Contribution of Infrastructure to Economic Growth in Africa

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Abstract: *Africa is a continent endowed with many resources but lags behind in development compared to other continents. The development of rural sector (agricultural sector) and raise more people from absolute poverty is a one of the first goals of most countries. Another goal is to change the countries from being agricultural led economy to be industrial led economies. In order to reach these goals there are many prerequisites that have to be in place. These prerequisites might not be the same as the ones that other developed countries needed during the time of their economic transformations due to cultural difference, globalization and historical difference. One of the important prerequisites to achieve industrial revolution is theavailability of physical infrastructure to move resources, labour and end products across different points and places. It is evident through the rule of thumb that if industrial performance exceeds infrastructure capacity to carry the industries there shall be a jam in the economy which hasnegative impact in the society. Many African countries have very poor physical infrastructure. The story behind the research question explains that African economies are emerging economies and in most cases they lack necessary infrastructure such as all-weather roads. This is a bottleneck to economic growth.*

Keywords:*Africa,rural sector, industrial led economies, physical infrastructure, Globalization.*

JEL Codes*: B23, H54, I25, O18*

I.   Introduction

Achieving high economic growth has been a goal of the African continent since Independence in order to enable them to lift population from poverty. This ambition however has been facing various bottlenecks such that despite time and global advancement in economy and technology Africa has been lagging behind the achievement. It is therefore necessary to raise a question why other countries develop whereas Africa is still lagging behind. In order to achieve high economic growth various factors have to be m place. Mam factors for developing a nation include natural resources,human resource, capital formation and technological progress. The impact of each of these factors is very significant to economic growth of any country. It is important therefore to examine these factors and identify the main limiting factors and find solution therefore.

African countries are just at the emerging economies stage. Agriculture and natural resources have been the backbone of most African economies independence. These countries have been going under various reforms to but the reforms has not been able to ensure high growth over time. It is Important to analyse the key issues that hate been keeping Africa at this lower stage for years to move to the next level development It is well known that African countries are endowed with many natural resources', have a big population and currently have many educated people personnel in various fields. There therefore remain two main obstacles which are capital formation and technological progress.

Since the majority of African population is employed in agriculture sector. 1t is Important therefore to analyse the limitation of this sector as the limitation of economic development' given that the African land is fertile for agriculture and rich in mineraland other natural resources it is therefore logic to identify the missing link thereby. As it had been explained earlier that capital formation and technological progress are lagging behind in Africa compared to other countries. This can be expressed through the physical Infrastructure that explains both available capital and level of technology in a country. Physical infrastructure includes transportation infrastructure. Communication, power supply, water,irrigation and sanitation among others.

Since efficiency of infrastructure increases production, poor infrastructure will slow down production. Lack of efficient Infrastructure leads to less production in the rural areas (Including agriculture sector). Poor agricultural sector leads to rural urban migration, poor Infrastructure in the urban areas leads to unemployment and poor living condition in the towns and cities. Since the migration was not due to technological progress there will be lesser production in the agricultural sector since the man power has declined because of the movement to urban areas

II.   Physical Infrastructure in Africa

Africa is a continent that lags behind in development compared to other continents of the world. Sub-Saharan Africa refers to African countries that are south of the Sahara. This pan of Africa is the one that is typically lagging behind development proved by various indicators. According to the World Bank data (2014) ". Sub-Saharan Africa has a population of about 973.4 million people of which 37% is the urban population and "nth a GDP of about SL728 making per capital income to be $|775.22 billion Despite that Sub-Saharan Africa is endowed With many different kind of natural resources African economic growth has faced inside and outside economic bottlenecks that have hindered It to experience various economic shins are occurring In other parts of the world.".

This article endeavours to integrate the linkage between development and infrastructure growth in Africa by introducing the infrastructure situation of the many African countries. In the next two paragraphs the infrastructures has been explained to highlight the economy and infrastructure situation of African countries so as to understand the continent better. In justifying the choice of the respective countries, the paper argues that the two countries represent the Situation of the larger Sub-Saharan Africa. Some of the Sub-Saharan African countries have been in political unrests for a long time and some have not. Choosing these two countries W1" represent these two names, South Sudan not only being a new nation but also a new nation that has been birth from serous political unrests for decades (although the country experienced peace for two years and now is at war again) and Tanzania being a country that represent countries that hate experienced peace for a long time.

III.   Types of Physical Infrastructure in Africa

Physical infrastructure will be explained in five main areas; Transport, Information and Communication Technology. Irrigation, Power Supply and Water Supply and Sanitation. in one way or another African economies are faced with infrastructure problem and this problem makes most of the countries not to experience the inflow of FDI and tourism as other developing counties such as the East Asian countries that shares almost the same beginning with Africa.

IV.   Types of Physical Infrastructures and Their influence to Economic Growth

Young E. (20l2)" found that in 2012, there were over 800 active infrastructure projects across different sectors in Africa, with a combined value in excess of US$700b. The large majority of the total infrastructure projects were related to power (37%) and transport (41%). This information however includes countries like South Africa and Northern Africa countries which have bigger budgets. Once this information is directed to the other Sub-Saharan countries the figures could be lower. However, despite the average time for the completion of these projects has not been explained. According to World Bank database shows that in 2007 African infrastmcture (transportation, storage and communication) was valued at 81.7 billion dollars whereas Sub-Saharan Africa excluding South Africa and Nigeria had their infrastructure valued at 262 billion dollars. From this it can be seen that the difference between African infrastructure as a whole and African infrastructure excluding South Africa and Nigeria is very Significant. Predictively, from a US$700 billion Sub Saharan countries may contain only US$200 billion, considering that these countries make around two third of the African continent the amount assigned to develop infrastructure is therefore very small. Some of these projects are expected to take place for three, four or more years.

The finances therefore assigned to the development of infrastmcture sector in Africa are not promising. The rapid rising population is another threat to infrastructure development in Africa. And therefore quick measures are to be put to generate and help allocate more funds to infrastructure sector particularly transportation. African cities suffer from heavy traffic due to narrow roads available in these cities and lack of long term planning. In Dares Salaam (Tanzania) road trellis causes a loss of approximately USD$220 million infrastructure n per year".

This amount could be directed in development sectors and bring a significant change. Transportation infrastructure in Sub-Saharan Africa is a challenge in both rural and urban areas. Most of rural areas are faced with lack of transport infrastructure to as far as lack of basic transportation whereas urban areas face a congestion of cats and passengers due to narrowness of the road system which are the main transportation system.

V.   The Need of Physical infrastructures

Most of African countries are interested in changing their economics from being agricultural led economies to industrial led economies. Most of these countries seem to be interested in the development of East Asian countries particularly China. Before initiating the move or the shift of the economy to industrial led economy it is important to appreciate the gap that exists between these two economies. Once the gap is ignored it's either that the economies of the concerned countries will fail to move to the industrial led economy, the move might be successful with very high externalities within the process or experience it at the new industrial led economy.

It is necessary therefore to analyze the reality whether infrastructure is thus important in African economy or in other words to analyze the magnitude of the importance of infrastructure and realize the urgency thereby so as to provide suggestions on what should be done. External investors that's, FD] that Africa is also highly looking {onward to receive to bring about changes in the pattern of development and economic structure of the continent are not actually planning to invest in infrastructure. Although investors have typically favored natural resource assets, there has been a substantial shift away from the extractive industries and the continent is seeing growing investment in other sector. The top three sectors are technology. Media and telecoms, accounting for over 50% of FDI projects for the reported year up to 20l4".

This paper is trying to analyze the importance of infrastructure in general using regression to see its contribution to economic grow1h but also tries not see how infrastructure is linked to economic development in a country. Thus how infrastructure apart from being linked to economic sectors that will boost growth how also in qualitative way infrastructure is linked to development sectors to bring about economic development. Example, one of the significant {attires happening in most African countries is nuts] urban migration. Rural-urban migration has become an issue in most of the African countries. People move to cities and towns in search of employment, social needs like education and health and others due to peer pressure.

VI.   The Role of Physical Infrastructure

Infrastructure plays a role as in linking various aspects of development as follows: Infrastructure role as a link between rural and urban development. Development of infrastructure l0 reach the rural areas is an important act to be executed to hit and improve life in both areas. The crucial assumption to be made in our model is that rural-urban migration will continue so long as the expected urban real Income at the margin exceeds real agricultural product i.e. prospective rural migrants behave as maximums of expected utility". Infrastructure can play a role in filling this gap that is ensuring a balanced development in rural areas the various causes of rural-urban migration can easily be tackled or at least the magnitude effects reduced by improved infrastructure Transportation. Communication and irrigation infrastructure serves as key infrastructure projects to reduce these problems causing the migration. Once transportation has been improved it will be easy for the farmers to transport their produce to urban areas where the big market is. Around 50 percent of the Afncan population is employed in agriculture sector this means around 50 percent of the population is still living in the rural areas. Once transport Infrastructure in the rural areas is insufficient then overproduction will be common and result to serious loss of produced crops 0n the other hand if storage infrastructure is likewise poor then most of the food crops would be destroyed before time.

In Tanzania, many rural areas suffer from poor storage infrastructure when it comes to food crops such as Yams. Cassava and potatoes. Likewise when it comes to fruits, many fruits are seasonal and in their season the supply exceeds demand, prices drop significantly making them worthless. In district in Tanzania on average, good mango fruit is sold for 200 TZS in non-mango harvesting season whereas the same mango is sold SOTZS in mango harvesting season. The price, however, is way lower than that. since is what available in the market but in real sense people no longer buy mangoes as they are everywhere in their homes and no one to buy (a writer has a taken this data from observation from the area).

Effective transportation and storage infrastructure could solve this problem. Importance of infrastructure to reach rural areas would also improve the living standards and the availability of food in urban areas. This may happen in two ways, first is that improvement in infrastructure would ensure the low and stable price of food which means that high food price does not cause inflation in the country. Once the infrastructure is constructed to link these two areas and prices are in balance in the toe areas then the income gap highly be reduced in the two areas and therefore reduce the rural-urban migration.

FAO (2003) explained that "Agricultural production in these countries takes place in mm] areas that are frequently deficit in physical infrastructure. Hence foreign sources of competition may face low transport costs while domestic producers in low-income countries may face high transport costs. Such costs are reduced by investment in physical infrastructure most notably roads. But also communications. "The second is the availability of food itself as a necessity will improve the living conditions. Transport infrastructure to rural areas. That is,to connect rural areas to urban areas will bring mutual benefit to both rural and urban areas. Harris JR. and Todaro M.P explain in their empirical research that "it has been shown that either a limited "ape subsidy or a migration.

VII.   Methodology

The Solow Growth Model

It develops its analysis from a Solow model developed to a Cobb-Douglas function of aggregate constant returns to scale production function. Introducing the Solow growth model, the model shows the evolution of income and consumption per worker in a country are affected by structural parameters such as the countries rate of savings and investment and the rate of growth of its population. The model also explains how capital stock will increase in any two successive periods as a result of changes in the difference between gross investment and depreciation of capital stock that has already been invested in the country The model explains GDP (Y) a as a function of total factor productivity (A), physical capital (K). Human capital (H), and labor (L) ".ln considering a Solow model with human capital they provided the following model;

$$Y_t = K_t^\alpha H_t^\beta (A, L)_t^{1-\alpha-\beta}$$

According to the theory, if we consider that K, H and L have constant returns to scale which for brevity of the paper can be explained that we can't increase raw labor, L, without proportionally increasing human capital, H_t. This means that if human capital is not increased then raw labor, L will have a poor effect in production as there must be a balanced in proportionality between raw labor and skilled labor so as to operate the capital. If new capital has been introduced and there is no skilled labor that have been proportionally increased to run the capital invested given laborer labor then the efficiency of the capital will be low and the machine might not be able to operate as there is no labored Labour to operate such machines. That is to say the productivity of physical capital, K and that Labourlabor will remain constant unless human capital, H has been altered. Then the input of human capital can be $H_t = hL_t$ and the model can be rewritten as:

$$Y_t = K_t^\alpha h_t^\beta A_t^{1-\alpha-\beta} L_t^{1-\alpha}$$

And dividing it with L_t in both sides we obtain:

$$y_t = k_t^\alpha h_t^\beta A_t^{1-\alpha-\beta}$$

For variable physical infrastructure which is our main variable the most obtainable data contains transport, storage and communication infrastructure.
For the independent variable y, which stands for GDP per worker it will be included as GDP, Y since the corresponding variables data are not taken as measures per worker. This does not affect the results neither does affect the interpretation. The new regression model will therefore be will;

$$logY_t = b_o + b_1 logkOCF_t + b_2 loghEX_t + b_3 logITSC_t$$

Whereas; Y Gross Domestic product measured in USD

kOCF = other gross capital formation, that is Capital Formation excluding Transport, storage and Infrastructure measured in current US dollars

ITSC = value added infrastructure in transport , storage and Communication measured in current US dollars

EX = this stands for the expected years of schooling. It was important to include this variable to explain human capital. In Africa there is enough supply of unskilled labor but suffers a serious insufficiency of unskilled labor. The best proxy that could be used to measure human capital is education. Education has been measured in expected years of schooling and the amount of expenditure the government directsto education, that is expenditure on education EXPED. In the Solow model three factors are, important to determine national income. These one of the factors are human capital and therefore variables help to explain human capital these two variables EX and EXPED.

Summary table for baseline regression

Variable	obs	Mean	Std. dev	Min	Max
Kocf	281	4.38e09	7.14e09	7698055	5.03e10
Exped	170	1.71e11	3.44e11	5.57e09	2.17e12
Itcs	357	2.08e09	4.51e09	4.34691	3.03e10
lnKocf	281	21.20376	1.527357	15.85648	24.64034
Lnitsc	357	17.18119	6.463832	1.46948	24.13463
Inhex	209	1.924137	0.43425	01096352	2.569715
Lnitsc lag1	351	17.15366	6.43591	1.462481	24.12629
Itsc lag3	352	2.03e09	4.34e09	4.34698	3.03e10
Lnkocf lag1	270	21.23069	1.442901	15.85648	24.41271
Lnexpedlag1	167	24.33838	1.830163	20.1304	28.40804
Lnitsc lag2	352	17.22478	6.390699	1.4696841	24.13463

In these data 476 observations were collected. Some countries had missing observations of some type of variables, this has made the regression results to have a big difference in the number of observations. This is because the data availability of many African countries before year 2000 are not easily available.

In order to analyse the regression equation efficiently we will include various regression equations moving around the regression equation that is drafted from the model. As explained earlier physical infrastructure has two main feature that distinguish it from other variables; first is that it takes a long to time to construct, especially transport infrastructure which may take 2 to 5 years depending on the size and the finances set for the project and the second thing is that infrastructure takes a long time to showing its effect on the economy.

VIII. Baseline regression

The paper has used two methods of in the first regression analysis. The five regressions have used GLS method. Some regressions have log values because the trend of the increase in physicalinfrastructure is always a nonlinear in nature. It follows a nonlinear pattern. Likewisefor expected years of schooling and fixed capital formation. A: the countries develop the expected number of years of schooling also increase but since there is a limit in the number of years once can study and then: is a point at which one can make personal choice whether to continue with school or not (can be due to different reasons) then the number people expected to drop suddenly from school increase and therefore their expected years of schooling fails from following a linear nature. Likewise it is for physical infrastructure. However this was only used in two regressions as most of countries were stuck between 8 to 11 years of schooling and no data were given to explain small changes therein. The following are the regression equations for the first (baseline) regression;

$$Y_t = b_o + b_1 kOCF_t + b_2 hEX_t + b_3 ITSC_t$$

$$lnY_t = b_o + b_1 lnkOCF_t + b_2 lnhEX_t + b_3 lnITSC_t$$

$$lnY_t = b_o + b_1 lnkOCF_t + b_2 lnhEXPED_t + b_3 lnITSC_t$$

$$lnY_t = b_o + b_1 lnkOCF_{t-1} + b_2 lnhEXPED_{t-1} + b_3 lnITSC_{t-1}$$

$$lnY_t = b_o + b_1 lnkOCF_{t-1} + b_2 lnhEXPED_{t-1} + b_3 lnITSC_t + b_4 lnITSC_{t-1}$$

The Breusch pagan test has been used to check if the variables in the model suffer from heteroscedasticity. The p-value obtain from the test is 00000 which shows that the model variables suffer from heteroscedasticity problem hence we can reject the null hypothesis that there is constant variance. In order to solve this problem. Regression with robust cluster is used. The model also used Hausman test to check whether to use fixed effects model or random effects model. The null hypothesis is that random effect model is appropriate and the alternative hypothesis is that the fixed effect model is appropriate. The p-value shows 0.002 which means that we can reject the null hypothesis and therefore use fixed effect model which is an appropriate model for given this dataset. F-test however has p-value of 0.0000 which shows that the groups have a common intercept.

IX.   Regression results on GPD against variables that influence it using the above models are as follows

	1	2	3	4	5
	M1	M2	M3	M4	M5
Variables	GDP	lnGDP	Ln GDP	lnGDP	lnGDP
kOCF	1.533***				
	(0.171)				
EXPED	0.04142***				
	(0.000827)				
ITSC	6.864***				
	(0.652)				
LnkOCF		0.0274	0.364*		
		(0.0813)	(0.169)		
lnEXPED		0.728***			
		(0.113)			
lnITSC		0.0191	0.05701**		
		(0.0152)	(0.0230)		
lnhEX			1.249		
			(0.294)		
lnkOCF lag1				0.626***	0.0614
				(0.124)	(0.0705)
LnhEX lag1				0.689	
				(0.647)	
LnITSC lag1				0.0601***	0.00457
				(0.0224)	(0.000613)
LnEXPED lag1					0.716***
					(0.0107)
LnITSC lag2					0.0180**
					(0.0007)
ITSC lag3					0**
					(0)

Constant	2.983e09**	4.357*	11.64***	7.249***	3.887**
	(1.082e09)	(2.040)	(2.820)	(2.326)	(1.699)
Observations	123	123	127	123	115
R-Squared	0.992	0.884	0.688	0.721	0.890
No. of Countries	10	10	10	10	10

Robust standard error***1% ,** 5% and * 10 % SL

From the regression we can see that over time infrastructure has been seen to play an important role in contributing to economic growth. In the 1st regression which is simple GLS regression that was trying to show a simple relationship among the variables in question showing how GDP is increased by infrastructure improvement.

In this regression it shows that an Increase In the value of transport, communication and storage (that Is. Investment done by both private and public sector) by l USD causes the national GDP to increase by increase by 6.8 USD. This means that the return from an investment on transportation infrastructure other factors being constant is around six times the investment cost. The regression however may face the some questions such as; the impact of the three infrastructures has been exaggerated since if it would have been so in the real world then various governments would have simply deposited their finances in this in this sector.

Another question would have been about the time lag for infrastructure to create returns as infrastructure construction such as transportation Infrastructure always takes some time to be constructed (despite that there is no specific time but since from the theory the paper explains more of long distance roads that is connecting the rural Africa to the urban Africa or the agricultural based Africa (most living in rural areas) to the industrial based Africa mostly living in urban areas hence roads connecting these areas are always long distance roads, and also given that African countries have small budgets. to support high cost budget such as road construction is a challenge. Hence they always built in phases such as three or four years), Communication and storage infrastructure on the other side can be constructed/ installed quicker.

Since it was impossible to separate the data for these three variables the time lag for general ITSC was reduced to bring balance between these three types For the purpose of this paper therefore we will test up to three lags. The third question that would have been posed to the regression is that of linearity. These questions are answered in the upcoming regressions.

The second and the third regression are more less the same. The only difference is that the former uses expenditure on education unable to measure human capital and the later uses expected years of education. The one using expected years of education was no longer used after that the data (hEX) was facing explained reasons (the reason was explained just a page before regression table). They introduce non linearity by using log values of variables. The effect is insignificant in the second regression but Significant at 5 percent in the third regression. It shows that Infrastructure increase by I percent results to a 0.057 percentage increase in GDP There is a big poss1bt|tty that the third regression is more precise than the second regression because. The third regression used expected years of schooling which once presented using log values it better fits the model specification. The second reason is that expenditure on education would best fit using a lag value than the current year expenditure as education returns are not easily within a year.

To improve the outcomes of the regression the lag values were introduced, n the fourth regression therefore we can observe some similar outcomes as in the third regression. The regression shows that increase of ITSC by one percentage results to a 0.06 Increase in GDP one year after being constructed. Other factors being constant though this seems to be small it should be known that once infrastructure has been Installed It will continue to serve for a long time and hence provide Income in the future.

X.   Conclusion

This paper shows that it is possible for African economies to take-off as other parts of the world. However the paper shows that not every country can succeed by following the development steps of other countries that have succeeded earlier. Poor physical infrastructure that is in Africa has been the mam hindrance of development.

The development models that have been adopted and sometimes even formed by the western powers do not provide a promising solution to African economies. The World Bank, IMF and other Africa development partner should further look at the urgency of physical infrastructure to connect various areas of the African countries. Africa fails to trade among itself because of poor infrastructure connecting the countries. Some countries have excess of some products but trading is difficult because of poor or even lack of transport infrastructure that would link them investing in physical infrastructure will uplift many Africans out of poverty and provide more employment opportunities as people will be sure of market and therefore they willbe encouraged to produce more.

XI.   Important of Infrastructure

The study therefore calls for the acknowledgement of physical infrastructure impact on economic growth, that is, by government, donors and private entities and therefore they should see It as one of the mam hindrances to African economy. Unless the basic physical infrastructure is not built to provide a foundation of production linkage between the rural and urban sector then there will always be imbalance within the two. The continual Imbalance will then lead to worse economic conditions in the future as more labor will be in the urban areas and the rural areas will not be able to provide enough resources to the urban areas.

In addition to worsening climatic condition worldwide and rapid population growth in African continent without developing basic infrastructure systems in the rural areas (transportation and irrigation) food insecurity and other land resources are at risk. On the other hand the infrastructure role as a linkage between agricultural led economy and industrial led economy must be recognized by the governments setting this goal. Once the link has been ignored it is more likely that the established factories might fall due to lack of resources and high cost of production as discussed in this paper. The study also advice the African governments and points out for upcoming studies to see the difference in the path of development that Africa has to take The study shows that Africa at the current stage should among its priority protects invest highlyinfrastructure linking the rural and urban areas.

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