Government spending and inclusive growth in sub-Saharan Africa: A panel VAR analysis

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Abstract

This paper assesses the effects of government expenditure components on both equity and growth, especially whether it is possible to design public spending to promote a more equitable society without sacrificing economic growth. We employ a panel VAR technique to use a large annual dataset on 10 sub-Saharan African countries over the period 1990-2015. The VAR approach addresses the problem of endogeneity by allowing endogenous interaction between system variables. The panel has a medium time dimension and a relatively small number of countries, thus the panel with fixed effect specification (LSDV) is the most appropriated. The estimation and drawing Impulse Response Functions (IRFs) of different shocks were done using the Stata code (XTVAR). Our findings from impulsive response function give evidence that investment in infrastructure (quality and stock) contributed to more inclusive growth in sub-Saharan African economies than others government spending in long term. Moreover, social spending in developing countries often benefits the rich and middle classes more than the poor. Therefore, a higher share of social spending on items such as health and education will not be reflected in higher incomes for the poor. These results are confirmed by the variance decomposition analysis (FEVD).

Keywords

Government spending, Income inequality, Growth, Inclusive growth, Panel VAR.

JEL Codes

H50, D31, O47, I31, C23.

1. Introduction

Achieving inclusive growth has become the most significant long-term strategic challenge for many policymakers for decades. Development policymakers are interested not only in economic growth per se, but also in how the gain from that growth is distributed. As pointed out by García-Peñalosa (2008), understanding economic growth and inequality is both important and controversial; it is important because policy makers need to understand the way in which the increase in output will be shared among heterogeneous agents within an economy, and the constraints that this sharing may put on future growth. Its controversy stems from the fact that it was difficult to reconcile different theories, especially since the empirical evidence has been largely inconclusive. Beginning with Arrow and Kurz (1970) and Barro (1990), the relationship between public investment and growth has been widely studied, and most results have shown that public spending on infrastructure, education, and health can generate productivity and growth benefits. At the same time, by influencing the factors productivity and thus the relative return of factors, public spending also plays a key role in the evolution of wealth and income distribution as the economy grows with time. This brings us to the question of the potential relationship between growth and inequality generated by public spending, although the nature of this relationship is not "a priori" clear.

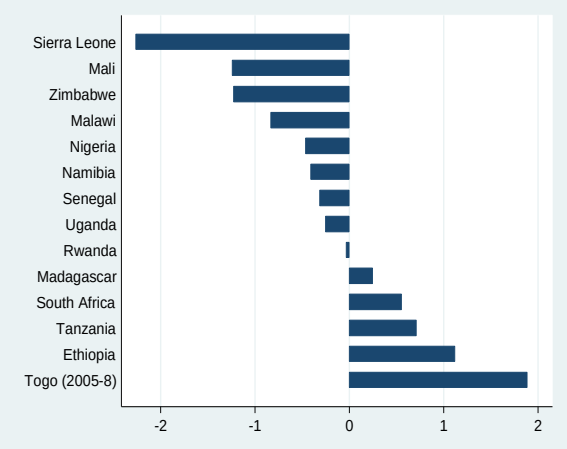
The economy of sub-Saharan Africa has grown at an exceptional pace over the last decade. However, growth has been concentrated in particular sectors of the economy and specific geographical areas within countries. The benefits of this growth have not been widely shared and have left out large segments of the population. Poverty has not fallen as much as expected and economic inequalities have remained high. The percentage of those living in poverty rose from 36% of the population in 1970 to 50% in 2010. There are, of course, significant differences between the countries in the region and their trends of inequality. The World Bank (2016) report on poverty in Africa shows for example that seven out of the world's 10 most unequal countries are African, their Gini indexes ranging from 0.31 (Niger) to 0.63 (South Africa) (with zero implying perfect equality and one, perfect inequality).

In Sub-Saharan Africa, there have been fewer attempts to understand the causes of high levels of inequality measured in many African societies. On the other hand, there is much less agreement on the extent to which efforts to address inequalities need or should be part of strategies to reduce poverty in the region.

Since the early 2000s, while efforts have been made to reduce income gaps, some countries in the region have experienced growing income disparities, which explains their low record of equitable growth, especially in sub-Saharan African countries (Figure 1 & 2). Over the two sub-periods, several countries recorded a decline in their level of inequality, which is designated by a negative change in Gini coefficient. Countries that outstandingly achieved such achievements are Mali, Sierra Leone and Zimbabwe. However, some countries have seen their level of inequality increased over the two sub-periods considered. Thereby, Togo and Ethiopia are those that register accentuate deterioration in the repartition of income. Countries such as Tanzania and South Africa have also made efforts to reduce income inequality. This justifies the shift from a positive change (increase in inequality) that can be observed in Chart 1 to a negative change (decrease in inequalities) in the Gini coefficient as shown the Chart 2.

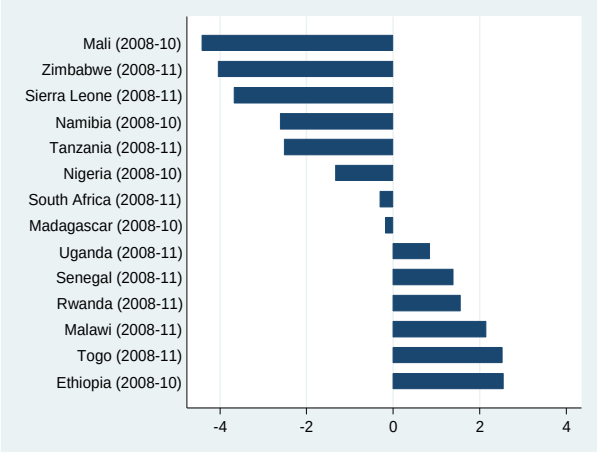
Nevertheless, the level of inequality observed remains high in the region. This disparity in income distribution certainly has consequences and therefore is worrying for two reasons. First, recent literature has revealed that high levels of inequality are detrimental to the pace and sustainability of growth (Ostry, Berg, & Tsangarides., 2014). In particular, they can lead to sub-optimal investments in health and education, which hamper growth. Also, the growing inequality can also undermine growth-enhancing reforms and encourage governments to adopt populist policies and intensify instability in politic. Second, in sub-Saharan Africa, the impact of growth on poverty reduction has been limited due to growing income inequality in the region. In addition to income inequality, Sub-Saharan Africa, in line with other regions, faces a considerable inequality in opportunities.

Figure 1: Selected Sub-Saharan Africa: change in income inequality, 2000-2008 [1]



Sources: Net Gini from SWIID Version 5.0; and Authors calculations.

Figure 2: Selected Sub-Saharan Africa: change in income inequality, 2008-Latest



Sources: Net Gini from SWIID Version 5.0; and Authors calculations.

The widening of the income gap in sub-Saharan Africa reinforces the arguments for a government response. Therefore, a several countries have placed the issue of inclusive growth at the center of their national objectives and in a number of cases explicitly in their development plans. Governments can, in principle, play an important role in creating a more equitable society that offers opportunities for all and distributes more widely the fruits of growth. Fiscal policy is one of the most appropriate instruments for direct government intervention to fight against inequality and poverty. In fact, there is now great interest in taking advantage of tax policy to promote inclusive growth in sub-Saharan Africa. However, unlike advanced economies with long histories of using fiscal policy to redistribute income, sub-Saharan Africa has limited experience in this area. To some extent, this is due to the large gap between the two regions and, consequently, the difference in the relative importance of growth over redistribution.

Public expenditures are likely to be endogenous, due to reverse causality. Countries with higher income inequality may choose to rely relatively more on public expenditures, and vice versa. As a result, these regressors may be correlated with the error term. Some empirical articles solve this endogeneity issue using Instrumental Variables. However, finding good instruments for all observed types of public expenditures is a significant challenge. For example, Martinez-Vasquez et al. (2011) address the endogeneity of their fiscal measure by using an instrumental variable corresponding to the fiscal measures from neighboring countries weighted by the distance between the two countries. The use of MCO is likely to generate bias and inconsistent

[1] Change in Gini coefficient for Togo is calculated between 2005 and 2008

estimate coefficients due to the presence of heterogeneity among countries. However, using a fixed effect estimate to account for this heterogeneity is questionable given the small variation in Gini coefficients for a large part of the sample. This paper is linked to the vast literature on growth inclusiveness impact of fiscal policy. Specifically, the work is in line with previous studies on the endogenous interaction between government expenditure and inclusive growth in developing countries. The paper contributes to the existing literature on the effect of government spending on growth and income inequality by using a panel vector autoregression (panel VAR) approach. This method addresses the endogeneity problem by enabling the variable in system to interact endogenously between them. In other words, the VAR approach takes into account the fact that public spending can have an impact on the growth inclusiveness; at the same time, public spending can be influenced by the inclusive growth. Our work is relatively close to that of Hur (2014) that employs this methodology to examine the effect of government spending and inclusive growth in Asian developing countries.

The main objective of the study is to analyze the impact of public expenditure in the social sectors (infrastructure, health and education) on inclusive growth in the context of the sub-Saharan African economy. The results of this paper should better indicate targets for which the quality of public spending should be improved to ensure sustainable and inclusive growth.

This study is important for countries in sub-Saharan Africa at the time when governments face many political and economic challenges such as commodity price volatility, inflation, terrorism, and poor institutional quality (corruption, poor governance). Thus, the inclusion of the growth target could only be achieved through a quality institution and productive pro-poor government expenditures in the form of broad-based spending on education, health and infrastructure. As a result, this study provides relevant policy recommendations that would rise awareness of policymakers about the need to address some of the issues that are detrimental to inclusive growth in sub-Saharan Africa.

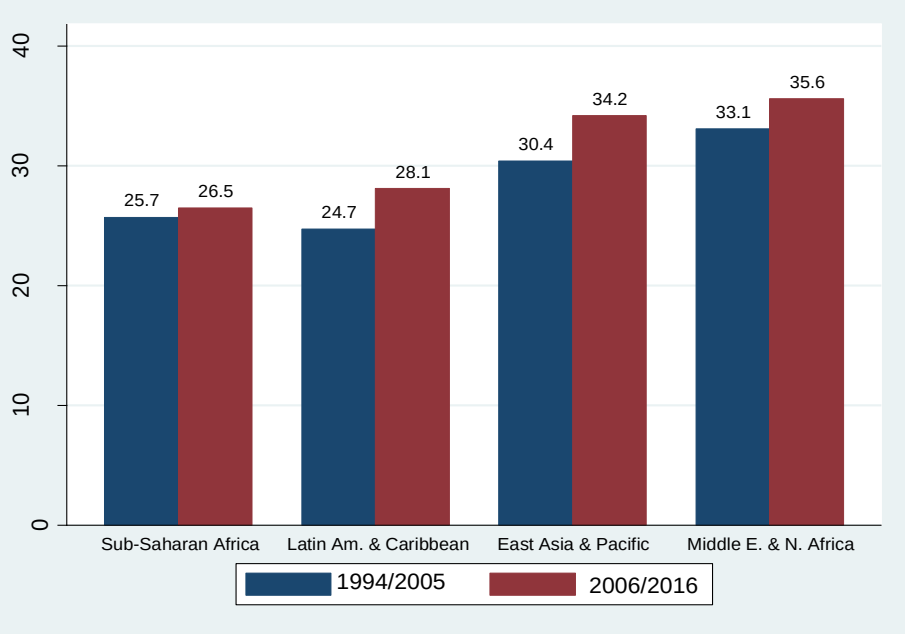
The rest of the paper is structured as follows. In section two we take a preliminary look at the data on the share of government expenditure to GDP over the 1994 -2016 period. Section three reviews the empirical literature. In section four we develop our empirical approach. Section five describes the data that are used in the empirical investigation. Section six details the empirical results and their interpretation. Finally, Section seven concludes.

2- Public spending for inclusive growth

Public spending is one of the central instruments through which governments influence economic trends. Though some spending's do not have a significant effect on the economic situation, increasing the right type affects long term growth. In the developing countries, the variation in public expenditure is not only to ensure economic stability but also to generate and accelerate economic growth and to promote employment opportunities. Public expenditure can also be used to improve income distribution, to alleviate mass poverty, to direct the allocation of resources in desired lined, and to influence the composition of national product.

Figure (3) plots the average public expenditure expressed as percentage of GDP across different regions. In average, government spending in sub-Saharan Africa are substantially less than those in the Middle East or North Africa or East Asia and Pacific over the period 1995-2016. However, they are almost similar to those in the Latin American region. In a certain way, this result reflects the implementation of austerity measures by the institutions, which is causing fiscal prudence in developing countries. In other words, the governments of sub-Saharan African countries should avoid spending largely beyond their public resources.

Figure 3: Ratio of government expenditures to GDP by region over the period 1994-2016



Source: Authors estimates based on data from IMF World Economic Outlook database
NB: Countries classification by income according to World Bank in 2016 are used

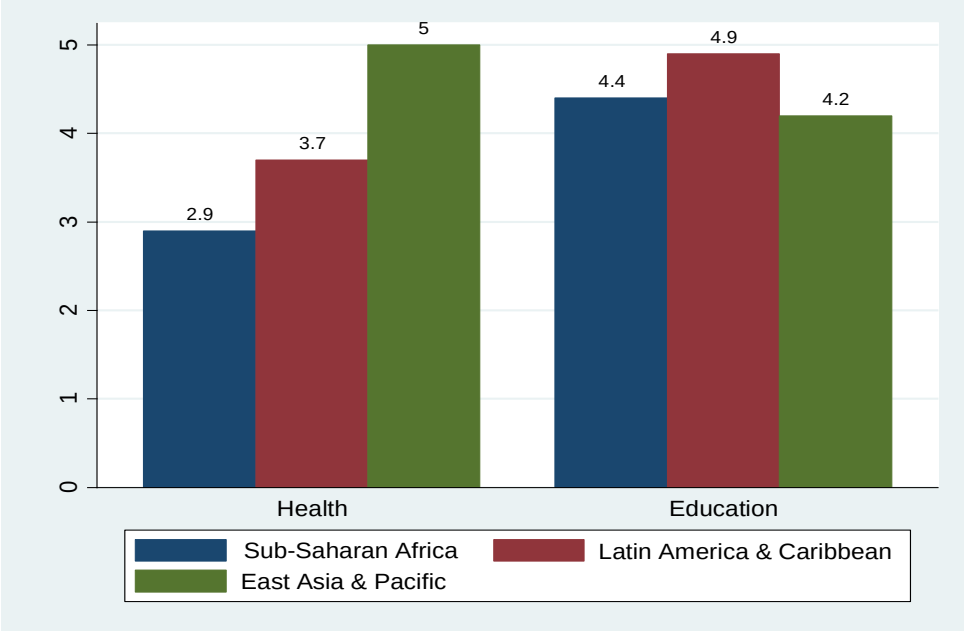
In modern times, the government is changing the free functioning of the market mechanism with respect to income distribution, not only through the development of an appropriate tax structure but also through various forms of public expenditure. However, the appropriate role of government spending in fostering economic growth and equity remains an element of policy debate in the literature. Beyond their macroeconomic impact, expenditure policies can affect growth through several channels, including their effects on the development of physical and human capital. Thereby, a more efficient public spending on human capital and infrastructure is crucial to promote growth and equity in sub-Saharan Africa. The region faces significant challenges in terms of development outcomes: growth performance has been low; inequality has increased; and progress in achieving the Millennium Development Goals (MDGs) in education and health is under threat. There is evidence that gaps in the provision of basic education, health and infrastructure have adversely affected education and health outcomes and as well as investment and competitiveness. In addition, human capital and infrastructure must be provided efficiently and effectively to address the current global financial crisis, protect the poor, and lay the foundation for a return to vigorous growth.

Public spending on education averages 4.2% of GDP in East Asia and Pacific and 4.9% in Latin America while it is 4.4% in sub-Saharan Africa (Figure 4). The gap is large enough for public spending on health care which stands at only 2.9% of GDP in sub-Saharan Africa compared with 3.7% in Latin America and 5% for East Asia and Pacific. It is clear that sub-Saharan Africa governments must do more to promote inclusive growth by directing expenditure policy towards the promotion of greater equity.

Although government fiscal policy can reduce poverty and income inequality from spending or revenue side, evidence suggest that social indicators including health and education have gained large interest in the literature of inclusive growth. According to Barro and Sala-i-Martin (1997) and Pritchett and Summers (1996), there exists positive relationship between health care and economic growth. Whereas Barro and Lee (1997) stressed the positive impact of education on the latter growth. In particular, it improves social mobility, productivity, the distribution of benefits and enhances social participation in decision-making. Brenneman and Kerf (2002) emphasized on the development of infrastructures that lead to access to high quality of education and health and also improves people's general living conditions. Studies conducted by Claus et al. (2012) for Asian developing countries confirmed that public expenditures, rather than taxation, offer the most effective tools for reducing inequalities and that education and

health are best able to reach this goal. Their analysis shows that despite progressive tax systems, public spending was more effective in reducing inequality. The government's social spending policies have distributional implications not only because they can offer immediate benefits (eg health and education), but also because they affect the distribution of the earning capacities of individuals and households and thus allowing the distribution of market incomes over time. Some social expenditures like expenditure on primary schooling can affect income distribution with a long-time lag.

Figure 4: Share of government expenditure on education and health in GDP (2010-2016)



Source: Authors estimates based on data from IMF World Economic Outlook database
NB: Countries classification by income according to World Bank in 2016 are used

Moreover, recent studies in most developing countries have often stated that their allocation of public expenditure on human capital development is often considered unfair and ineffective. Creating human capital involves training with formal education systems and good health care systems. Low levels of education and rates of return to school are the factors that explain why developing country governments continue to spend to improve the quality of schools.

Current studies have shown that, especially in sub-Saharan Africa, school enrollment is low, mediocre and combines with the increasing level of child labor; often at the expense of

inadequate health, education and good nutrition; although the government spends a lot on the human capital development programs (education and health) in these countries.

Infrastructure status

Infrastructure spending, by their nature, affect the economy of each country differently and can be used to facilitate the infrastructure that is best suited to growth.

For inclusive growth, infrastructure is the key to delivering a number of essential services. It provides a basis for much of the vision of SDGs for inclusive growth. The infrastructure is directly addressed in SDG, which require resilient infrastructure and sustainable industrialization. Several other objectives, for example, on clean water, sanitation, and on affordable, reliable, sustainable and modern energy for all, are essential. These core components, in turn, enable to achieve sustainable and inclusive economic growth, full and productive employment and decent work for all. On the growth side, increasing investments in sustainable infrastructure can boost demand at a time when many economies are in trouble. The IMF (2014) estimates that for advanced economies, investing 1% of additional GDP in infrastructure will result in, on average, 1.5% increase in GDP in four years. According to the same study, for emerging and developing economies, where infrastructure is often inadequate, there is a need for structural reform. Therefore, the benefits of productivity and growth in these countries can be even greater, especially if investments are accompanied by reforms that strengthen the institutional capacity for better planning and budget processes and more rigorous rules to guide public spending. Above the immediate boom in growth, investments in sustainable infrastructure can drive innovation and efficiency in key systems such as logistics, and mobility.

Figure 5 describes the evolution of indicators for the provision of infrastructure such as energy, water and transport. The graph shows that electricity production (measure by electric power consumption) in sub-Saharan Africa remains very low compared to that of other economic zones over the period 1990-2013. In sub-Saharan Africa, the average annual consumption is about 488 kWh per capita, equivalent to about 5% of U.S. per capita consumption (World Bank, 2014)[2]. This average is driven by high rates of access to electricity in South Africa. When South Africa is excluded, annual electricity consumption is only 150 kWh per capita. However, these

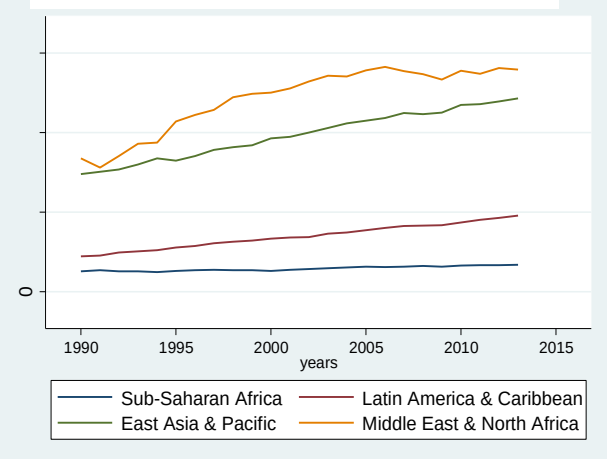
[2] World Bank. (2014). Electric power consumption (kWh per capita). http://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC

estimates may be conservative due to the latent demand that remains unsatisfied with the lack of access to the network in rural areas and unreliable networks and epileptic power supply in areas linked to the urban network. In addition to this low output, sub-Saharan Africa is experiencing a large loss in the distribution of electricity between sources of supply and distribution points and in the distribution to consumers. This is due to poor infrastructure network. The relatively low transmission costs (which do not reflect the market) and high amount of maintenance costs (at least to secure existing capacity) do not support new investments in transmission lines infrastructure.

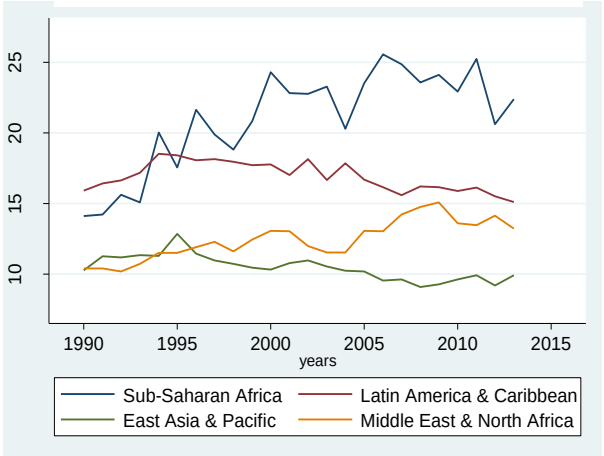
Although access to water and sanitation in sub-Saharan Africa has improved steadily over the past two decades, the region is still lagging behind all other developing regions. Access to improved water supply has increased from 56% in 1990 to 72% in 2013. However, sub-Saharan Africa is unlikely to achieve the Millennium Development Goals of halving the proportion of people without access to safe drinking water and sanitation between 1990 and 2015. Indeed, there are still large disparities between countries and between urban and rural areas. Africa lags far behind the rest of the world in all aspects of infrastructure (quantity, quality, cost and access). While the construction efforts on trans-African highways are going on, the quality of existing roads is deteriorating. In some countries, the parts of the network are currently not operational, either due to war damage, natural disasters, general negligence or lack of funds. In many countries, the roads are concentrated in urban areas or around sea ports (they were built during the colonial era to ship agricultural products abroad). Roads linking neighboring countries within a regional road network are much smaller. Due to insufficient infrastructure, the freight transport costs in Africa are among the highest in the world. African products are therefore less competitive than those in other regions.

Figure 5: Evolution of infrastructure indicators[3]

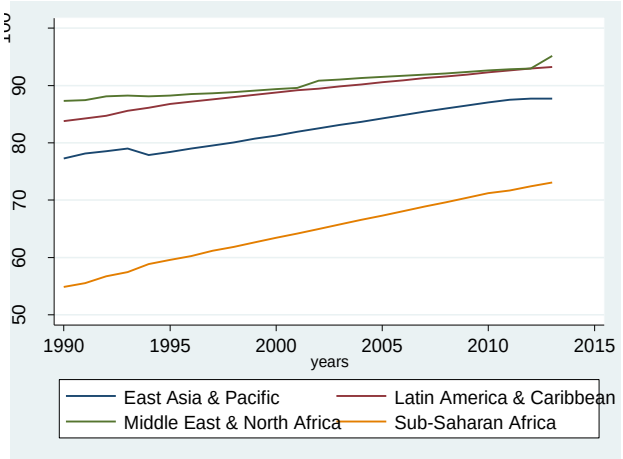
Electric power consumption (kWh per capita)



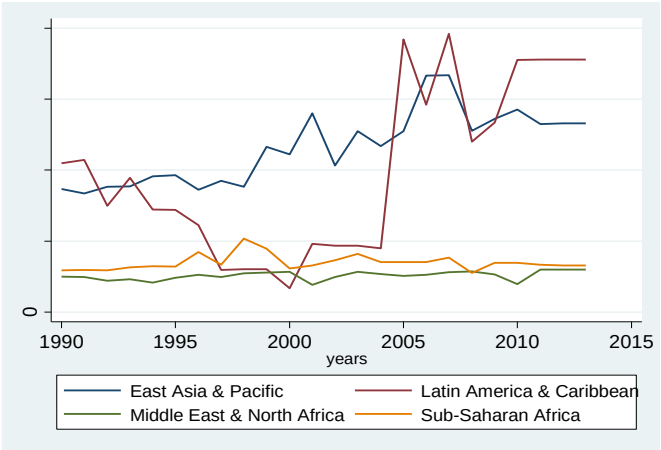
Electric power transmission and distribution losses (% of output)



Improved water source (% of population with access)



Rail lines (total route-km)



Source: Authors estimates based on data from World Bank database

[3] ***Electric power transmission and distribution losses*** include losses in transmission between sources of supply and points of distribution and in the distribution to consumers, including pilferage.
Electric power consumption measures the production of power plants and combined heat and power plants less transmission, distribution, and transformation losses and own use by heat and power plants.

3. A survey of the literature

Several previous studies have shown that some types of government spending tend to reduce inequality income distribution in many countries and regions of the world (Goñi et al., 2011; Lustig, 2016 ; Lustig et al., 2013 ; Martinez-Vazquez et al., 2012). However, it is also recognized that the relationship between public expenditure and inequality is complex and many doubts have been raised about the effectiveness of public spending as a policy instrument for redistribution, especially in low-income and middle-income countries. In this literature survey we focus on three types of public expenditure: education, health and infrastructure.

Public education spending and income inequality

Policymakers usually emphasize education as one of the major factors that affect the degree of income inequality. However, some theoretical studies suggest that the relationship between education and income redistribution is not always clear. For example, the human capital model of income distribution, derived from the work of Mincer (1958), Schultz (1961) and Becker (1962) implies that the distribution of income is determined by the level and distribution of schooling in the population. While the model predicts an unambiguous positive association between educational inequality and income inequality, the effect of increasing average schooling on income inequality may be positive or negative depending on changes in rates of return to education. According to Knight and Sabot (1990), the impact of educational level on income inequality depends on the balance between the "composition" and the "wage compression" effect. Regarding the "composition" effect, an increase in tertiary education tends, at least initially, to increase income inequality. With regard to the "wage compression" effect, over time education leads to a decrease in income inequality.

Contrariwise, for several authors, education must be considered as a relevant factor in the fight against poverty. Referring to the particular case of education Musgrave and Musgrave (1973) stated that the public sector had technical reasons for participating in education, if not through a direct offer, at least through a procurement subsidy of the private sector. With regard to income and wealth distribution, education policy could reduce inequalities in their distribution since they are strongly correlated with inequalities in education spending. Although education is not seen as a typical public good but is valued as a mixed asset, education spending generates positive social gains and market failures may occur, as in the case of credit markets, which can lead to under-investment in human capital by the private sector and the informal sector. A more even distribution of education can reduce private earnings differentials. In terms of stabilization

and growth, public spending on education will generate tangible social and economic benefits such as the ability to add new knowledge, generate and disseminate technological change and innovations in general, to promote economic structural changes, to induce productivity gains, more diffuse and intangible gains concerning the extra-economic environmental aspects. For Tinbergen (1977), an increase in tertiary education reduces the wages of highly skilled workers, and simultaneously enhances the wages of less educated workers. As a result, more educated labor is likely to increase competition for positions requiring advanced degrees and should therefore narrow the income gap between the highly educated and the less educated.

Studies suggest that the allocation of public investment for human capital development in many developing countries is often inefficient and inequitable. There is consensus that expanding knowledge in the skills and capabilities of individuals, increasing human capital is necessary to economic growth and poverty reduction. Education with formal education systems and health care plays a key role in the creation of human capital. The human capital theory predicts that more educated individuals are more productive, and a good childhood education improves cognitive functions and reduces future poverty. As a result, children with better education can be expected to be more productive in the future and to get higher income. In addition, educated people would have more incentives to invest in their children's future education and training and to contribute to society as a whole Suhrcke et al. (2005). A notable feature of the role of education in reducing poverty is the direct linear relationship between education and earnings. Education does not only increase the likelihood of being employed. Once in employment, better educated individuals earn much more than the less educated. From economic point of view, this result is not surprising and has been supported by numerous studies. Njong (2010) investigated the impact of different levels of education upon poverty in Cameroon. The results showed that educational level affect negatively poverty. Another interesting result is that individuals tend to move away from poverty as education levels progress. This means that the higher the educational attainment, the lower the probability of a person becoming poor. Achieving education improves the income potential of individuals and, therefore, will help them out of poverty. According to Krueger (2009), the economic growth is seen as the main policy to significantly reduce poverty. However, to emphasize the effect of growth on poverty reduction, the poor need to have access to social and economic services that enable them to become more productive. Furthermore, it also involves concentration on policies that will allow most of the society's citizens to become more productive (pro growth). Pro-growth policies are

implemented with particular attention to poverty alleviation through education, health care and provision of means to increase productivity.

Public health spending and poverty

Regarding at the health level, economists have argued that poor health leads to poverty and have shown that ill health has a negative impact on household income and economic growth rate (Barro, 1996, Mayer et al, 2001, Bhargava et al., 2001). Poor health would reduce a household's ability to earn income and accumulate wealth by limiting work, increasing medical costs and reducing savings. In addition, economists, especially those working in the theory of sustainable economic growth, have increasingly recognized health as a form of human capital. Thus, better health increases the productivity of other forms of capital and contributes to economic growth. Healthier children have higher enrollment ratios and better cognitive development, resulting in a higher rate of return to education and making investment in education more attractive. The thought of retirement planning occurs only when individuals expect to live long enough for retirement to be a realistic prospect. Increasing longevity motivates the current generation to save - an incentive that has dramatic effects on national saving and subsequent economic growth (Bloom et al., 2004). It is estimated that a 10% increase in life expectancy at birth leads to a 0.35% increase in the annual growth rate of per capita income (Arora, 2001). The impact of such a rate of economic growth that result from better health over time is quite significant.

It is recognized that the primary goal of a country with respect to its citizens concerning the delivery of health services is to provide better security for the poor through easy access to health care, to ensure good and regulate health systems. Low income households are subject to serious impoverishment and when they are victims of serious illness, these poor households have no safety net. To do this, public health spending should be primarily and firstly directed towards interventions with public goods characteristics. The strong positive externalities should be directed towards the poor (Roberts, 2003). Gupta et al. (2003) found that the poor have a significantly worse health status in developing and transition economies; and when the poor are more heavily affected by public spending than the non-poor, increasing public spending will not guarantee improved health. The consensus is that the increase in public spending alone is insufficient to improve the health status of the poor. Health services depend on a variety of variables or factors and some of these factors include; environmental, cultural, social, economic, geographical, as well as interventions in the sector. Odior (2015) shows that the re-

allocation of public spending to the health sector appears to have contributed significantly to the reduction of poverty. The implication of the result is that allocating more public fund towards improving basic health services will reduce the level of poverty in Nigeria. Although, there will be a decrease in poverty level in terms of good health services, the base scenario results show that Nigeria will not achieve its Millennium Development Goal (MDG) of improving health service by 2015. The findings recommend that for Nigeria to achieve this goal in terms of reduction in poverty by 2015, the government should double its spending on health care and equally ready to maintain the existing public health services in the future. These will drastically reduce poverty at the national, urban and rural level.

While most studies have shown that public spending on health can reduce poverty, others, on the contrary, lead to the conclusion that rising public spending on health care increases or has no effect on poverty. Asghar et al. (2012) assessed in various sectors over the period of 1972-2008, the long run effect government expenditure on poverty in Pakistan. Using the cointegration and Error Correction Mechanism (ECM), the study found no significant effect of government spending on health. Sourya et al. (2014) investigated in a similar way using data for Lao PDR. The results found a positive and significant correlation between domestic health funding and poverty meaning that poverty rise when government increase its expenditure in health sector.

Infrastructure and inclusive growth

The recent literature examination indicated that infrastructure development can have a positive effect on the income and welfare of the poor. Taking into account the impact of both quantity and quality of infrastructure on income distribution, Calderón and Chong (2004) provide evidence of a negative and statistically significant link between those from 1960 to 1997. That is, infrastructure development is associated with an improvement in the distribution of income. This result is due to the use of a purely cross-country or a panel approach. In his seminal paper, Lopez (2004) uses telephone density as a proxy of infrastructure while Calderón and Servén (2008) use synthetic index of infrastructure quantity and quality. In both cases, the result shows that infrastructure reduces income inequality. Therefore, this finding combined with the idea that infrastructure enhances economic growth can be a powerful tool for poverty reduction. Khandker et al. (2006) sought to determine if the infrastructure development fostered economic growth and poverty reduction in the context of Bangladesh. From an analysis of household panel data and using quantile regression techniques, their results suggest that growth in overall

income indeed led to a significant reduction in poverty and had a significantly higher impact on the households at the poorest end of the distribution. While those pure growth effects on household poverty incidence were not very large, authors found that income growth through certain policies (that is proximity to roads, electrification, and commercial bank penetration) could lead to substantial reductions in overall poverty in the sample. Therefore, investment in specific infrastructure can improve welfare and enhance distributional effect compared to pure growth.

Seneviratne and Sun (2013) investigated the relationships between infrastructure and income distribution in ASEAN-5 countries. They based on regressions covering 76 advanced and emerging market economies for the time period between 1980 and 2010 and using a set of pooled ordinary least squares (OLS). They conclude that better infrastructure, both quality wise and quantity wise, promote income equality, but it is not the same for investment. In fact, they found the weak link between investment and income distribution. For them, if not supported by enhancement in efficiency and institutions, an increase in infrastructure investment may lead to large waste that has little impact on equitable growth. The study shows that infrastructure development can have double effects on poverty reduction and inclusive growth. For the ASEAN-5 countries, removing infrastructure gaps could raise potential growth, and also shared the benefits of growth more evenly. Zheng and Kuroda (2013) emphasize the role of two public infrastructure, transportation and knowledge infrastructure, on industrial geography, regional income disparities, and growth across 286 cities in China. The study found that an improvement in transportation infrastructure reduced trade costs, increased growth, and decreased the income gap but at the expense of increasing industrial agglomeration between cities. Authors suggested that knowledge infrastructure increases growth but also decreases income gap as well as industrial agglomeration. Moreover, the impact of knowledge infrastructure is found to be larger in the case of high labor mobility.

For Jahan and McCleery (2005), the infrastructure development can contribute to reduce poverty directly or indirectly. In fact, it directly affects poverty by improving people's access to health and education services. Through the indirect channel, investment in infrastructure influences poverty by increasing workers productivity, reducing transport costs, and by generating further employment, thereby leading to growth. Therefore, the infrastructure development can affect economically and socially the lives of the population. Jahan and McCleery (2005) also claim that investment in infrastructure affects growth and poverty

reduction in several manners. They identified the first-round effects followed by subsequent impacts. In the first instance, the infrastructure development could lead to poverty reduction through economic growth. This can be done through the supply and demand side. Through supply, the infrastructure development is impacting the economy in terms of reducing costs, improving the business climate and creating new opportunities. These supply-side effects entail the attraction of foreign and domestic investment that can foster industrial growth, increase employment and domestic production. Regarding the demand side, the actual effect of the demand for infrastructure development is expected when employment and revenues are generated by project implementation. The social dimension of good infrastructure corresponds to increases access to basic social services such as transportation and power. This would improve the living standards of the poor.

Anderson et al. (2006) argue that there are two main effects whereby public infrastructure might affect the economy. They distinguish the macro from the micro effects. According to these authors, the macroeconomic effects focus on the potential impact of public investment on growth, investment and aggregate productivity. Regarding the microeconomic effects, public investment has both, quantity and price effect. The quality and quantity of public goods and services raise with the increasing in public investment in infrastructure. The quantity of public goods is initially rationed by firms and households because they are produced exclusively by the government. However, the quality and quantity of this rationed good raise if government make additional investment in infrastructure, therefore benefiting both firms and households in the process. In this case, direct welfare benefits is providing by many public infrastructure in the form of increased quality and quantity of final goods and services. Ogun (2010) studied the impact of physical and social infrastructure on living standard or poverty in Nigeria. The study showed that infrastructure development more to poverty reduction. These results also contributed showed that while infrastructure reduces poverty, specifically social infrastructure explains a greater part of the forecast error in poverty indicators relative to physical infrastructure. This suggests that wide investment in social infrastructure in town would reduce poverty significantly in urban areas.

4. Econometric methodology

This study employs panel-data vector autoregressive (panel VAR) method developed by Love and Zicchino (2006) to examine the government spending effect on inclusive growth by modeling the endogenous behavior between growth, income inequality and government spending. The specificity of the Panel VAR approach it combines two things together. On the one hand, it uses the traditional VAR approach, by treating the variables in the system as endogenous. On the other hand, it uses the panel-data method, enabling for unobserved individual heterogeneity by introducing fixed effects, resulting in an improved consistency of the estimation (Love and Zicchino, 2006). According to Martinez et al. (2012) public spending, are likely to be endogenous, due to reverse causality– from income inequality to select the instruments of expenditure policy and vice versa. Specifically, countries with higher unequal revenue distribution may decide to rely relatively more on public expenditures, and vice versa. Therefore, since government expenditure responds to underlying exogenous shocks, conventional econometrics methods that treat government spending as exogenous variable may be biased. The panel VAR approach is notably interesting as it overcomes usual econometric limitations. Moreover, the panel VAR procedure also has the advantage from panel-data framework to allow unobserved individual heterogeneity for all the variables by introducing fixed effects which enhances the consistency of the estimation. We utilize a panel vector autoregressive (VAR) model to identify the possible causal relationship between the variables. The key benefit of this method is to exploit the individual time series and the cross-sectional variations of the data and to avoid the bias associated with the cross-sectional regressions by considering the country-specific fixed effect. For Canova and Ciccarelli (2013), it allows to account static and dynamic interdependencies. It is definitely a helpful tool to give a good interpretation of inclusive impacts of government fiscal expenditure without modeling the global economy. This setup also allows us to study the Impulse Response Functions (IRFs) of different shocks and how these affect other imbalances.

The first step of the empirical analysis was to choose the optimal lag order in panel VAR and the moment condition. According to Andrews and Lu (2001) consistent moment and model selection criteria (MMSC) are based on Hansen's (1982) statistic of over-identifying restrictions. Therefore, according to three model selection criteria by Andrews and Lu (2001), the preferred model in our case was the first-order Panel VAR. This panel VAR model can be specified as follows:

$$Y_{it} = A(L)Y_{it} + \mu_i + \varepsilon_{it}, \qquad (1)$$

$$Y_{it} \equiv \begin{bmatrix} growth \\ gini_{it} \\ B_{it} \end{bmatrix}$$

where Y_{it} is a $(1 * k)$ dimension vector containing all stationary variables. $A(L)$ is a matrix polynomial in the lag operator with $A(L) = A_1L^1 + A_2L^2 + \cdots + A_pL^p$, μ_i is a vector of country specific effects and ε_{it} is a vector of idiosyncratic errors. B_{it} is a vector or scalar of public expenditure in education, health and infrastructure index.

In the Panel VAR framework, it is important to impose some restrictions to make sure that the underlying structure is the same for all the cross-sectional members. In practice, such constraints are likely to not be respected; one can resolve this problem by using fixed effects denoted by μ_i in equation (1) to allow for individual heterogeneity in all the variables. However, the conventional approach of average differentiation, commonly used to remove fixed effects, can lead to biased coefficients because the fixed effect hypothesis means that the individual specific effect is correlated with the independent variables. Therefore, to overcome this problem we use forward mean-differencing, also known as the Helmert procedure (Arellano and Bover, 1995). In this procedure, to remove the fixed effects, all variables in the model are transformed in deviations from forward means. Let $\bar{y}_{it}^m = \sum_{s=t+1}^{T_i} y_{is}^m /(T_i - t)$ denotes the means obtained from the future values of y_{it}^m, a variable in the vector $Y_{it} = (y_{it}^1, y_{it}^2, \dots, y_{it}^M)'$, where T_i denotes for a given series of countries, the last period of data available. Let $\bar{\varepsilon}_{it}^m$ indicates the same transformation of ε_{it}^m, where $\varepsilon_{it} = (\varepsilon_{it}^1, \varepsilon_{it}^2, \dots, \varepsilon_{it}^M)'$. Hence, transformed variables are obtained:

$$\tilde{y}_{it}^m = \delta_{it}(y_{it}^m - \bar{y}_{it}^m) \qquad (2)$$

And

$$\tilde{\varepsilon}_{it}^m = \delta_{it}(\varepsilon_{it}^m - \bar{\varepsilon}_{it}^m) \qquad (3)$$

where $\delta_{it} = \sqrt{(T_i - t)/(T_i - t + 1)}$.

This procedure gives more weight to data from the early period and allows no transformation on the last one since no future observation is available. The same transformation is applied on the error vector; In fact, with the hypothesis of neither auto-correlation nor homoscedasticity, the procedure does not modify its features. The final transformed model is thus given by:

$$\tilde{Y}_{it} = A(L)\tilde{Y}_{it} + \tilde{\varepsilon}_{it} \qquad (4)$$

where $\tilde{Y}_{it} = (\tilde{y}_{it}^1, \tilde{y}_{it}^2, \dots, \tilde{y}_{it}^M)'$, and $\tilde{\varepsilon}_{it} = (\tilde{\varepsilon}_{it}^1, \tilde{\varepsilon}_{it}^2, \dots, \tilde{\varepsilon}_{it}^M)'$, and $Y_{it} \equiv \begin{bmatrix} growth \\ gini_{it} \\ B_{it} \end{bmatrix}$

Moreover, the differencing could also result from a simultaneity problem since the lagged regressors are correlated with the differenced error term. In addition, heteroscedasticity may also exist due to the presence of heterogeneous errors with different countries in the panel. Accordingly, after eliminating the fixed effects by differencing, the generalized method of moments estimator (GMM) using lagged regressors as instruments is applied to estimate the coefficients more consistently.

In our model, we assumed that the residuals vector (ε_{it}) was independent and identically distributed. However, this assumption typically fails in practice, as the concrete variance-covariance matrix of errors is unlikely to be diagonal. Thus, to isolate the shocks on one of the VAR errors, it is necessary to decompose the residuals so that they become orthogonal. According to Sims (1980), the variables in VAR should have a recurrent causal order based on their degree of exogeneity. This procedure is also known as the Cholesky decomposition of the variance-covariance matrix of residuals and ensures the orthogonalization of the shocks. In other words, the variables that come earlier in the order affect the subsequent variables at the same time and with a lag, whereas the variables that come later only affect the previous variables with a lag (Love and Zicchino, 2006).

The panel has a medium time dimension and a relatively small number of countries, thus the panel with fixed effect specification (LSDV) is the most appropriated (Bun and Kiviet, 2006) and found to be consistent (Nickell, 1997). So we estimate equation (4) and draw impulse response functions by using the Stata code (XTVAR) of (Cagala and Glogowsky, 2014). XTVAR estimates a panel vector autoregression by employing a least square dummy variable estimator (LSDV). The estimator fits a multivariate panel regression of each dependent variable on lags of itself and all the other dependent variables.

The special feature of the use of VAR is that it allows to draw the impulse response function (IRF) and the variance decomposition of the error (FEVD)[4] to identify the shocks. The impulse

[4] Impulse response functions describe the response of an endogenous variable over time to a shock in another variable in the system. Variance decompositions measure the contributions of each source of shock to the (forecast error) variance of each endogenous variable, at a given forecast horizon.

response functions (IRFs) are calculated by counting on the Cholesky decomposition. They describe one variable's reaction in reply to changes in another variable in the system, as all other shocks are held equal to zero. However, to isolate shocks to one of the variables in the system, it is essential to decompose the residuals using a method by which they turn into orthogonal, because the actual variance-covariance matrix of the errors is unlikely to be diagonal. The usual convention is adopting a particular ordering, and then any correlation between the residuals of any two elements is allocated to the variable that is coming first. The identifying assumption is that the following variables are affected simultaneously by the variables that appear earlier in the ordering, as well as with a lag, whereas the variables coming later affect the preceding variables only with a lag. That is to say, in the system, the variables coming earlier are more exogenous, while the variables coming later are more endogenous. Finally, to analyze the impulse response functions an estimation of their confidence intervals is needed. The standard errors of the impulse response functions need to be considered, because the matrix of IRFs is built from the estimated VAR coefficients. Consequently, the standard errors of the impulse response functions and the confidence intervals are generated by use of Monte Carlo simulations (Garita, 2011).

5. Data and empirical investigation

5.1. Data and variables

To investigate the effect of public expenditure component on inclusive growth, we use annual observations from 1990 to 2015 for 10 Sub-Saharan African countries. The sample does not include early years because of the scarcity of fiscal data in macro level for Sub-Saharan African countries. In the study, we focus on three kinds on spending variables (education, health, and infrastructure) because according to the literature, these expenditures account for a major part of public expenditure in different countries. Also, the distributive nature of these expenses has been extensively debated.

To carry out the study, we analyze the effect of these public expenditures on GDP per capita growth and Gini index. The fiscal variables (spending on health and education) are expressed in percentage of GDP.

Source and discussions of income inequality database

The Gini coefficients are from the Standardized World Income Database (SWIID) and measured the net Gini i.e., the Gini after tax and transfer. By maximizing comparability for the largest possible sample of countries and years, the SWIID is better suited to broadly cross-national research on income inequality than previously available sources: it offers coverage double that of the next largest income inequality dataset, and its record of comparability is three to eight times better than those of alternate datasets (Solt, 2016). Even if there is a lot data from various sources on income inequality, it is important to note that it is quite complex to make comparisons at cross-country level and overtime. These difficulties are due how to define the well-being whether in term of market income or consumption; and how to classify individuals in a population in terms of age, geography, and employment status. The SWIID database tries to solve the problem of data scarcity through covering data from the broadest possible sample of countries and years.

Infrastructure index

Due to the lack of infrastructure spending in Sub-Saharan African countries, we are building an infrastructure indicator. For the construction of our indices of infrastructure which takes into account both quantity and quality, we follow (Calderon and Serven, 2014). We use the principal component analysis to construct synthetic indices that capture information in two core infrastructure sectors – transport and power- which play a major role in economic development. The aggregate Index of infrastructure stocks is the first component of two variables: air transport, freight and improve water source (% of population with access).

*Infrastructure Index= 0.7071 *Transport + 0.7071 * Improve water*

The variables used in this study and their descriptive statistics are shown in Table 1. These variables are from World Development Indicators (World Bank) and World Economic Outlook Database (IMF).

Table 1: Description Statistics for variables

Variables	Observation	Mean	Std. Dev.	Min	Max
GDPpc growth	311	1.06	4.05	-15.28	15.65
Net Gini	237	40.8	7.51	31	58.8
Investment	312	20.32	9.48	4.30	61.46
Education spending	312	3.67	1.56	.11	8.65
Health spending	312	2.38	1.24	.02	6.93
Infrastructure	260	2.44	1.3	0.04	6.93

Source: Author calculation using data from World Development Indicators (World Bank) and World Economic Outlook Database (IMF).

5.2. Panel unit root test and cointegration analysis

The aim is to establish the dynamic properties of the effect of government expenditures composition on both equity and economic growth in Sub-Saharan Africa countries over the 1990-2015 period. In particular, we are interested in the following questions: are government expenditures linked to economic growth and income inequality by a stable long-run relationship? Which component of public spending has a more significant effect on economic activities and equity? Are these relations robust over time?

To overcome the issue of spurious regression that characterized earlier studies on the relation between government expenditure and growth and equity due to the neglect of time series properties, we follow the now standard approaching consisting of (i) assessing the stationarity of the time series, (ii) in the case the variables are not stationary, checking whether they are characterized by a cointegration relationship, (iii) in case cointegration holds, estimating error correction mechanism (ECM), which permits to analyze the long-run relationship between the variables jointly with the short-term adjustment towards the long-run equilibrium.

Table 2 presents the results of unit root tests of IPS, ADF, and PP for the variables in the system. At the 5% level of significance, the results show that GDP per capita growth and net Gini are stationary in levels. By against, the results find that time series variables, such as investment, public spending in education, spending in health and infrastructure are having unit roots at the level data. This is because the null hypothesis of non-stationarity cannot be rejected by the estimated unit root test statistics at 5% level of significance. However, they are stationary at the first difference level, as the null hypothesis of non-stationarity is rejected at 5% level of significance (see Table 3). This confirms that these variables are integrated of order one, 1 (1).

Table 2: Results of Panel Unit Root Tests (in levels)

Variables	Im, Pesaran and Shin	ADF-Fisher	PP-Fisher	Level of Integration
GDP pc growth	-3.805	-4.053	-11.412	I(0)
	(0.000)	(0.000)	(0.000)	
Net Gini	-1.908	-1.894	-1.681	I(0)
	(0.028)	(0.029)	(0.046)	
Investment	0.933	1.445	0.220	I(1)
	(0.824)	(0.926)	(0.587)	
Education spending	2.118	2.241	1.831	I(1)
	(0.983)	(0.987)	(0.966)	
Health spending	-1.617	-1.492	-2.123	I(1)
	(0.053)	(0.068)	(0.017)	
Infrastructure	6.500	6.089	3.304	I(1)
	(1.000)	(1.000)	(0.999)	

P values shown below test statistics. The null hypothesis for all test is a unit root (assumes individual unit root process). Two lags are introduced to allow for serial correlation in the errors.

Table 3: Panel Unit Root Tests (At First difference)

Variables	Im, Pesaran and Shin	ADF-Fisher	PP-Fisher
Investment	-6.149	-6.7257	-16.871
	(0.000)	(0.000)	(0.000)
Education spending	-3.297	-3.499	-8.956
	(0.001)	(0.000)	(0.000)
Health spending	-2.146	-2.130	-8.709
	(0.016)	(0.017)	(0.000)
Infrastructure	-4.075	-4.317	-14.192
	(0.000)	(0.000)	(0.000)

P values shown below test statistics. The null hypothesis for all test is a unit root (assumes individual unit root process). Two lags are introduced to allow for serial correlation in the errors.

Cointegration test

Once the stationarity order is defined, our next step is to apply panel cointegration test. Granger (1988) showed that when the time series become stationary only after being differentiated once, they might have linear combinations that are stationary without differencing. These series are generally called cointegrated. If the integration of order one is implied, the next step is to use the cointegration analysis to determine whether there is a long-term relationship between the set of integrated variables. Panel cointegration tests are improved aiming to analyze long-term relation-ships between panel series after advances in panel unit root tests. The most important

cointegration tests in econometric literature are these: 1995, 1999 and, 2004. Mccoskey and Kao (1998), Kao (1999), Larsson et al. (2001), Mark and Sul (2003), Guitierrez (2005).

In this investigation, Westerlund (2007) cointegration test is deployed to test the existence of long run equilibrium relationship between public expenditure and inclusive growth. Westerlund (2007) implements the four error-correction-based panel cointegration tests which are general enough to allow a large degree of heterogeneity, both in the short-run dynamics and, in the long-run cointegration relationship and dependence across as well as within the cross-sectional units. The fundamental idea is to test the absence of cointegration by establishing if the individual members of panel are error-correcting or not. Consider that we have a process of generating data in the form:

$$\Delta y_{it} = \delta_i' d_t + \alpha_i\left(y_{i,t-1} - \beta_i' x_{i,t-1}\right) + \sum_{j=1}^{P_i} \alpha_{ij}\Delta y_{i,t-j} + \sum_{j=0}^{P_i} \gamma_{ij}\Delta x_{i,t-j} + e_{it} \quad (3.11)$$

Where $i = 1,\ldots,N$ and $t = 1,\ldots,T$ indicate the cross-sectional units and time-series, respectively, while, d_t includes the deterministic components and can be grouped into three cases. Case one, d_t = 0 so absence of deterministic terms in equation (3.11); in the case two, d_t = 1 so Δy_{it} is estimated with a constant; and in the case three, $d_t = (1, t)'$, so Δy_{it} is estimated with both a trend and a constant. The parameter α_i measures the speed of adjustment, that is, the speed at which the system returns to its equilibrium relationship $y_{i,t-1} - \beta_i' x_{i,t-1}$ after a sudden shock in one of the model variables. If $\alpha_i < 0$, then we make assumption of error correction which suggests that y_{it} and x_{it} are cointegrated; if $\alpha_i = 0$, there is absence of error correction and, thus absence of cointegration. Thus, we can formulate the null hypothesis of absence of cointegration as $H_0: \alpha_i = 0$ for all i. The alternative hypothesis depends on what is supposed about the homogeneity of α_i. Two of the tests, called group-means tests, do not need that the coefficients α_i be equal, implying that H_0 is tested versus $H_1: \alpha_i < 0$ for at least one i. The second pair of tests, called panel test, assume that α_i is equal for all i.

Westerlund (2007) computes the group-mean tests in three steps. The first step will be to estimate equation (3.11) using least squares method for each unit i. After having e_{it} and γ_{ij}, the second step consists of calculating $\hat{u}_{it}$ and then of $\hat{\alpha}_i$. The third step is the computation of the group-mean tests using the following formula:

$$G_T = \frac{1}{N}\sum_{i=1}^{N} \frac{\hat{\alpha}_i}{SE(\hat{\alpha}_i)}$$

$$G_a = \frac{1}{N}\sum_{i=1}^{N} \frac{T\hat{\alpha}_i}{\hat{\alpha}_i}$$

Similarly, the panel test is computed in three steps. The first test is the same as for the group-mean tests and involves regressing Δy_{it} and $y_{i,t-1}$ on d_t, the lags of Δy_{it}, and the contemporaneous and lagged values of Δx_{it}. Then, the second step focuses on the estimation of the common error correction parameter, $\hat{\alpha}$, and its standard error, SE. Finally, the panel statistics are given by:

$$P_T = \frac{\hat{\alpha}}{SE(\hat{\alpha})}$$

$$P_T = T\hat{\alpha}$$

The above cointegration tests, proposed by Westerlund (2007) can be executed using command called "xtwest", which can be used in Stata software.

Table 4: Panel cointegration tests

Dependent variable: GDPpc growth

Statistic	Value	P-value
Gt	-2.780	0.004
Ga	-8.635	0.728
Pt	-8.647	0.008
Pa	-8.954	0.089

Dependent variable: Net Gini

Statistic	Value	P-value
Gt	-1.069	0.999
Ga	-0.932	1.000
Pt	-2.470	0.993
Pa	-0.574	0.996

The Westerlund and Edgerton (2007) tests take no cointegration as the null, and P-values are robust critical values obtained through one lag.

Table 4 reports the results of panel cointegration tests developed by Westerlund (2007). The G_T and G_a statistics test whether cointegration exists for at least one individual. The P_T and P_a statistics pool information over all the individual series to test whether cointegration exists for the panel as a whole. As shown by the robust p-value, for models with dependent variables Gini, the null hypothesis of no cointegration cannot be rejected by all the four tests. Regarding the model that have GDPpc growth as dependent variable, the statistic G_a and P_a does not allow to reject the null hypothesis of no cointegration. Therefore, the empirical properties of the

variables examined require estimation of the VAR in first differences, since no cointegration relationships exist between the (non-stationary) variables (in level).

Model Selection

Panel VAR analysis is based on the choice of the optimal lag order in the panel VAR specification and the moment condition. Based on Hansen's (1982) *J* statistic of over-identifying restrictions, Andrews and Lu (2001) proposed consistent moment and model selection criteria (MMSC) for GMM models. Andrews and Lu's MMSC requires that the number of moment conditions be greater than the number of endogenous variables. Their proposed MMSC are similar to several usually used maximum likelihood-based model selection criteria, namely the Akaike information criteria (AIC) (Akaike, 1969), the Bayesian information criteria (BIC) (Schwarz, 1978), and the Hannan-Quinn information criteria (HQIC) (Hannan and Quinn, 1979).

The evidence shown in Table 5 is supportive to the choice of first-order panel VAR (one lag) since this has the smallest MBIC, MAIC and MQIC.

Table 5: Lag-order selection statistics for panel VAR estimated

Lag	CD	J	J pvalue	MBIC	MAIC	MQIC
1	.999963	143.0066	.0135994	-421.9531	-72.9934	-214.392
2	.9999982	73.83436	.4179817	-302.8055	-70.16564	-164.4314
3	.9999964	33.7613	.5755131	-154.5586	-38.2387	-85.37158

Note: CD is the coefficient of determination

Stability test

Prior to estimating impulse-response functions (IRF) and forecast-error variance decompositions (FEVD), however, we first check the stability properties of the estimated panel VAR model. The stability of the panel VAR requires the modulus of the eigen-values of the dynamic matrix to lie within the unit circle. The resulting table and graph of eigenvalues reported in Annex (2) confirms that the estimate is stable.

6. Empirical results

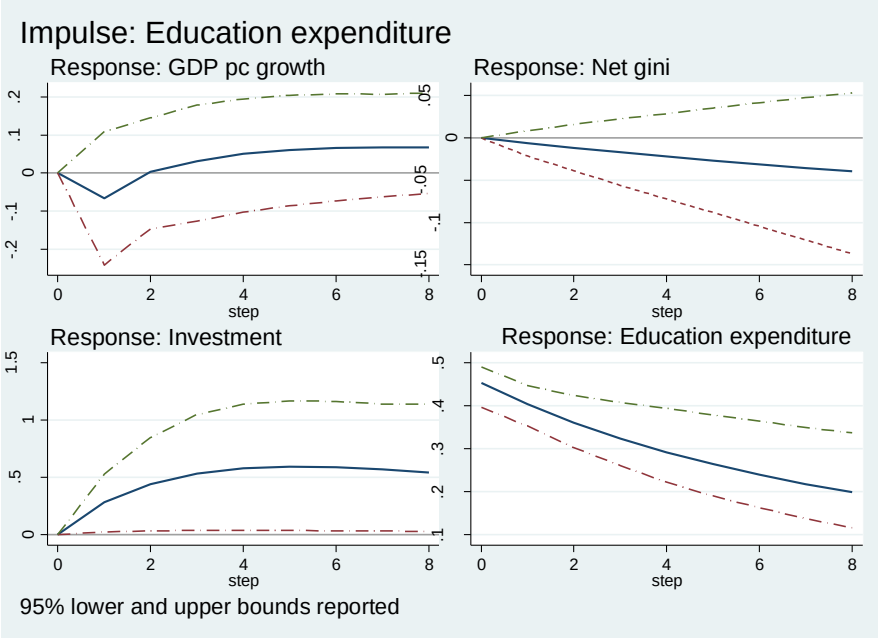
This section presents the impulse response functions and the variance decomposition from the panel VAR. Each of these IRFs is generated by Monte Carlo simulations with 200 repetitions. Areas between the upper and lower lines have a 95% confidence interval for IRFs over the next 10 years. The four-variable XTVARs consist of investment, government spending on education and health as well as net Gini and GDP per capita growth.

The impulse response functions in Figure 6 show that GDP per capita responds negatively to public spending on education, before having a positive but low impact. Reaching its minimum level in the first period, the increase in growth level appears nearly about 0.06 %. This positive response of income conserves its statistical meaningfulness from the 4th period. However, increases in government spending on education are likely to have a negative effect on the Gini coefficient. Figure 6 also shows that public investment reacts positively and significantly to government expenditure on education. These results indicated that the economic impact of public expenditure on education might be positive but limited in the case of growth in Sub-Saharan African countries, whereas educational spending is likely to reduce income inequality slightly.

These results are in line with some previous studies including Afzal and al. (2012) and Hanushek and Woessmann (2008) that report a significant and positive relationship between government expenditure on education and growth. Higher education always improves the quality of labor supply, thus increase in total factor productivity and growth towards equilibrium output. Also, education promotes the innovative techniques, which encourages growth. However, our findings do not corroborate the results of Martinez et al. (2012) who find that government spending (education, health, and housing) tend to have greater effects on reducing income inequality than other spending items. This difference in results can be explained by the difference in samples (time period and number of countries) or methodology used in these studies. On the other hand, the difficulty in targeting the poor with regular education spending in developing countries might explain the limited effect of government spending on education on Gini coefficient. In fact, among other reasons, these programs are in many countries targeting in urban areas, thus does not directly benefit the poor in rural areas or even those live in informal neighborhoods in urban areas. Thereby, given that inclusive growth implies there is an increase in economic growth on the one hand an equitable redistribution of

the fruits of this growth on the other hand, our results show that a shock of public spending on education affects both aspects of inclusive growth but with minimal effect.

Figure 6: Impulse response functions – change in public expenditure on education



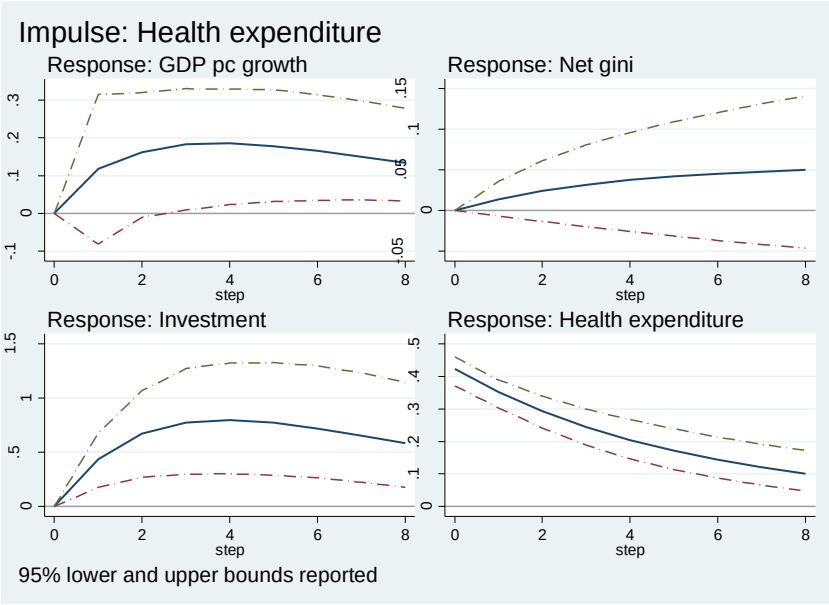
Source: Author's estimates.

According to impulsive response functions obtained from public spending on health (Figure 7), the reaction of GDP per capita in response to an impulse given to government health expenditure is positive and significant during the entire period. However, after five periods, economic effects of an increase in health expenditure are likely to decrease. A plausible explanation is that in developing countries, a large share of health spending is allocated to operating expenditure rather than funding medical equipment. These expenditures have little impact on the population's health, especially those living in rural areas. Thus, unhealthy individuals are less fit both physically and mentally, they are expected to disrupt production and decrease productivity and tend to reduce economic growth.

The response of net Gini coefficient, which measures the degree of inequality in the distribution of income in a country, is positive during the entire period. These results indicate that the public

spending on health seems to increase the income gap between rich and poor in the countries used in this study. The finding confirms those found by Dollar and Kraay (2002). In fact, they have attempted to address how certain components of public policies like public spending on health and education impact poverty. They find that many supposedly "pro-poor" policies that direct investment in health and education do not have any significant impact on the income of the poor. They argue, however, that social spending in developing countries often benefits the rich and middle classes more than the poor. Therefore, a higher share of social spending on items such as health and education will not be reflected in higher incomes for the poor. Unlike to the education, health expenditure in sub-Saharan Africa appears to make it possible to reach only one aspect of inclusive growth (i.e. economic growth).

Figure 7: Impulse response functions – change in public expenditure on health

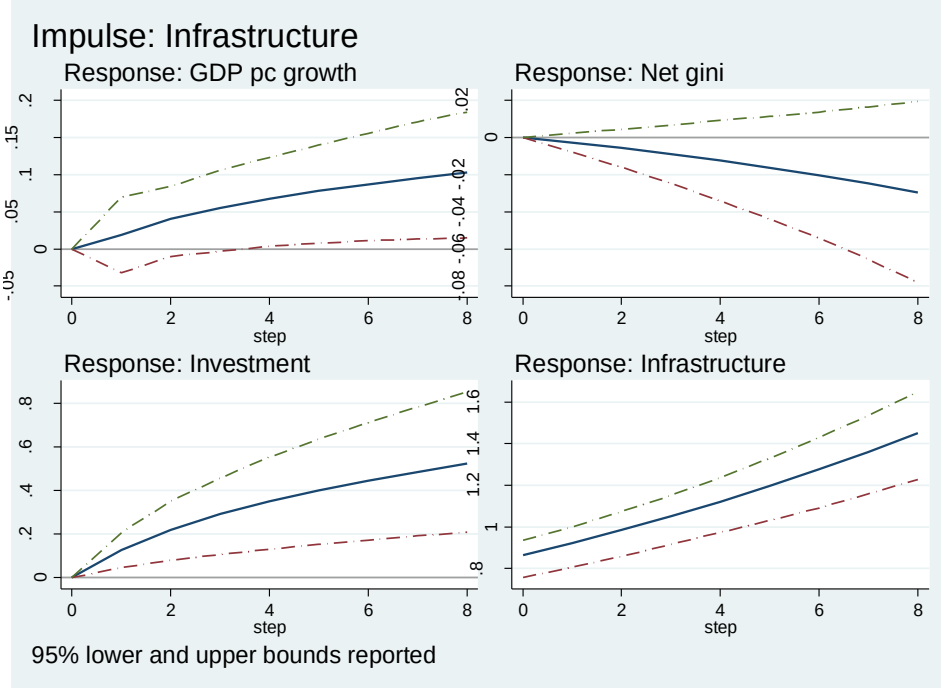


Source: Author's estimates.

Figure 8 draws the impulsive response function for infrastructure. The effect from a change in infrastructure is different to public education expenditure and public health spending. An expansion in infrastructure has a positive effect on growth and allows a reduction of the income gap between rich and poor (negative curve of Gini). Compared to the previous two cases for public expenditure on health and education which do not or have little growth inclusiveness effect, this result shows an increase in infrastructure has a long-term effect in achieving

economic growth and in reduction of income inequality. This leads to an inclusion of growth in Sub-Saharan Africa.

Figure 8: Impulse response functions – change in infrastructure



Source: Author's estimates.

Although the impulsive responses provide information about the effect of changes in one variable on another, it is important to note that they do not show the proportions in which shocks on a variable explain the fluctuations of other variables. To estimate the extent of changes in one variable in explaining the shifts in other variables, we perform a variance decomposition. The variance decompositions display the proportion of movements in the dependent variables that are due to their own shocks versus shocks to the other variables. Table (6) reports the variance decomposition analysis derived from the orthogonalized impulse–response coefficient matrices. The variance decomposition in Table (6) clarifies how government spending on education and health and infrastructure index affect each component of inclusive growth (income inequality and economic growth) in the sample used in this study. The variance decomposition shows that public education expenditure explains approximately 0.14% and 0.31% of the fluctuations of GDP per capita growth and Gini coefficient respectively. Health expenditure explains approximately 0.48% of changes in GDP per capita growth and 2.01% of Gini index. The results in Table (6) also indicate that infrastructure shocks are essential to

explain the inclusiveness of growth. Infrastructure explains 1.96% of the variation in growth and 0.20% of the change in net Gini.

Table 6: Variance decomposition analysis

Variation in the row variable explained by column variable (in %, 8 periods ahead)				
Model 1 (Education)				
	GDPpc growth	Net Gini	Investment	Education spending
GDPpc growth	81.83	0.26	17.77	0.14
Net Gini	1.21	96.83	1.65	0.31
Investment	.84	1.18	96.28	1.70
Education spending	1.83	0.24	0.26	97.66
Model 2 (Health)				
	GDPpc growth	Net Gini	Investment	Health spending
GDPpc growth	82.82	0.45	16.25	0.48
Net Gini	1.21	96.23	0.55	2.01
Investment	0.47	3.03	93.38	3.12
Health spending	0.87	21.60	0.61	76.92
Model 3 (Infrastructure)				
	GDPpc growth	Net Gini	Investment	Infrastructure
GDPpc growth	80.48	0.25	17.31	1.96
Net Gini	1.70	96.42	1.68	0.20
Investment	0.41	1.55	97.72	0.31
Infrastructure	0.02	0.30	0.21	99.47

Numbers are expressed in percentage of the total variance; Projection: 8 periods ahead; Columns explain lines.

To summarize, from impulsive response function and variance decomposition results, we find evidence that improving the infrastructure quality and stock has a significant impact on the inclusiveness of growth in long term. This effect could be observed by an increase in GDP per capita growth and a reduction on income inequality measured by Gini index. However, public expenditure on education and health do not allow at the same time to increase the growth on the one hand and reduce income inequality in the other hand. In other words, our results do not find evidence that these two kinds of public spending affect the inclusiveness of growth in Sub-Saharan Africa countries.

Firstly, these results can be explained by the fact that in many developing countries, a large part of public health budgets is allocated to hospital services, usually located in urban areas. These services are difficult or not at all accessible to large parts of the population living in rural areas

and have high mortality rates caused by diseases. Besides, good governance is important in the delivery of health care, and returns on investment in health are low in poor governance environment (Lewis, 2006). Consequently, the allocation of funds to the health sector in the context of poor governance may be insufficient to improve health outcomes. Indeed, poor intra-sectoral distribution, inadequate targeting, and inefficient delivery also explains the low impact of public spending on health. Some authors like Ugur and Dasgupta (2011) suggested that governance affects health through two main channels: its indirect effect on national income (corruption reduces economic growth) and thus on household income, and the determinants of health and directly on the health sector. In more developed countries, good governance in the health sector has a positive effect on health, while in less developed countries good governance affects it mainly through its indirect impact on income.

Second, the limited effect of public expenditure on education in achieving inclusive growth can be explained by the fact that there may be variations in individual choice and parental human capital. In such a case, public spending on education does not reduce the income gap between the rich and the poor, even if everyone has equal access to education (Glomm and Ravikumar, 2003). Moreover, expansion of education would not benefit the poor if they did not have enough resources to attend school, especially if they are taxed to generate revenue to finance education (Sylwester, 2000).

Finally, several reasons support the view that infrastructure investment boosts inclusive growth, especially in developing countries with low infrastructure stocks (Easterly and Rebelo, 1993, and Arslanalp et al., 2010). Improving road network or access to electricity increases the productivity of firms, and thus the economy as a whole. However, the lack of access to physical infrastructure could have adverse effects on the poor (Estache and Fay, 2007). Therefore, maximizing the inclusive impact of infrastructure requires expanding access to and affordability for the poor.

7. Robustness

Another estimator (PVAR)

In this part, we focus on another panel VAR model estimator developed by Abrigo and Love (2016) which use the Stata code (PVAR). The method allows us to examine the dynamic relationship between governments spending and inclusive growth over time. The PVAR methodology treats all variables as endogenous and interdependent, so all the feedback effects are included explicitly in the model. In fact, the PVAR estimator uses the lagged values of regressors as instruments and estimates the coefficients by the generalized method of moment (GMM). Thus, it is a methodology that is well-suited to the questions this study aims to address. Figure 9, 10 and 11 (see Annex 1) are impulsive response functions (IRF) for public expenditure on education, health, and infrastructure index respectively and the Variance decomposition analysis is reported in table (7). First, the IRFs of education spending shows that the effect GDP per capita growth and net Gini have practically the same tendency as in the case of XTVAR estimator to a shock on public spending on education. However, the magnitude of the curves remains slightly higher in the case of the GMM method used by the PVAR estimator than the LSDV method. Second, given an impulse of public spending on health, the results are qualitatively the same as the case of XTVAR. Except that here, there is a considerable drop in the GINI index, which is even negative, indicating a decrease in income inequality. Third, according to figure 11, investment in infrastructure seems to have a positive effect on growth even if this effect decreases other times. In the case of income inequality, a shock on investment in infrastructure is likely to lower the Gini coefficient up to the 7th period beyond which effect becomes positive and this is not significant.

Overall, the inclusiveness of growth in African countries in the south of Sahara seems to be mainly driven by infrastructure. This finding is closed to the previous results using the LSDV estimator. The difference is being felt in the magnitude of the effect.

Sub-panel

The main goal of this part is to focus more precisely on a sample consisting essentially of countries in West Africa. A specific attention is paid to the six following countries: Côte d'Ivoire, Ghana, Guinea, Mali, Niger, and Senegal. The aim here is to check whether our results are not affected when we are specifically interested in countries operating in the same geographical space. These countries all belong to ECOWAS, thus sharing the same trade policy aimed at increasing intra-regional trade to promote the harmonious integration of the region into the world economy and stimulate economic activities in the region and also contribute to the improvement of the economic welfare of the citizens. The results represented in Figure 12, 13 and 14 (see Appendix) confirmed that our results are quite similar to those obtained with the whole sample, the difference being that in the reduced sample, education spending does not affect income inequality.

8. Conclusion

This paper examines empirically the effect of government expenditure policy on two critical aspects of inclusive growth that are economic growth and income inequality. The study is conducted using a panel VAR approach using data from 10 sub Saharan African countries over the period 1990 to 2015. The results are as follows:

- Public health spending and infrastructure investment have significant positive effects on economic growth.
- Public spending on education has a temporary negative effect before having a positive but limited effect on GDP per capita growth.
- Educational spending and infrastructure investment seem to alleviate income inequality significantly.
- The effects of public health spending items on the Gini coefficient are positive and significant during the entire period, denoting an increase of income gap between rich and poor in the studied countries.

These findings imply that investment in infrastructure may contribute to more inclusive growth in Sub-sub Saharan African economies than other government spending. Based on these results, we recommend that the following measures should be implemented to create government expenditures policies that will support the successful implementation of inclusive growth. In order to make growth more inclusive, temporary and well-targeted programs could be considered to help those being left out by the growth process. Governments of sub Saharan African countries should direct their policies strategies on increasing productive public expenditure on health, education, and infrastructure.

First, an increase in government spending on education would result in improved primary and secondary school enrollment, academic excellence, research and development, human capital development, as well as skilled and productive work. Therefore, this would greatly contribute to inclusive growth in the country.

Second, if governments increase their expenditure on health by providing quality medicines, skilled health personnel, a clean and supportive environment, significant progress will be made to reduce waterborne illness, sexually transmitted diseases, malaria, poliomyelitis, etc. Above all, infant and maternal mortality would decline across the country.

Last, since the use of public resources as infrastructure has led to inclusive growth, governments could improve further their productivity by providing infrastructural facilities such as good roads, electricity, water supply, communication, school and hospital buildings. In fact, good roads will have the effect of lowering the price of products and therefore increasing household consumption. Concerning investment in electrical infrastructure, they guarantee a constant power supply to households and industries. A steady power supply would help to reduce production costs and prices, but with significant output across sectors of the economy. Finally, water infrastructure would improve the supply of potable water, thereby eradicating the health risk associated with water consumption from unsafe sources. In short, the provision of infrastructure would necessarily create more jobs which, in turn, would translate to economic growth and social well-being.

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10. Appendix

Annex 1

Figure 9: Impulse response functions – public expenditure on education

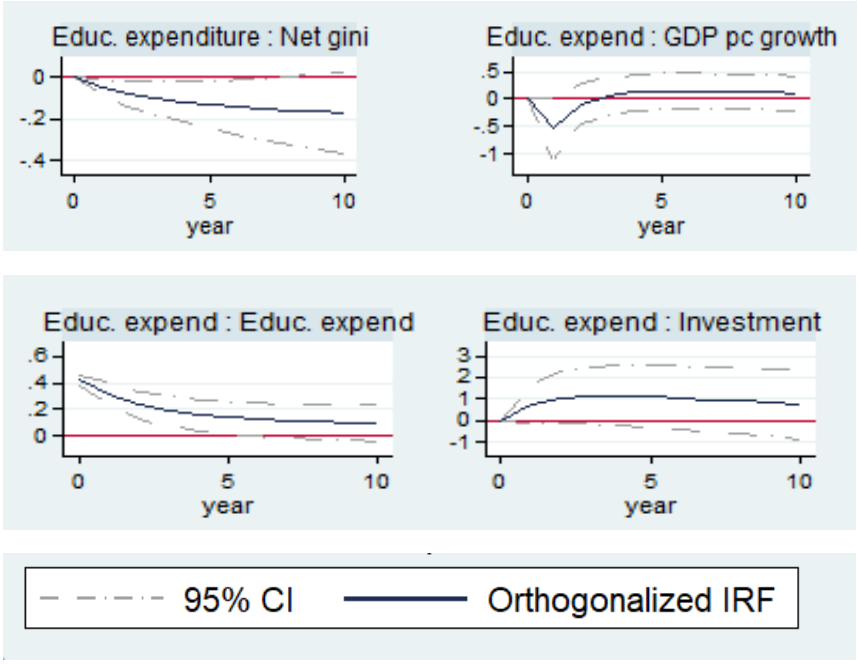


Figure 10: Impulse response functions – public expenditure on health

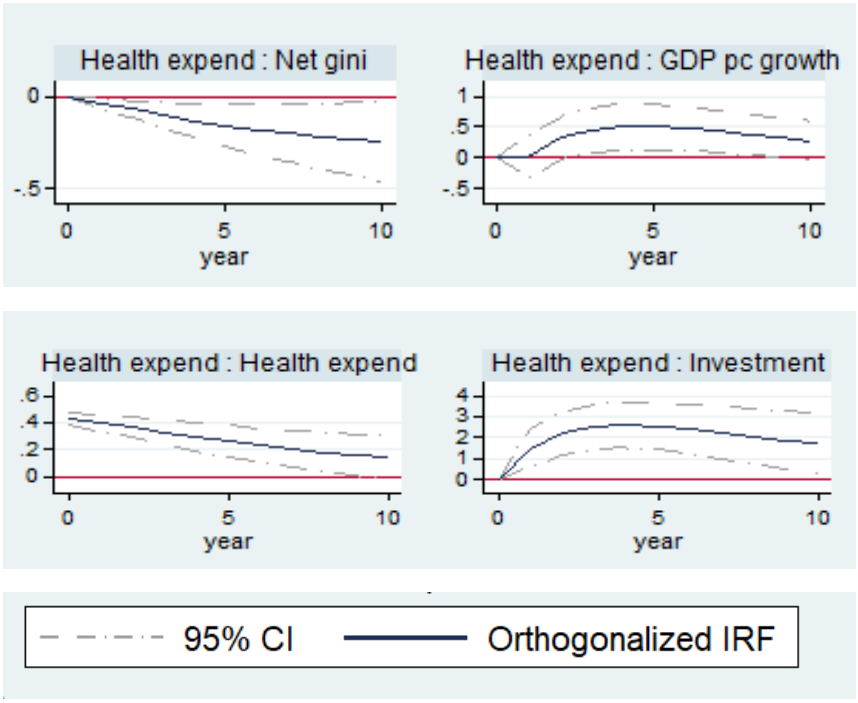
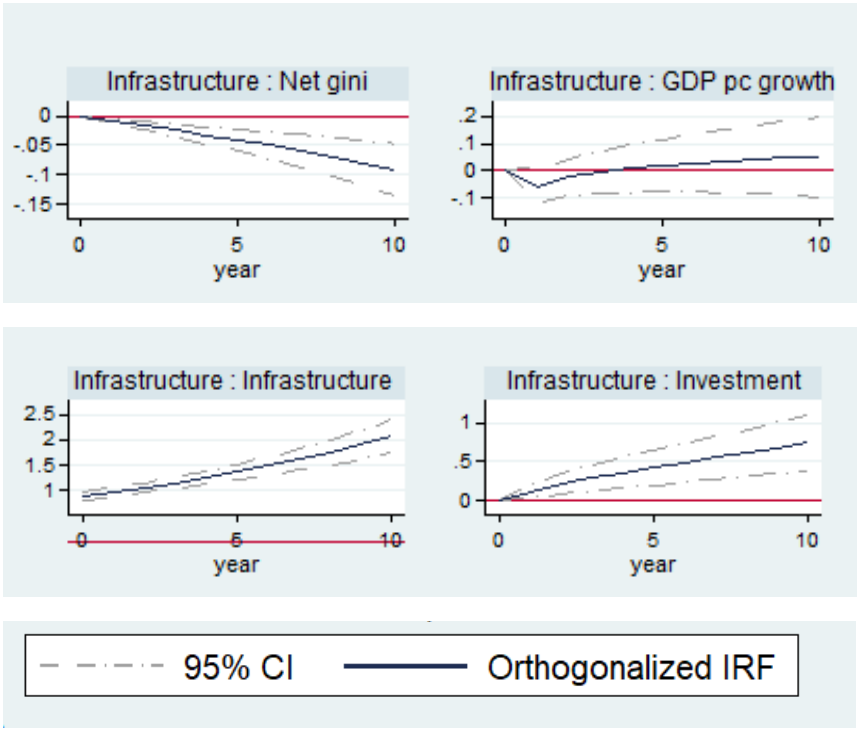


Figure 11 Impulse response functions – infrastructure

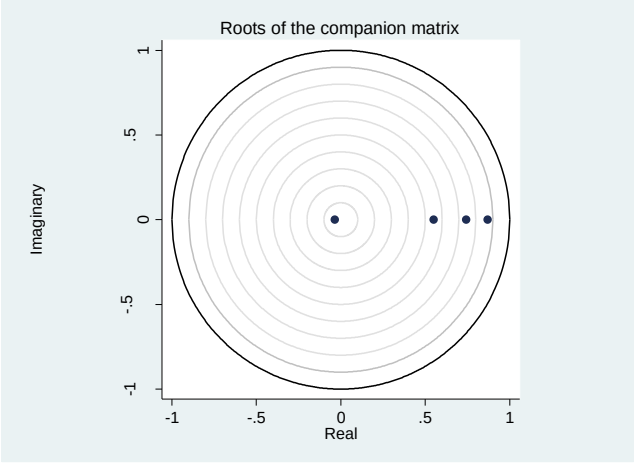


Annex 2: Stability test

Model 1: with education

Eigenvalue		
Real	Imaginary	Modulus
.8695113	0	.8695113
.7425849	0	.7425849
.5494624	0	.5494624
.0364844	0	.0364844

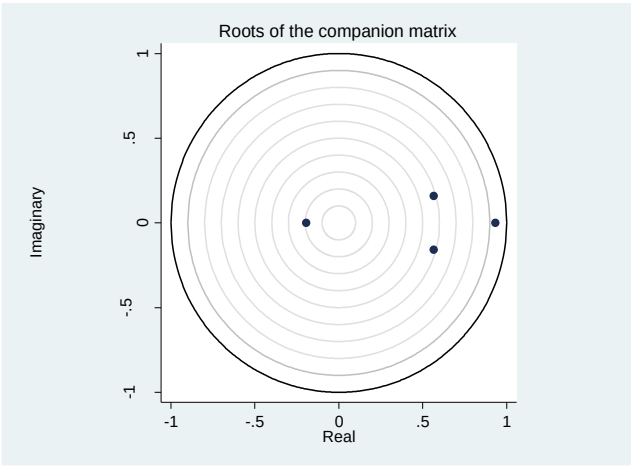
All the eigenvalues lie inside the unit circle.
Panel VAR satisfies stability condition.



Model 2: with health

Eigenvalue		
Real	Imaginary	Modulus
.933654	0	.933654
.5644591	.158592	.5863151
.5644591	-.158592	.5863151
.1943048	0	.1943048

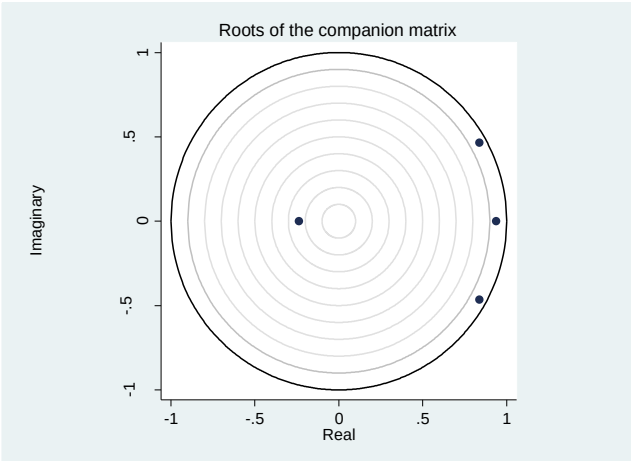
All the eigenvalues lie inside the unit circle.
Panel VAR satisfies stability condition.



Model 3: with infrastructure

Eigenvalue		
Real	Imaginary	Modulus
.8378146	.4656283	.9585109
.8378146	-.4656283	.9585109
.9381855	0	.9381855
.2383254	0	.2383254

All the eigenvalues lie inside the unit circle.
Panel VAR satisfies stability condit



Robustness 2

Figure 12: Education

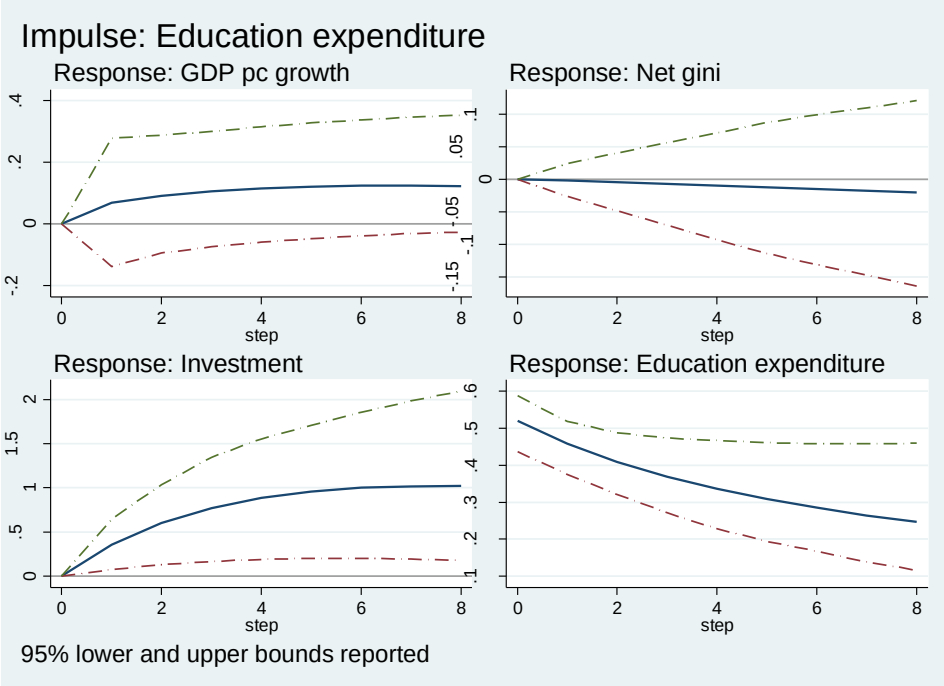


Figure 13: Health

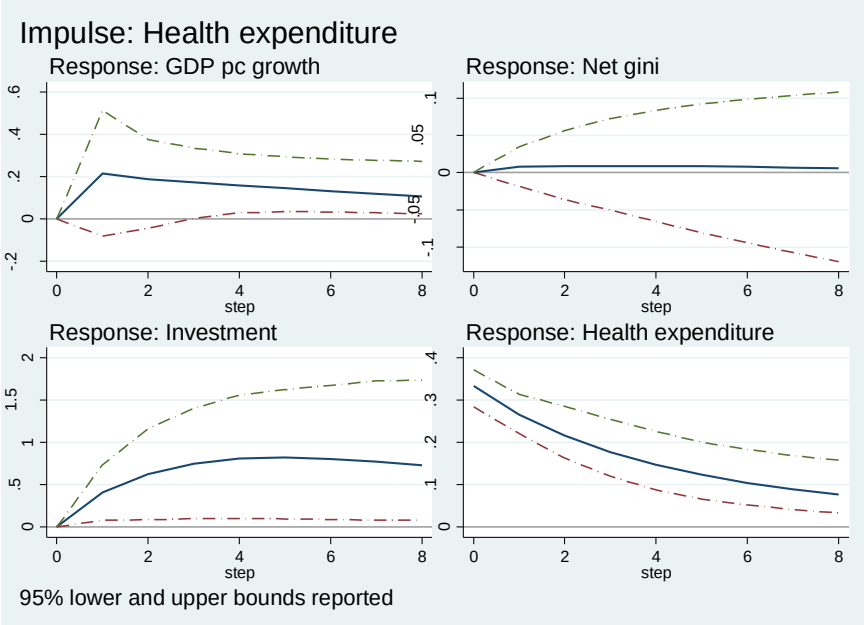


Figure 14: Infrastructure

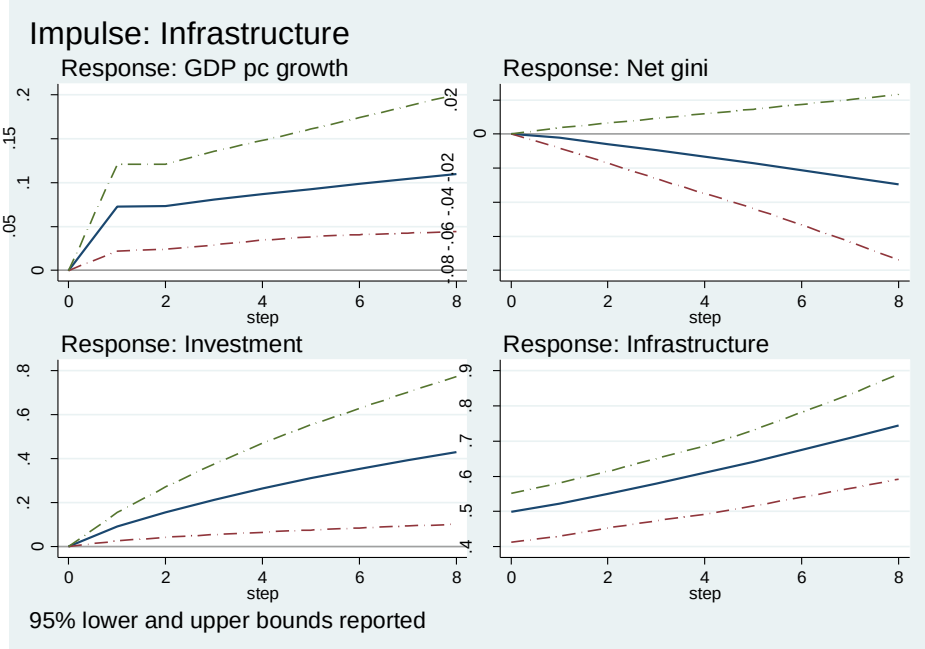


Table 7: Variance decomposition analysis using PVAR estimator

Variation in the row variable explained by column variable (in %, 10 periods ahead)				
Model 1 (Education)				
	GDPpc growth	Net Gini	Investment	Education spending
GDPpc growth	88.35	0.53	10.0	1.12
Net Gini	0.96	93.46	1.64	3.94
Investment	0.56	3.70	77.12	18.62
Education spending	4.87	1.03	2.66	91.44
Model 2 (Health)				
	GDPpc growth	Net Gini	Investment	Health spending
GDPpc growth	86.26	3.50	5.73	4.51
Net Gini	4.37	67.76	16.51	11.36
Investment	0.63	3.42	89.48	6.48
Health spending	4.37	30.72	41.81	23.09
Model 3 (Infrastructure)				
	GDPpc growth	Net Gini	Investment	Infrastructure
GDPpc growth	80.13	2.03	16.48	1.36
Net Gini	10.48	27.07	46.59	15.86
Investment	0.66	1.55	95.52	2.27
Infrastructure	10.24	18.18	37.66	33.92

Countries

Côte d'Ivoire	Mali
Ghana	Mauritania
Guinea	Niger
Madagascar	Senegal
Malawi	Zambia