Rural Financing, Infrastructural Investment and Agricultural Productivity: any hope for Poverty Reduction in Africa?

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Abstract
Poverty is the root cause of hunger which in turn causes malnutrition, low productivity and low income, leading to a phenomenon called 'vicious circle of poverty and hunger', which is a common feature associated with African countries. A breakaway out of this circle is to improve agricultural productivity of the continent via infrastructural investment. The preoccupation of this paper, therefore, is to provide a link between rural financing, infrastructural investment, agricultural productivity and income inequality in some selected African countries. The Generalized least square (GLS) estimation technique is adopted to analyse the panel data drawn from secondary sources. The analysis reveals that electricity per capita and health expenditure which are proxy for infrastructural investment have significant impact on agricultural output. The policy implication that emanates from this study highlights the need for the various African States to improve on its electricity generation so as to meet the increasing demand of the growing population and also increase the percentage of health expenditure to GDP in order to improve the health sector.

Introduction

The term "Poverty" is not an easy concept we can tag a single definition to. Its ambiguity has raised many definitions from both economics and non-economic scholar. An excerpt from Todaro and Smith (2012), gave some striking definitions of the concept of poverty as opined in the voice of the poor below:

"When one is poor, she has no say in public, she feels inferior. She has no food, so there is famine in her house; no clothing, and no progress in her family", said a poor woman from Uganda.

"Don't ask me what poverty is because you have met it outside my house. Look at the house and count the number of holes. Look at the utensils and the clothes I am wearing. Look at everything and write what you see. What you see is poverty", said a poor man in Kenya.

"When food was in abundance, relatives used to share it. These days of hunger, however, not even relatives would help you by giving you some food", said a young man from Nichimishi, Zambia.

In recent years, many approaches have defined poverty in a more multidimensional way. These approaches include the capabilities approach (Sen, 1999), the human development approach (UNDP, 1990) and the basic needs approach (Streeton, 1981). Their acceptance is reflected in the use of the United Nations Development Program's (UND) Human Development Index (HDI), which is a composite measure of three dimensions of human developments: (i) educational attainment, (ii) life expectancy and (iii) standard of living, measured by income in terms of its purchasing power parity (UNDP, 2006).

Hunger, a twin of poverty, does not necessarily mean the absence or shortage of food supply. This is because there can be plenty of food and people will still be hungry. Hence, poverty is the root cause of hunger which in turn causes malnutrition, low productivity, and low income, leading to a phenomenon called 'vicious circle of poverty and hunger', which is a common feature associated with African countries. Poverty is still one of the major problems facing the rural dwellers. Globally about 1.2 billion people live on less than US$1.25 a day. About 870 million people suffer from hunger, and 76% of the World's very poor people live in rural areas. Most of them are excluded from the

formal financial services (FAO, 2013). The slow pace of poverty and hunger reduction points to an urgent need for strategies that better target the areas where poor people live and the activities on which their lives depend. A successful strategy for alleviating poverty and hunger in Africa must begin by recognizing that they are mainly rural phenomena and that agriculture is at the heart of the livelihoods of rural people.

In Africa, agriculture is the principal driving force for the rural sector, especially those countries without substantial mineral resources. Dependence on agriculture for economic growth and export earnings increases with the prevalence of hunger, and so does the proportion of people whose lives depend on the rural economy. Hunger and poverty reduction require that the incomes of poor people and the sources from which they derive their livelihoods be enhanced. Therefore, pro-poor income growth needs to be encouraged. This means that income growth originating in agricultural development will reduce poverty, provided that it does not occur in a context of high inequality in asset ownership.

Health is one of the major components of physical, social and mental well-being and remains one of the primary concerns of well-being. Good health is a crucial element of human development. Health is one main cause of poor performance of people in the agricultural sector in Africa. Therefore the health sector requires huge capital expenditure budgets (health facilities, training, medical equipment, etc.) and operating expenditure (remuneration of medical staff, drug purchase expenditure, etc.). It therefore seems that there is the need to increase the total expenditure given the rapid population growth in Africa. This is achieved with difficulty insofar as the share of total health expenditure as a percentage of GDP has remained below 6 percent since 1995 in all African regions with the exception of Southern Africa (FAO, 2014).

The preoccupation of this paper, therefore, is to provide link between rural financing, infrastructural investment, agricultural productivity and income inequality in some selected African countries. The specific objectives are; (i) to examine the impact of rural financing and infrastructural investment on agricultural productivity; (ii) to investigate the effect of agricultural productivity on income inequality.

Rural financing, Agricultural productivity and Infrastructural investment in Africa

In the 1960s, following the incidence of market failure, subsidized agricultural credit programs were popularized as a way to correct the market failures thought to be the cause for the small amount of credit allocated to agriculture. These programs usually set interest rate ceilings that undermined the health of the financial institutions delivering credit. Eventually this rather naïve supply-lending approach was largely declared a failure so by the 1980s, government failure replaced market failure as the fundamental problem (Adams et al., 1984). This fundamental problem gave birth to a new approach known as the financial system paradigm, which encompassed financial institutions, markets and instruments, the legal regulatory environment, and financial norms and behavior. The approach argued for relaxation of interest rate controls and developments at the micro, meso and macro levels. These views conveniently coincided with the emergence of microfinance that supplied small, usually non-collateralized, relatively high interest rate loans to the poor who lacked collateral required by banks.

Agricultural productivity is central to the lives of most Africans. Two-thirds of the population of sub-Saharan Africa is rural, and the FAO counts nearly half of sub-Saharan Africa's rural population as "economically active" in agriculture. For some countries, such as Burundi, Rwanda, Uganda and Burkina Faso, the rural population share approaches 85-90%, with 45-50% the total population counted as economically active in agriculture. Even among the most urbanized countries of sub-Saharan Africa, such as South Africa, one-third of the population remains rural. In addition, up to 80% of Africa's poor live in rural areas, nearly all of whom work primarily in agriculture (World Bank, 2000). For these producer groups, agricultural productivity is the key determinant of welfare, and agricultural productivity growth is the key hope for poverty reduction (at least in the short- to medium-term). Non-farm rural employment, too, is often closely linked to agriculture - either directly (as in the marketing of agricultural inputs and outputs), or indirectly (as in the provision of other services in rural markets). The indirect benefits of agricultural productivity growth, in the form of lower food prices, are also critical to the welfare of Africa's rapidly expanding urban populations, the poorest of whom devote 60-70% of total expenditures to food (Sahn, et. al., 1997).

Agriculture accounted for about 15 percent of Africa's GDP. This, notwithstanding, there is a wide variation in the share of GDP among African countries. For instance, the African Economic Outlook 2012 (AfDB et al, 2012) reported that agriculture contributed more than 72 percent to Liberia's GDP and other countries with high dependence on agriculture including Sierra Leone (61.5 percent), Central African Republic (55.2 percent), Comoros (44.9 percent), Nigeria (40 percent) and Democratic Republic of Congo (39.4 percent). On the other hand, the sector's contributions to GDP in some other countries are minimal, such as Equatorial Guinea (2.4 percent), Gabon (5.4 percent), Tunisia (8.9 percent), Namibia (9.4 percent) and Algeria (9.7 percent). In other words, the share of agriculture GDP is much higher in relatively poor countries, and thus, the sector is more critical for those countries in the context of inclusive growth.

From a macroeconomic perspective, as well, agriculture continues to play a central role in sub-Saharan Africa, accounting for 15% of total value added (20%, excluding South Africa). Of course, every generalization about sub-Saharan Africa and masks the region's vast heterogeneity. In Liberia, for example, agriculture accounts for 66% of total value added, while in other countries, such as oil-rich Angola, agriculture accounts for only 10% of the value added (World Bank, 2010).

A major determinant of agricultural productivity growth is infrastructure. This is evidenced - by the fact that AfDB tagged one of the pillars of its 2008-2012 - Medium Term Strategy is infrastructure. In addition to other factors such as human capita credit markets, extension services and technological research, the presence of reliable infrastructure increases both output per capita and output per unit of land. It is therefore a key contributor to productivity, mainly by reducing transaction costs in input and output markets, as well as better integrating markets within sub-regions. Three key areas of infrastructure that should be given attention are: (1) road networks; (2) irrigation technology; (3) post-harvest storage technology - as these all have a direct impact in boosting agricultural productivity. Other types of infrastructure (e.g. telecommunications and electricity supply) also play a major role, but their impact is more evenly dispersed across all sectors, less specifically targeting agriculture (AfDB, 2011a).

According to the Rural Accessibility Index, only 34% of the African rural population lives within two kilometers of rural roads,

compared to 90 percent in East Asia and the Pacific countries (fifty nine percent of rural populations in Latin America have this type of access as well) (World Bank, 2007).The Africa Infrastructure Country Diagnostic (AICD) estimates that 39 million hectares of agricultural land in Africa is physically suitable for irrigation purposes. In addition, the CAADP notes that "in Africa, the percentage of arable land that is irrigated is seven percent (barely 3.7 percent in SSA), whereas percentages for South America, the East and South-East Asia and South Asia being 10 percent, 29 percent and 41 percent respectively". In the area of telecommunication, Africa is making positive progress. In 2000, the continent had 11 million mobile cellular subscriptions and three million internet users. By the end of 2008, there were 32 million internet users, and 246 million mobile cellular subscriptions. The annual growth between 2003 and 2014 in both services in Africa has been in double digit rates, reaching a penetration rate of close to 41% (ITU, 2016). The total number of mobile-broadband subscriptions is expected to reach 3.6 billion by the end of 2016 (ITU, 2016).

Review of Related Studies

There is consistent evidence that agriculture-induced growth has the potential to deliver significantly greater positive impact on poverty reduction than growth based on other sectors (de Janvry and Saddoulet, 1996; Gallup et al, 1997; Timmer, 1997; Bourguignon and Morrisson, 1998; Thirtle et al, 2003; DFID, World Bank, 2005; Salami et al, 2010).

Thirtle et al (2003), in their study on the impact of agricultural productivity growth on poverty reduction, discovered that a percentage increase in agricultural yields reduces the number of poor people by 0.72 percent in Africa, far above 0.48 percent in Asia.

Gallup et al. (1997), in a cross-country examination of the relationship between growth and poverty, revealed that a 1 percent growth in per capita agricultural GDP resulted in 1.61 percent growth in the incomes of the poorest 20 percent of the population. They noted that similar increases in the manufacturing or service sectors contributed to much less impact on poverty reduction.

The strong linkages between agriculture and poverty reduction were further confirmed by Ligonand Sadoulet (2007) and magnified in the World Bank's World Development Report (2008). Specifically, Ligon and Sadoulet (2007) found that a one-percent increase in GDP due to agriculture results in a more than 6% increase in expenditure

growth for the poorest decile, with a significantly disproportionate effect on expenditure growth for all but the top two expenditure deciles. Conversely, non-agricultural income growth is disproportionately beneficial for the upper expenditure deciles, but has no significant effect on expenditure growth for households in the bottom 30 percent of the expenditure distribution.

According to IFPRI data, during the decade of 2000-2010, Africa's annual total GDP growth grew by an average of 4.8% compared, to 2.1% in the previous decade (1990-1999). The agricultural sector's annual GDP growth rates were 3.2% and 3.0%, respectively for the two decades. Although agriculture grew at a moderate rate, this growth has contributed to significant reductions in poverty in many African countries. As noted above, however, there is a long way before benefits of growth reach the majority of the rural poor. Agriculture-induced growth is paramount for inclusivity because it assists to ensure that most of the rural poor receive a share of the benefits of growth. By raising rural incomes and promoting the purchasing power of smallholder farmers, agriculture could maintain equitable and comprehensive growth and contribute to sustainable reduction of poverty in Africa (Benedict et al, 2014).

Fan, Hazell and Thorat (2000), carried out a research in India, considering the effect of infrastructure on agricultural productivity. They concluded that government expenditure on rural roads and agricultural research and extension promote greatest growth in agricultural productivity, while additional government spending on rural electrification has low productivity effects.

Fan, Jitsuchon and Methakunnavut (2004), pointed out that investment in rural electrification have the second largest impact on agricultural productivity growth after agricultural research and development in Thailand.

According to Fakayode et al. (2008), efficient infrastructure is considered indispensable to agricultural progress as it is certain that infrastructure reduce poverty, enhance economic growth and make development environmentally sustainable.

According to PCU-NFDO (2005), infrastructure such as transportation networks, electricity, safe water, and good health center play key role in promoting development. Improvement in any of these infrastructures increases the efficiency of production and contributes to standards of living.

Ahmed and Rustagi (1987) pointed out that rural infrastructure plays a crucial role in poverty reduction, economic growth and empowerment for the African rural poor.

According to Lipton (1977), since the rural areas majorly characterized by poor people and the source of income of these people are from their labour, it has often been argued that agricultural growth based on the introduction of labour-intensive technologies is very key in the fight against poverty in developing countries.

From the available literature, it is obvious that increase and improvement in rural infrastructure have the potential to enhance agricultural productivity, which will further lead to poverty reduction in the continent.

Data Sources and Model Specification
Choice of Variable and Data Sources

The data used in this analysis are annual time series on Gini coefficient (GINI) as a measure for income inequality; agricultural output (AO) as a measure of agricultural productivity; international bank for reconstruction and development loan (IBRDL) as a measure of rural financing; and infrastructural investment measured by health expenditure (HEXP) and electricity per capita (EPC) of ten African countries namely: Nigeria, Senegal, Kenya, Botswana, Ghana, South Africa, Gabon, Angola, Cote D'Ivoire and Ethiopia during the period of 2000 to 2015. All data are obtained from World Bank's World Development Indicators, 2016.

Model Specification

In order to analyze the objective of this paper, two models are used to capture the relationship that exists among the variables. The functional form of the model is specified as follow:

$$AO = f(IBRDL, AE, HEXP) \qquad (1a)$$
$$GINI = f(AO) \qquad (1b)$$

The mathematical log linear form is specified as follows:

$$LogAO_{it} = \beta_{0i} + \beta1iLogIBRDLit + \beta_{2i}LogEPC_{it} + \beta_{3i}LogHEXP_{it} + \varepsilon_{it} \qquad (2a)$$

$$LogGINII_{it} = \alpha_{0i} + \alpha_{1i}LogAO_{it} + \varepsilon_{it} \qquad (2b)$$

Where,

$GINI_{it}$ = Gini coefficient of countries at time t

$IBRDL[1]_{it}$= International bank for reconstruction and development loan of countries at time t
AO_{it} = Agricultural output of countries at time t
EPC_{it} = Electricity per capita of countries at time t
$HEXP_{it}$ = Health expenditure per capita of countries at time t
ε_{it} = Error term at time t
Log = Logarithm
t = 1, …, 15
i = 1,…, 10

Estimation Techniques and Procedures

The method of analysis is basically time series econometric. The Generalized least square (GLS) estimation technique is adopted in this study. Panel data analysis will be employed to estimate the models. Many studies (e.g. Rockoff (2004); Gallagher and Frith (2003)) have found that panel-based tests have higher power than tests based on individual series.

To determine whether a long run relationship exists between the dependent variable and the explanatory variables, Pedroni (1999, 2004) cointegration test was conducted.

In order to determine the presence of a unit root in individual country specific data, a standard Augmented Dickey Fuller (ADF) and Philip-Perron Tests are employed.

For a panel unit root, Levin, Lin and Chu (2002) and IPS (2003) tests were conducted. Both the panel tests include a constant and a heterogeneous time trend in their specifications. The series are generated by an I(1) process. Cointegration tests for all the sample individual countries are performed by using Johansen and Juselius (1990) method and for the panel by using the Pedroni (1999, 2004) procedure. In this context, Pedroni (2004) panel cointegration test has the advantage that it allows for heterogeneity across countries.

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[1]IBRDL: IBRD provides loans to middle and low income countries. Due to the unavailability of data on rural financing from most of the African countries used in this study, we used IBRD loan as a proxy for rural financing.

Result and Discussion
Panel Unit Root Test

A prerequisite for implementing the Pedroni (2004) panel cointegration test is to establish that the variables are stationary. The results of the tests for unit roots (stationarity tests) are summarized in Table no. 1.

Table no. 1. Summary of Panel Unit Root Test Result

METHOD/ VARIABLE	GINI	AO	IBRDL	EPC	HEXP
LLC	-5.25723 (0.0000)*	-7.89752 (0.0000)*	-4.42938 (0.0000)*	-6.66200 (0.0000)*	-3.64322 (0.0000)*
IPS	-3.99803 (0.0000)*	-4.89316 (0.0810)	-3.13202 (0.0009)*	-5.28300 (0.0000)*	-4.41718 (0.0000)*
ADF-Fisher Chi Square	30.5236 (0.0002)*	61.3760 (0.0000)*	42.1978 (0.0026)*	65.3302 (0.0000)*	58.1996 (0.0000)*
PP-Fisher Chi Square	48.2454 (0.0000)*	65.6266 (0.0000)*	66.9880 (0.0000)*	129.927 (0.0000)*	130.596 (0.0000)*

Source: Computed by the author from E-views 8

Notes: LLC= Levin, Lin and Chu (2002), IPS = Im, Peseran and Shin (2003).
* denotes the rejection of the null hypothesis at 5% significance level.
Probabilities are in brackets. The probabilities for Fisher tests are computed using asymptotic Chi Square distribution. All other tests assume asymptotic normality.

Panel Cointegration Test

Having established that the variables are stationary at first difference, I(1), the study proceeds to test whether there is a long run relationship among the variables. The Pedroni (2004) heterogeneous panel cointegration test is used. The results for the seven different panel test statistics suggested by Pedroni are reported in Table no. 2

Table no. 2. Summary of Pedroni Residual Cointegration Result

METHOD	STATISTICS	PROBABILITIES
Panel V Statistics	0.058107	0.4768
Panel rho Statistics	1.857463	0.9684
Panel PP Statistics	-1.878951	0.0301*
Panel ADF	-2.572405	0.0050*

Statistics		
Group rho Statistics	3.250040	0.9994
Group PP Statistics	-2.678554	0.0037*
Group ADF Statistics	-2.634857	0.0042*

Source: Computed by the author from E-views 8

* denotes the rejection of the null hypothesis at 5% significance level.

Estimation

The result of the estimation for model (2a) is given in Table no. 3 (a) below.

Table no. 3(a). Model (2a) Estimation

Dependent Variable: (AO)

Variable	Pooled	Fixed Effect Model (FEM)	Random Effect Model (REM)
EPC	-2.231008(0.0000)	1.485404(0.0000)*	1.156176(0.0000)
HEXP	2.635311(0.0000)	1.154502(0.0000)*	1.232429(0.0000)
IBRDL	0.310740(0.0043)	0.057361(0.0854)	0.059175(0.0755)
C	18.69689(0.0000)	10.64767(0.0000)	12.04808(0.0000)
R^2	0.368417	0.981695	0.632226
F-stat	30.33283	656.9588	89.39115
Hausman Test	30.406101(0.0000*)		

Source: Computed by the author from E-views 8

*denotes the rejection of the null hypothesis at 5% significance level.

The result of the estimation for model (2b) is given in Table no. 3(b)

Table 3(b): Model (2b) Estimation

Dependent Variable: (GINI)

Variable	Pooled	Fixed Effect Model (FEM)	Random Effect Model (REM)
AO	0.033616(0.0000)	0.008741(0.1721)*	0.006134(0.0328)
C	4.655883(0.0000)	3.554143(0.0000)	3.621948(0.0000)
R²	0.006116	0.944145	0.006116
F-stat	32.72935	251.8627	0.972246
Hausman Test	2.896482(0.0888)		

Source: Computed by the author from E-views 8

denotes the rejection of the null hypothesis at 5% significance level.

In Table no. 3(a) and 3(b), the pooled effect model was not adopted. This is because it fails to take into cognizance of either the individual characteristics or time characteristics of the countries selected (Heterogeneity).

In Table (3a), electricity per capita (EPC) and health expenditure per capita have positive relationship with agricultural output (AO) and also were both significant. 37% variation in AO can best be explained by the explanatory variable adopted. The choice for model interpretation was based on the Hausman test done which suggests that Fixed Effect Model is good fit as compared to random effect model. This is because the Hausman test p-value is less than 5%. On a close examination, IBRDL was found to be insignificant. The puzzle then is: can we say that the loans given are not properly used for the purpose it was meant for? Or can we say that in the various countries examined, there is a bottleneck in the access to these loans?

In Table (3b), AO has a positive relationship with GINI and also it is statistically significant. The choice for model interpretation was based on the Hausman test done which suggests that Random Effect Model is good fit as compared to fixed effect model. This is because the Hausman test p-value is greater than 5%. On a closer examination, the positive relationship between AO and GINI which indicate that a percent increase in AO will lead to a 6% increase in GINI hence, creating a wider inequality gap. The puzzle then is: can we say that the growth in agricultural output is not an inclusive-led growth?

Conclusions and policy recommendation

Going by the current African and international development agenda as captured by the first and second goals (ending poverty and overcoming hunger and food insecurity permanently), in the Sustainable Development Goals (SDGs) endorsed in September 2015 by the UN member States; in consonance with one of the 'High 5' priorities of the African Development Bank (AfDB), that is 'Feed Africa' priority, the bank aims to frame its agricultural operations within a business-oriented approach and improve food security in the continent; the right of all Africans to be well-nourished and live healthy and productive lives as stressed by the African Union Agenda 2063; and the call for a structural transformation of African agriculture as a pathway to growth and poverty eradication in the continent, as sited in the Comprehensive Africa Agricultural Development Programme (CAADP), as well as the June 2014 Malabo declaration, it became so paramount that an Agro-allied industrialization led growth is the pathway to achieving the various goals for the African continent. This gave birth to this current study.

The empirical findings that emanate from this study highlight various key policies that will be of importance to the various developmental institutions as well as individual government in the continent. First, the foundation for achieving an agro-allied industrialization led growth rest on the strength of the power sector. This can be deduce from the significant impact of electricity per capita on agricultural output in Table 3(a), above. Hence, there is need for the various States in the continent to improve on its electricity generation so as to meet the increasing demand of the growing populace. Policies that will attract foreign private investment should be encouraged since foreign investment capital is a vehicle for industrial growth in any developing country.

Second, the significant impact of health expenditure to agricultural output shows that government should increase the percentage of health expenditure to GDP in order to improve the health sector. Government should encourage public-private partnership in order to improve infrastructural investment in health facilities across the country.

In conclusion, government should ensure that significant fractions of the loans from International Bank for Reconstruction and Development (IBRD) should be channelled towards project that will

help boost agricultural productivity in Africa. Proper enlightenment and awareness should be given to the general public on how to get the available loans for agricultural-based investment. Monitoring teams should be set up for proper supervision of how these loans are spent by the recipient.

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