups = 40

Wald $chi^2(3) = 37.81$

corr(u_i, X) = 0 (assumed) Prob > $chi^2 = 0.0000$

Government revenue	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lag1(GDP per capita growth)	0.0711124	0.0282281	2.52	0.012	0.0157863	0.1264385
Gross national saving	0.2891884	0.0572414	5.05	0.000	0.1769973	0.4013796
lag1(Total investment)	0.1215012	0.0709466	1.71	0.087	-0.0175515	0.260554
Constant	17.27909	2.021626	8.55	0.000	13.31678	21.24141
sigma_u	7.442652					
sigma_e	6.2500096					
rho	0.58644503	(fraction of variance u_i)				

All variables have hypothesized positive signs. Gross national saving is significant at 1%, GDP per capita growth is significant at 5% and total investment is weakly significant at 10%. SSA countries therefore made consistent revenue gains from improvement in these macroeconomic variables over time. This means over the past decade, but prior to financial crisis the governments of these economies succeeded in taking advantage of performance of these selected macroeconomic variables, *inter alia*, to enhance their revenues collection accordingly.

Regarding budget deficit, a parsimonious model indicates that GDP per capita growth rate affects deficit with one lag, and this on account of the fact that it affects deficit through its implication on revenue, which it impacted with a lag. Budget deficit results for the period before financial crisis are presented in Table 8.

Table 8. Fiscal deficit model – fixed-effects regression results (*pre-crisis*)

Fixed-effects (within) regression. Number of obs = 280

Group variable: country. Number of groups = 40

F(3,237) = 9.05.

corr(u_i, Xb) = -0.0119. Prob > F = 0.0000.

Budget deficit	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lag1(GDP per capitagrowth)	-0.0767799	0.027938	-2.75	0.006	-0.131818	-0.021741
Gross national saving	-0.2347343	0.0620346	-3.78	0.000	-0.356944	-0.112525
Total investment	0.1576826	0.0778995	2.02	0.044	0.0042186	0.3111466
Constant	1.927313	1.849617	1.04	0.298	-1.716476	5.571102
sigma_u	5.0494471					
sigma_e	6.088833					
rho	0.40748903	(fraction of variance due to u_i)				

Note. F-test that all u_i=0, F(39, 237) = 4.21, Prob > F = 0.0000.

The results show that both GDP per capita growth and gross national saving have hypothesized negative signs and are significant at 1%, i.e. they considerably contributed to reduction in budget deficit in SSA countries before financial crisis. In contrast, total investment has a positive sign and is significant at 10%, which is against the hypothesized relationship. Explanation for this finding is that in SSA economies' public sector investment (which on average is 35% of total investment) makes a large proportion of these governments' spending and so becoming one of the factors for high public expenditure and thus budget deficit.

5.2 Post Financial Crisis, 2008–2012

All over the world, global economic crisis changed trends of economic growth and other macroeconomic variables, which have bearing on fiscal outcomes. Here we are estimating panels of the post crisis to establish the status of fiscal benefits in terms of revenue and deficit during this era. Table 9 gives Hausman test criteria for revenue model selection.

Table 9. Hausman test results for deficit model (*post-crisis*)

Hausman fixed-random (dependent variable is government revenue)				
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Coefficients			
	fixed	random	Difference	S.E.
GDP per capita growth	-0.0042434	-0.0033478	-0.0008956	0.0048591
Gross national saving	0.1312993	0.1435728	-0.0122735	0.0301171
Total investment	0.0745029	0.1029531	-0.0284502	0.0492493

Note. Test: Ho: difference in coefficients not systematic. $chi^2(3) = (b-B)'[(V\_b-V\_B)^{(-1)}](b-B) = 0.57$, Prob > $chi^2 = 0.9041$.

Prob > Chi^2 is insignificant and for that reason we accept the Ho to use random effect model for this equation, and the implication we made in the pre-crisis model holds. Likewise, Hausman test for the deficit model in the post crisis period opts for random effects model (Table 10).

Table 10. Hausman test results for deficit model (*post-crisis*)

Hausman fixed-random (dependent variable is budget deficit)				
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Coefficients			
	fixed	random	Difference	S.E.
GDP per capita growth	-0.6530454	-0.4972396	-0.155806	0.2492551
Gross national saving	1.630913	-0.3279723	1.958885	1.518875
Total investment	2.064623	0.5845133	1.480109	2.223123

Note. Test: Ho: difference in coefficients not systematic. $chi^2(3) = (b-B)'[(V\_b-V\_B)^(-1)](b-B) = 2.50$, Prob > $chi^2 = 0.4760$.

Table 11 summarizes results of the test of variations across countries in the revenue and deficit models. Cross country variations are significant for the post-crisis government revenue, which validates random effects model as a right choice. However, for the government deficit, it is insignificant; suggesting that pooled regression could be a better choice for deficit case. Even so, being that pooled regression runs simple OLS and panels are constructed from four years period; it does not make enough sense especially when we think on the basis of an individual country, doing OLS over a span of four years (entries) per each series. For that matter, we will as well estimate random effects model for deficit model anyway, and then OLS will be run for comparison.

Table 11. Breusch and Pagan Lagrangian multiplier test for random effects (*post-crisis*)

(a) Var sd = sqrt(Var) (Government revenue model)		
GDP per capita growth	132.0733	11.49232
e	36.14304	6.011908
u	96.2552	9.810973
Test: Var(u) = 0. $chi^2(1) = 200.02$, Prob > $chi^2 = 0.0000$		
(b) Var sd = sqrt(Var) (Budget deficit model)		
GDP per capita growth	19616.59	140.0592
e	19836.64	140.8426
u	65.91991	8.119108

Note. Test: Var(u) = 0. $chi^2(1) = 0.06$, Prob > $chi^2 = 0.4001$.

The period of reference, 2008–2012 is too short to use restricted Breusch-Pagan unit root test, but unrestricted Harris-Tzavalis approach can fit better this type of panels and it is employed for that purpose. Table 12 summarizes results of stationarity of panels during post crisis period.

Table 12. Harris-Tzavalis unit-root test (*post-crisis*)

	Statistic (rho)	*z*	*P-value*
Government revenue	-0.0762	-7.4775	0.0000
Budget deficit	-0.3473	-10.9962	0.0000
GDP per capita growth	-0.3828	-11.4563	0.0000
Gross national saving	0.1243	-4.8752	0.0000
Total investment	0.0737	-5.5318	0.0000

Null hypothesis is panels contain unit root. Harris-Tzavalis test in the table rejects this postulation, that there is no unit root in any one of these panels. With this conclusion, it means we can proceed to estimation of the two fiscal models of interest analysis. Tables 13 and 14 present random effects estimates of parsimonious government revenue and budget deficit models, respectively.

Table 13. Government revenue model–random-effects GLS regression results (*post-crisis*)

Random-effects GLS regression. Number of obs = 200

Group variable: country. Number of groups = 40

Wald $chi^2(3) = 6.92$

corr(u_i, X) = 0 (assumed). Prob > $chi^2 = 0.0745$

Government revenue	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lag1(GDP per capita growth)	-0.0033478	0.0350308	-0.1	0.924	-0.072007	0.0653113
Gross national saving	0.1435728	0.0730086	1.97	0.049	0.0004787	0.286667
lag1(Total investment)	0.1029531	0.097523	1.06	0.291	-0.088188	0.2940947
Constant	21.46941	2.704421	7.94	0.000	16.16884	26.76998
sigma_u	9.8109733					
sigma_e	6.0119084					
rho	0.72701266	(fraction of variance due to u_i)				

In the post crisis period, only gross national saving is significant at 10%, which means fiscal dividend from per capita income growth and total investment was insignificant. Saving has been the SSA governments' revenue cushion during and after financial crisis. Usually companies' reserves in the form of saving do increase under uncertainty to cushion themselves against the economic cycle and to provide funds for expansion, and this is the reason firms performance, taxable income and hence government revenue during crisis would be significantly related with savings (Note 7). Decomposition of national saving into private and public components might most likely show insignificant contribution of public savings to governments' revenue under crisis.

Table 14. Budget deficit model – random-effects GLS regression results (*post-crisis*)

Random-effects GLS regression. Number of obs = 160.

Group variable: country. Number of groups = 40.

Wald $chi^2(3) = 1.58$.

corr(u_i, X) = 0 (assumed). Prob > $chi^2 = 0.6649$.

Budget deficit	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lag1(GDP per capita growth)	-1.082973	0.955001	-1.13	0.257	-2.954741	0.7887945
Gross national saving	-0.45442	1.358748	-0.33	0.738	-3.117517	2.208677
lag1(Total investment)	0.6712525	1.556772	0.43	0.666	-2.379965	3.72247
Constant	-13.39815	34.40453	-0.39	0.697	-80.82978	54.03348
sigma_u	8.0539068					
sigma_e	158.2431					
rho	0.0025837	(fraction of variance due to u_i)				

In terms of budget deficit, SSA countries did not have significant dividend from developments of these variables of interest during the crisis. Despite income shock resilience of these countries, deficit was much more than offset by the advantages derived from income, saving and investment growth.

6. Conclusion

Before global economic crisis which started at the end of 2007, sub-Saharan Africa countries accrued substantial fiscal benefits of economic development manifested by the contribution of per capita income growth, total investment and gross national saving to governments' revenue and thus reduction of budget deficits. Even so, economic situation was relatively tougher during the crisis; and it is evident from this study except for the saving – which cushioned governments revenue in particular – that fiscal dividend from income and investment performance were insignificant in terms of both revenue generation and deficit reduction. Although the rate of growth of saving was modest all through, it was actually the most significant variable that bolstered governments' revenue before and after global economic crisis. Budget deficit was reduced by positive developments in all these variables before the crisis but none of them was significant during the crisis. The key implication from these results is that enhancing national savings (*public and private*) in SSA countries can appropriate surpassing return to fiscal stance. Notwithstanding that saving is well embarrassed by growth theory, is unfortunate that, it is among the variables that receive stumpy attention as macroeconomic performance benchmarks, and also it goes without sufficient advocacy as a key trigger point for breakthrough in most development dialogues of poor countries.

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Notes

Note 1. The term "fragile countries has been used particularly by IMF but amid strong contention in several debates that such a nomenclature undermines countries included in this category. In this study we maintain the use of this terminology since the employed data set includes that category a priori. However, I don't subscribe to defense of the authenticity of this term. I am not giving these countries any new name though, but reclassification consideration will definitely be appreciated by quite a good number of people.

Note 2. These making SSA countries a growing repository of foreign savings

Note 3. The reason per capita income matters a lot when it comes to tax payment is because if we presume no income distribution, it does not mean that the equivalent amount of tax will be paid by a few individuals that hoard it like it would have been done if tax was paid by the majority. Tax payment multiplication occurs in the process of income distribution.

Note 4. Income broadly defined as earnings from labour, profits, and capital gains generally levied on (i) compensation for labour services; (ii) interest, dividends, rent, and royalty incomes; (iii) capital gains and losses; (iv) profits of corporations and partnerships; (v) taxable portions of social security, retirement account distributions, and life insurance; and (vi) miscellaneous other income items.

Note 5. And this in turn reduces budget deficit.

Note 6. b = consistent under Ho and Ha; obtained from random effects estimation. B = inconsistent under Ha, efficient under Ho; obtained from random effects estimation

Note 7. These are indispensable to the highly needed internal financing under crisis.

Appendix A.

List of countries included in the panel

	Country		Country
1	Angola	21	Kenya
2	Benin	22	Lesotho
3	Botswana	23	Madagascar
4	Burkina Faso	24	Malawi
5	Burundi	25	Mali
6	Cameroon	26	Mauritius
7	Central African Republic	27	Mozambique
8	Chad	28	Namibia
9	Comoros	29	Niger
10	Democratic Republic of the Congo	30	Nigeria
11	Republic of Congo	31	Rwanda
12	Côte d'Ivoire	32	Senegal
13	Equatorial Guinea	33	Seychelles
14	Eritrea	34	Sierra Leone
15	Ethiopia	35	South Africa
16	Gabon	36	Swaziland
17	The Gambia	37	Tanzania
18	Ghana	38	Togo
19	Guinea	39	Uganda
20	Guinea-Bissau	40	Zambia