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The Role of Fiscal Transparency in Road Transport Infrastructure Quality in Sub-Saharan Africa

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Abstract

Transport Infrastructural Development, specifically, road transport infrastructure has been argued to play an important role in the growth of economic activities. In this way, countries all over the world, Sub-Sahara African countries alike, have made critical efforts to improve the quality of this infrastructure. However, the results of these efforts have not been felt much in Sub-Sahara African countries. The quality of road networks in Sub-Sahara African countries is relatively low to countries of other regions of the world. This has motivated this study to investigate the factors that determine the quality of road infrastructure, particularly, the role of fiscal transparency. The panel ARDL method, with a focus on its pooled-mean group (PMG), mean group (MG) and dynamic fixed effects (DFE) estimators was employed on the annual panel data of 34 Sub-Sahara African countries over the 2006 – 2018 periods. Also, Dumitrescu-Hurlin panel Granger non-causality were conducted to determine the casual relationship between fiscal transparency and quality of road transport infrastructure. The findings of the study revealed that more transparent fiscal activities are important to improve the quality of road transport infrastructure in Sub-Saharan Africa in the long run, with coefficient value of 0.008. More so, public debt and private investment are critical to long-run improvement in the quality of road infrastructure in the region (with coefficient values of 0.022 and 0.102 respectively). Therefore, the study recommended that better transparency of fiscal activities should be strengthened in these countries to achieve better quality of road transport infrastructure.

Highlights

- Transparency of fiscal activities is important to improve the quality of road infrastructure.
- Public debt undermines the quality of road transport infrastructure.
- Well-being improves road transport infrastructure.

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1. Introduction

The vital role of transport infrastructural development in general, and road transport infrastructure in particular, to economic development has been established in the literature (Cigu et al., 2018). This is usually based on the argument that a developed transport system ensures proper mobility of human and material resources and also guarantees efficient and effective distribution of resources for sustainable economic development. This argument has informed the decision of policy makers in most nations to allocate substantial amount of their annual budget to the development of transport infrastructure, particularly road transport, in order to influence the level of economic development (Arvin et al., 2015).

Transportation infrastructure plays a significant role in the success of every nation's economy (Sami et al., 2013). Road transport is the primary mode of national transportation (Agarwal et al., 2011). The maintenance of a reliable and durable road infrastructure is essential to economic growth and social development (Frangopol, 2011). Public roads play a critical role in this respect (Elwakil et al., 2012).

However, with the increased spending on transport infrastructure over the years, the nature of road infrastructure in most Sub-Sahara African countries is still in a shabby state (Wang et al., 2018). For instance, World Economic Forum (WEF) report (2019) revealed that out of about 152 countries of World, seven Sub-Sahara African countries are ranked among the lowest 20 countries regarding the quality of road infrastructure. Only four countries, Namibia (21st), Rwanda (38th), Mauritius (43rd) and South Africa (47th) made it to the top fiftieth. Furthermore, out of the 37 Sub-Sahara African countries included in the dataset, only 16 countries have their index score above the half way (3.5) of the total 7-point score of quality of road infrastructure. These facts simply show that the quality of road infrastructure in Sub-Sahara African is still in a shabby state compared to the rest of the world and should have become better, given the spending of the various governments. This suggests that some factors might be into play to undermine efforts to increase the quality of road transport infrastructure in these countries, particularly, those related to fiscal transparency.

A good level of fiscal transparency is expected to foster a timely access to comprehensive information contained in budget documents by the public. This will tend to restrict the government to implementing the relevant projects as expressed in the budget. In a way, budgeted expenditure for infrastructural development can be guaranteed to be spent judiciously. However, the status quo in many Sub-Saharan countries in terms of fiscal transparency is not encouraging. For instance, the open budget index report prepared by International Budget Partnership showed that the extent to which fiscal information is provided in most Sub-Saharan African countries can be regarded scanty, minimal or limited. The only exception is in the case of South Africa whose information provided is regarded as extensive. This poor level of fiscal transparency might have a lot to

do with the quality of road infrastructure, since a transparent fiscal process will connote better implementation of every infrastructure-related item in the budget.

Many studies have investigated the importance of transport infrastructural development on economic growth (see for example, Ke et al., 2020; Lenz et al., 2018; Deng, 2013) but ignored the factors that determines the level of development in transport infrastructure. The few studies that focused on the determinants of transport infrastructure (for example, Puvanachandran, 1986; Gurara et al., 2017; Copo et al., 2016) have not been able to examine the role of fiscal transparency as a determining factor of transport infrastructural development. This paper is therefore conducted to address the gap by examining the impact of fiscal transparency on road transport infrastructure in Sub-Saharan Africa, in order to extend the knowledge frontier to capture how aspects of budgetary activities determine the quality of road transport infrastructure.

In view of the above, this paper raises the following questions: (1) does fiscal discipline affects road transport infrastructural development in Sub-Saharan Africa? (2) what is the impact of transparency of budget process on road transport infrastructural development in Sub-Saharan Africa.

The broad objective of this paper is therefore to examine the role of fiscal transparency in road transport infrastructural development. The specific objectives are to:

i. examine the impact of fiscal discipline on road transport infrastructural development in Sub-Saharan Africa; and

ii. assess the impact of transparency of budget process on road transport infrastructural development in Sub-Saharan Africa.

The remainder of this paper is arranged as follows. The review of literature in presented in second section, the third section presents the methodology employed in achieving the aims of the study, the fourth section presents the results and the concluding remark is presented in the last section.

2. Literature Review

Liu and Luo (2019) examined the impact of government integrity on the efficiency of China's transportation infrastructure investment. The three-stage DEA (Data Envelopment Analysis) model was employed to eliminate the influence of environmental factors and statistical noise and the investment efficiency of transportation infrastructure was measured for 31 provinces of China from 2007 to 2017. A truncated regression was also used to calculate the efficiency of infrastructure investment in relation to government integrity in order to explain the regional differences in investment efficiency. The study found that environmental factors in various provinces reduce government investment efficiency, which suggests that a traditional DEA model would underestimate investment efficiency. It also found that regions with higher efficiency in transportation infrastructure investment are all located at the efficiency frontier while regions with better economic development exhibit rather low investment efficiency values. This may be due to the fact that transportation infrastructure

investment in these regions has become saturated, resulting in an inevitable decrease in efficiency when investment continues to flow.

Kyriacou and Muinelo (2019) examined the role of government quality in the efficiency of transport infrastructure investment. An empirical analysis was carried out on country-wide panel data basis to achieve the aim of the study. The empirical results of the study show that government quality explains the differences in infrastructure investment efficiency between countries.

Cerra et al. (2017) employed a panel data analysis to examine the determinants of stock of infrastructure across countries, including in Latin America and the Caribbean. The study employed the static panel data techniques such as pooled OLS and fixed effects, as well as the dynamic panel data techniques such as the difference and system GMM. The study found that public finance and private sector participation both contribute to improving the stock of infrastructure.

Copo et al. (2016) attempted to empirically examine the determinants roads construction in the Philippines. Panel data regressions were employed to assess the significant variables that determine road construction. The findings from the results of this indicates that the official budget, employed population, number of vehicles, number of firms, population density, and GDP per capita, are significant factors determining the monetary and fiscal allocation to road construction.

The study conducted by Välilä et al. (2017) attempted to describe the evolution of public investment in transportation infrastructure in the large EU countries, and to identify its macroeconomic determinants by means of a panel data analysis. The results of this analysis are contrasted with results of similar analyses for other public service sectors (education and health). The major findings of the study is that income level and debt largely determine the public investment in infrastructure.

Opawole et al. (2013) employed a survey method to examine the determinants of road infrastructure development in Osun State, South-western Nigeria. Structured questionnaire administered on 74 construction professionals and 32 financial administrators with official cadre ranging between principal and director in the public service of the State provided quantitative data for the study. The survey data obtained were analysed using percentage and relative significance index. The findings of the study from the results revealed that poor implementation incidence of road projects in the State are usually attributed to funding and coordination issues.

The study conducted by Gurara et al. (2017) examined the trends in infrastructure investment and its financing in low-income developing countries (LIDCs). The study found that infrastructure in LIDCs is largely provided by the public sector; private participation is mostly channelled through Public-Private Partnerships. It also found that grants and concessional loans are an essential source of infrastructure funding in LIDCs.

Tatari et al. (2013) investigated the nature and problems facing transport infrastructure in developing countries. The study focused majorly on employing

descriptive and explorative analyses in the investigation. The study found that one of the most significant problems that has clearly showcase in developing countries is economical problem. The study also found that, among others, inadequate cost recovery, corruption, insufficient competition, and low credibility of institutions undermine transportation infrastructure in developing countries. But majorly, a good economic situation was argued to result to efficiency in transportation and also the maintenance of transportation systems.

In summary, the reviewed empirical studies have largely focused on the impact of economic situations, corruption, public-private partnership, income level and debt on road transport infrastructure development. However, it is logical to think of a poor level of road infrastructure development as a poor fiscal performance phenomenon. This is because, the transparency of fiscal process largely tells how smooth and effective the implementations of key infrastructures are executed. Since previous studies have ignored the impact of fiscal transparency on road transport infrastructure development, it becomes a void in the literature which the present study seeks to fill.

3. Methodology

The theoretical background upon which this study rests is provided in this section alongside other methodological issues, such as the model specification, estimation techniques, sources and measurement of data, and sample and data collection.

3.1 Theoretical Framework

The common pool and agency phenomena provide the theoretical basis for the model specified in this study. The two phenomena are vital theoretical foundation to how institutional quality relates to fiscal outcomes and budget implementation. The common pool phenomenon occurs when there exists a competition for public resources among the players in the budget process which may lead to their failure to internalize the costs of their decisions. This makes the respective players in the budget process to only consider the costs and benefits of their constituents in the determination of their expenditure, while ignoring those of the society at large. This in turn, makes other players to demand for higher government expenditure to be allocated to favoured programmes relative to the socially optimal level. This might consequently, lead to an increase in fiscal deficit and public debt, as well as a decline in transparency of such process, which might have an adverse effect on the quality of key infrastructure (Ostrom et al. 2002).

On the other hand, the agency phenomenon justifies the provision of strong institutions with the aim of explaining the relationship between the voters and their political representatives. In political settings that lack appropriate institutions, corrupt politicians tend to acquire rents at the expense of developmental programmes spending which will increase the satisfaction of electorates, incentives are created for the electorates to maximize their satisfaction

through demanding for higher government expenditure (or lower taxes), especially in times of boom, in order for it to serve as constraint to the ability of political actors to spend on personal interests. The absence of appropriate institution to demand transparency of fiscal activities, therefore, results to lower quality of infrastructural development, since resources are being employed on irrelevant projects (Jensen & Meckling, 1976).

It is therefore expected that these two problems, i.e. the common pool and agency problem, to be present in countries where appropriate institutions, particularly, those that command transparency, are lacking. Consequently, poor quality of road transport infrastructure is expected to prevail.

3.2 Model Specification

The empirical model to be estimated in this paper is specified here by adapting the model of Cerra et al. (2017) to include the demographic factor (population growth), in line with Randolph et al. (1996); economic factors (gross domestic product and private investment), in line with Davidson (1989) and Wanmali and Islam (1995); and fiscal transparency. The model of this study therefore expressed the impact of GDP, population growth, private investment, public debt and fiscal transparency on quality of road transport infrastructure.

The inclusion of GDP and private investment is mainly to account for economic influence on road transport infrastructure. GDP measures the magnitude of economic activities in the country and it is expected that this magnitude will determine the extent of development of the transport system. The level of private investment is also considered as important as this improves economic activities and can facilitate better attention to the development of transport system. Population growth is a demographic factor that represents the demand for more transport infrastructure and the amount of pressure on the existing ones. Increasing growth of population suggests greater demand for transport infrastructure and a higher pressure on the existing ones, which may affect the quantity and quality of transport infrastructure. Public debt is a fiscal factor that determines the availability of resources to execute current and future projects. In this way, increase in debt, if judiciously employed, tend to increase the quality of present transport infrastructure. Fiscal transparency was included to account for the extent to which governments are open to the public in terms of the use of public resources. A transparent government will judiciously utilise public resources and items included in the budget regarding transport infrastructure are effectively implemented, consequently, resulting in a better quality of transport infrastructure.

The model of this study is therefore specified as follows.

$$Rinf_{it} = \varphi_0 + \varphi_1 Rinf_{it-1} + \varphi_2 lnGDP_{it} + \varphi_3 POPg_{it} + \varphi_4 PINV_{it} + \varphi_5 PD_{it} + \varphi_6 TRS_{it} + \epsilon_{it} \quad (1)$$

$Rinf$ is quality of road transport infrastructure, which is measured as an index, ranging from 1 to 7, with highest value denoting best quality. The data was obtained from global competitiveness index of the World Economic Forum.

$logGDP$ is real annual gross domestic product expressed in its natural logarithm and was obtained from World Bank's World Development Indicators (WDI). $POPg$ is population growth, measured by the annual growth of total population, i.e. change in the log of annual population. The data was obtained from World Bank's WDI. $PINV$ is private investment which is measured by the ratio of gross fixed capital formation to GDP. The data was obtained from World Bank's WDI. PD is public debt and is measured by the ratio of central government debt to GDP. It was obtained from IMF's World Economic Outlook. TRS is fiscal transparency, which is measured by the Open Budget Index of transparency computed by International Budget Partnership. The index ranges from 0 to 100, with the highest value denoting extensive information being provided and lowest value denoting scanty or no information.

3.3 Estimation Technique

The techniques employed for the estimation of the effect of fiscal transparency on the quality of road transport infrastructure are described in here. Estimation of the regression model specified above in equation (1) was carried out employing the panel autoregressive distributive lag (PARDL) model. The error-correction modelling (ECM), proposed by Pesaran and Smith (1995) and Pesaran, Shin and Smith (1999), is employed in examining the link between the variables of the model where exogeneity is inferred from statistical tests. There are three forms of the PARDL procedures: the pooled mean group (PMG), the mean group (MG), and the dynamic fixed effect (DFE). While the PMG estimates the parameters by maintaining the same long run parameters across cross-sectional units, the MG in its first step separately runs the short- and long-run parameters for each unit, then takes their averages. The DFE estimates the parameters by maintaining the usual homogeneity assumption in the slope parameters. The PARDL model is specified as in the following equation.

$$\Delta Y_{it} = \sum_{j=1}^{p-1} \alpha_i^i \Delta Y_{it-j} + \sum_{j=0}^{q-1} \beta_j^i \Delta X_{it-j} + \delta^i \left[Y_{it-1} - \left\{ \theta_0^i + \theta_1^i X_{it-1} \right\} \right] + \mu_{it} \quad (2)$$

where Y is the dependent variable, in this case, quality of road transport infrastructure, X is the vector of all independent variables included in the model, $\alpha \; and \; \beta$ are the short run dynamic coefficients of lagged dependent and independent variables, θ denotes the long run coefficients, δ is the speed of adjustment to long-run equilibrium, i denotes the countries, t denotes time periods and μ stands for the disturbance term.

This paper also employed the panel Granger causality test developed by Dumitrescu and Hurlin (2012) to test for causal relation between fiscal transparency and quality of road transport infrastructure. The lag selection criteria were based on Akaike, Bayesian, and Hannan-Quinn criteria while the bootstrap procedure was employed in the statistical computations to account for cross-sectional dependence.

Dumitrescu-Hurlin (D-H) provided an extension to the usual Granger causality test in order to be carried out on panel data. The D-H procedure can be specified as follows:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \beta_{ik} y_{i,t-k} + \sum_{k=1}^{K} \gamma_{ik} x_{i,t-k} + \varepsilon_{i,t} \quad (3)$$

Where $x_{i,t}$ and $y_{i,t}$ are observations for two variables across cross sections and time which are stationary.

D-H test assumes there can be causality for some individuals but not necessarily for all. The alternative hypothesis thus writes:

$H_1: \gamma_{i1} = \ldots = \gamma_{iK} = 0 \qquad \forall_i = 1, \ldots, N_1$

$\gamma_{i1} \neq 0 \; or \ldots or \; \gamma_{iK} \neq 0 \qquad \forall_i = N_1 + 1, \ldots, N_1$

where $N_1 \in [0, N-1]$ is unknown. If $N_1 = 0$, there is causality for all individuals in the panel. N_1must be strictly smaller than N, otherwise there is no causality for all individuals and H_1 reduces to H_0.

3.4 Sources and Measurement of Data

The data for road transport infrastructural development were sourced from Global Competitiveness Report, data for GDP, population growth and private investment are sourced from World Development Indicators, public debt from World Economic Outlook, and open budget index is used to proxy fiscal transparency and is sourced from International Budget Partnership.

To see the overview of the data source and measurement, outline of explanatory variables used, their respective measurement and sources are presented in Table 1.

Table 1. Measurement and Sources of Variables

Variable	Measurement	Source
Road Infrastructure (RINF)	Quality of roads index (1-7)	Global Competitiveness Index (GCI)
Gross Domestic Product (lnGDP)	Natural log transformation of Real GDP	World Development Indicators (WDI)
Population Growth (POPg)	Annual percent growth of population	World Development Indicators (WDI)
Private Investment (PINV)	Gross fixed capital formation as ratio of GDP	World Development Indicators (WDI)
Public debt (PD)	Central government debt as ratio of GDP	WEO, IMF,
Transparency (TRS)	Open budget index	International Budget Partnership (IBP)

***Source**: Authors' Compilation.*

3.5 Sample and Data Collection

The focus of this study is mainly on the effect of fiscal transparency on road transport infrastructure quality in Sub-Sahara Africa. The Sub-Sahara African countries included in the sample are 34 in number over the different regions. These countries include Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cabo Verde, Chad, Cote d'Iviore, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone,

South Africa, Eswatini (Swaziland), Tanzania, Uganda, Zambia and Zimbabwe. The investigation covers an annual data for the period of 2006–2018.

4. Results and Discussions

The presentation of results is summarized in this section as well as the discussions thereof. The results of the analysis obtained from the secondary data are presented here alongside the discussion of its findings. Both the descriptive and inferential approaches were employed in the analysis. While the descriptive approach was used to describe the variables of the model with the use of summary statistics such as the mean, standard deviation, minimum and maximum values, on the other hand, the inferential approach was used to achieve the objectives of the study with the use of Dumitrescu-Hurlin panel Granger causality and one-step system GMM regression.

4.1 Descriptive Analysis

Table 2 shows the summary statistics of the variables employed in the analysis of this study. It shows that average road infrastructure quality index in Sub-Sahara Africa is about 3.32 (out of a possible overall of 7). This shows that Sub-Sahara African countries have a score below halfway of the overall score in terms of road quality. Road quality index in Sub-Sahara Africa has a standard deviation of about 0.897, minimum of about 1.357 and maximum of about 5.827.

Average real GDP in Sub-Sahara Africa is 39 billion US dollars, with a standard deviation of about 91.1 billion US dollars, minimum of about 0.77 billion US dollars and maximum of about 469 billion US dollars. Average population growth in Sub-Sahara African countries is about 2.4 percent, with standard deviation of about 0.90 percent, minimum of about -2.6 percent and maximum of about 4.1 percent. Public debt as ratio of GDP in Sub-Sahara Africa averaged 44.59 percent, with standard deviation of about 33.17 percent, minimum of about 5.51 percent and maximum of about 386.88 percent. Private investment as percent of GDP averaged 16.24 percent, with standard deviation of about 5.89 percent, minimum of zero and maximum of 35.96 percent. Transparency of fiscal activities, measured by the Open Budget Index has an average of 34.48 for Sub-Sahara African countries (out of possible 100 points), with standard deviation of about 18.31, minimum of zero and maximum of 92.

Table 2. Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
RINF	3.321738	0.897077	1.357143	5.827178
GDP	$39bn	$91.1bn	$0.766bn	$469bn
POPg	2.396755	0.901952	-2.62866	4.129405
PD	44.58798	33.17205	5.513	386.883
PINV	16.24488	5.89593	0	35.95725
TRS	34.48161	18.30734	0	92

***Source**: Authors' Computation, 2019.*
***Notes**: RINF is quality of road transport infrastructure; GDP is gross domestic product; POPg if population growth; PD is public debt; PINV is private investment; TRS is fiscal transparency.*

Table 3 presents the average values of road infrastructure quality index and open budget index over the regions of Sub-Sahara Africa. The regions contained here are Western, Central, Eastern and Southern Africa. Average values for Sub-Sahara Africa as a whole is also provided in the Table. Table 3 shows that average road infrastructure quality index is 3.32. The result shows that Western, Central and Eastern African regions fell below this Sub-Sahara African average while only Southern African region performed above the Sub-Sahara African average. In terms of transparency index, the result shows that average transparency index for Sub-Saharan Africa as a whole is 34.38. Western and Central African regions perform below this Sub-Sahara African average while only Southern and Eastern African regions performed above the Sub-Sahara African average.

The result is almost an indication of the picture that there exists a positive relationship between road infrastructure quality and fiscal transparency in Sub-Sahara Africa, i.e. higher levels of transparency in fiscal activities are associated with higher levels of road quality, and vice versa. To show a clearer picture of this relationship, a scatter plot of the average indexes of these regions is presented in Figure 1.

Table 3. Mean of Road Quality and Transparency across Regions of Sub-Sahara Africa

	RINF (Index ranges from 1 to 7)	TRS (Index ranges from 0 to 100)
Region		
Sub-Sahara Africa	3.321738	34.48161
Western Africa	3.159605	32.29989
Central Africa	2.47176	17.92977
Eastern Africa	3.280781	34.83612
Southern Africa	4.159731	46.35284

***Source**: Authors' Computation, 2019*

Figure 1 shows presents a scatter diagram of the relationship between road quality and fiscal transparency. A fitted line showing the direction of their relationship is also provided in the figure, alongside a fitted regression equation showing the extent of relationship. The fitted line is shown to be upward sloping, indicating a positive relationship between road infrastructure quality and fiscal transparency. The figure shows that regions with very low road quality index, such as the central African region, are associated with very low fiscal transparency index. Similarly, regions with very high road quality, such as the Southern African region, have higher fiscal transparency. The fitted regression equation shows that other things held the same, fiscal transparency alone can explain about 97.6 percent of variations in road infrastructure quality in Sub-Sahara Africa.

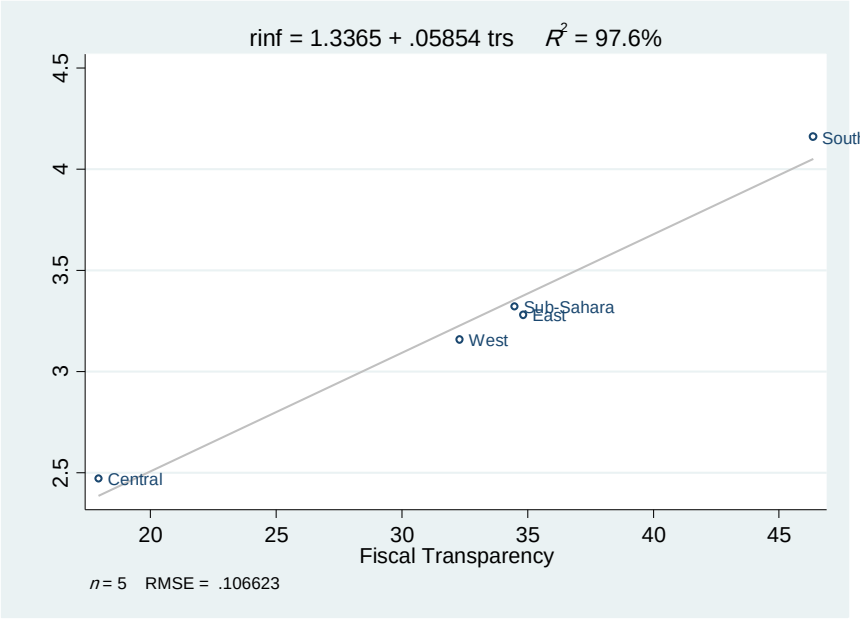

Figure 1. Scatter Plot of Relationship
***Source**: Authors' Plot*

Table 4 presents the correlation matrix of the relationship that exists among the variables employed in this study. This is presented here, basically, to examine the relationship that exist among the variables and to verify if none of the relationships have a high correlation coefficient as 0.8, which might cause a problem of severe multicollinearity in the models.

The result shows that road infrastructure quality is significantly related to population growth and transparency but not significantly related to GDP, public debt and private investment. While road quality is negatively related to population growth, it is positively related to transparency. This implies that higher levels of road quality are associated with lower levels of population growth but higher

levels of transparency of fiscal activities, and vice versa. The relationship between road quality and fiscal transparency in this result further buttresses the results obtained earlier.

Table 4. Correlation Matrix

	RINF	lnGDP	POPg	PD	PINV	TRS
RINF	1					
lnGDP	-0.0444	1				
POPg	-0.4778*	0.1762*	1			
PD	0.0841	-0.3082*	-0.0586	1		
PINV	0.0046	0.0517	0.006	0.0645	1	
TRS	0.2888*	0.1908*	-0.2198*	-0.0159	0.0679	1

***Source**: Authors' Computation, 2019.*
***Note**: * significant relationship at 5%. RINF is quality of road transport infrastructure; lnGDP is gross domestic product (in natural logarithm); POPg if population growth; PD is public debt; PINV is private investment; TRS is fiscal transparency.*

Table 5 shows that fiscal transparency has a unidirectional causal relationship with quality of road infrastructure, flowing from the former to the latter. This is shown by the first p-value being highly statistically significant and the second being insignificant, suggesting that the null hypothesis of no causality from transparency to road quality is rejected and the null hypothesis of no causality from road quality to transparency is not rejected. This result implies that it is better fiscal transparency that precedes better quality of road transport infrastructure, and not in the other way.

4.2 Inferential Analysis

The first of the inferential analysis to be presented in this study is the causality test, to examine the causal relationship that exists between road quality and fiscal transparency. The result of Dumitrescu-Hurlin (D-H) panel Granger non-causality test is presented here to examine the direction of causal relationship between road infrastructure quality index and fiscal transparency in Sub-Sahara Africa.

Table 5. Granger non-causality test results

Null Hypothesis	p-value	Remark
Fiscal Transparency does not Granger-cause Road Quality	0.0000	Unidirectional
Road Quality does not Granger-cause Fiscal Transparency	0.4878	

***Source**: Authors' Computation, 2019.*

The second of the inferential analysis to be presented in this study is the result of the panel autoregressive distributive lag (PARDL) regression to examine

the impact of fiscal transparency on the quality of road transport infrastructure, controlling for factors such as population growth, public debt and private investment. Table 6 presents the results in three variants, namely, the pooled-mean group (PMG), mean group (MG) and dynamic fixed effects (DFE).

The Hausman test result indicates that the PMG is a better estimator in terms of its consistency and efficiency than its MG and DFE counterparts. The findings of this study are therefore based on the result of PMG. Findings from the long-run result suggest that fiscal transparency has significant positive impact on the quality of road transport infrastructure to the tune of about 0.008 points. Even though the result suggests that fiscal transparency does not have short-run on the quality of road transport infrastructure, its long-run impact conforms to a priori expectation as it was expected that better transparency in fiscal activities will promote accountability, put political office holders in check and facilitate effective implementation of needed infrastructures. This will also improve the quality of road transport infrastructure in Sub-Saharan Africa.

The long-run coefficients of some control variables such as public debt and private investment are significant and rightly signed. Although there is evidence for short-run impact, their long-run impact suggests that increase in public debt and private investment increases the quality of road transport infrastructure. These findings are in line with the findings of Cerra et al (2017) and Gurara et al (2017) for Latin America and the Caribbean and low-income developing countries respectively. This can be argued with the fact that increase in private investment calls for an increase in infrastructure, particularly, transport infrastructure to match the increased demand for such social need as a result of increased economic activities. The finding that increase in public debt increases the quality of road transport infrastructure is also in line with the finding of Välilä et al (2017) for EU countries. They argue that judicious use of public debt in the face of strong institutions can enhance the provision of quality road transport infrastructure. This argument is also plausible for Sub-Sahara African countries as better budgetary institutions tend to constraint political office holders to effectively implement the projects upon which debts are acquired.

As for population growth, there is evidence for its long-run negative impact on the quality of road transport infrastructure, as its coefficient is negatively signed which is contrary to expectation and the findings of Copo et al (2016). This negative impact of might be as a result of higher rate of population growth than the growth of available resources to provide quality raid transport infrastructure, which causes an overuse of the limited facilities. This consequently reduces the quality of these infrastructure.

The long-run result indicate that GDP is insignificant and has no long-run impact on quality of road transport infrastructure in Sub-Saharan Africa. In the short run, however, the findings show that GDP has a positive impact on the quality of road transport infrastructure to the magnitude of about 0.033 points. This finding is consistent with the finding of Tatari et al (2013), Copo et al (2016) and Välilä et al (2017), who found that higher income level economic activities

enhance transport infrastructure development for developing countries, the Philippines and large number of EU countries respectively. This is based on the argument that improvement in economic activities and consequently, the income level, will facilitate the need for more development in road infrastructure.

Table 6. Panel ARDL Regression Result

Dependent	PMG		MG		DFE	
Variable=RINF	Coef.	p-value	Coef.	p-value	Coef.	p-value
			Long Run Estimates			
logGDP	0.234	0.215	-2.328	0.594	0.309	0.243
POPg	-1.715***	0.000	1.618	0.389	0.381**	0.033
PD	0.022***	0.000	0.134	0.252	-0.001	0.549
PINV	0.102***	0.000	-0.010	0.886	0.021	0.126
TRS	0.008***	0.005	-0.032	0.426	-0.003	0.446
			Short Run Estimates			
EC	-0.145**	0.028	-1.701***	0.010	-0.250***	0.000
ΔlnGDP	3.301***	0.000	-0.269	0.946	0.560**	0.050
ΔPOPg	1.144	0.290	3.849	0.799	-0.041	0.203
ΔPD	0.006	0.221	-0.002	0.943	-0.000	0.844
ΔPINV	-0.002	0.859	-0.180	0.558	-0.001	0.876
ΔTRS	-0.001	0.684	-0.098	0.200	0.002	0.048
Constant	-0.069	0.335	-126.7	0.094	-1.234	0.430
Countries	34		34		34	
Observations	408		408		408	
Hausman test			0.00		0.59	
p-value			1.000		0.988	

***Source**: Authors' Computation, 2019.*

***Notes**:*

1. **** significant at 1%, ** significant at 5%.*
2. *RINF is quality of road transport infrastructure; lnGDP is gross domestic product (in natural logarithm); POPg is population growth; PD is public debt; PINV is private investment; TRS is fiscal transparency.*
3. *The Hausman test was used to examine the appropriateness of PMG over each of MG and DFE. Its insignificance in both cases suggests that the PMG is consistent and efficient estimator than the MG and DFE.*

5. Concluding Remarks

This study examined the impact of fiscal transparency on the quality of road transport infrastructure in Sub-Saharan Africa over the period between 2006 and 2018. The PMG, MG and DFE estimators of panel ARDL were employed to

estimate the parameters of the model. The Hausman test result indicates that the PMG estimator is more consistent and efficient than its other counterparts and findings are based on the PMG result. The findings suggest that transparent fiscal activities promote quality road transport infrastructure only in the long run and not in the short run. Further findings suggest that public debt and private investment also promote quality road transport infrastructure only in the long run while GDP enhances better road transport infrastructure only in the short run. More so, the rate at which the population grows overstrains the available road transport infrastructure.

Based on these findings, this study recommends that the level of transparency of fiscal activities should therefore be strengthened in Sub-Sahara African countries in order to yield improved level of road infrastructure quality, which would in turn, facilitate the transportation and distribution of good and services to improve the flow of economic activities and wellbeing. This is because, even at its low level of transparent fiscal activities, countries that are relatively more fiscally transparent experience better road transport infrastructure.

References

Agarwal, S., Yadav, S. P., & Singh, S. P. (2011). DEA based estimation of the technical efficiency of state transport undertakings in India. *Opsearch*, 47(3), 216-230, http://dx.doi.org/10.1007/s12597-011-0035-4.

Arvin, M. B., Pradhan, R. P., & Norman, N. R. (2015). Transportation intensity, urbanization, economic growth, and CO2 emissions in the G-20 countries. *Utility Policy*, 35, 50-66.

Cerra, V., Cuevas, A., Goes, C., Karpowicz, I., Matheson, T., Samake, I., & Vtyurina, S. (2017). Determinants of infrastructure and its financing. *Emerging Economy Studies*, 3(2), 1-14.

Cigu, E., Agheorghiesei, D. T., Gavriluta, A. F., & Toader, E. (2018). Transport infrastructure development, public performance and long-run economic growth: A case study for the Eu-28 countries. *Sustainability*, 11(67).

Copo, A., Esquejo, M., Garcia, D., & Sarmiento, Z. (2016). A study about the determinants of road construction in the Philippines.

Davidson, P. (1989). Growth centers and rural development. *Economic Development Review*, 46-50.

Deng, T. (2013). Impacts of transport infrastructure on productivity and economic growth: Recent advances and research challenges. *Transport Review*, 33(6), 686-699.

Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling*, 29(4), 1450-1460.

Elwakil, E., Eweda, A., & Zayed, T. (2012). Modelling the effect of various factors on the condition of pavement marking. *Structure and Infrastructure Engineering*, 10(1), 93-105.

Frangopol, D. M. (2011). Life-cycle performance, management, and optimisation of structural systems under uncertainty: Accomplishments and challenges. *Structure and Infrastructure Engineering*, 7(6), 389-413.

Gurara, D., Klyuev, V., Mwase, N., Presbitero, A., Xu, X. C., & Bannister, C. (2017). Trends and challenges in infrastructure investment in low-income developing countries. *IMF Working Paper*, WP/17/233.

Jensen, M., & Meckling, W. (1976). Theory of the firm: Managerial behavior, agency costs, and ownership structure. *Journal of Financial Economics*, 3(4), 305-360.

Kyriacou, A. P., & Muinelo, G. L. (2019). The efficiency of transport infrastructure investment and the role of government quality: An empirical analysis. *Transport Policy*, 74, 93-102.

Lenz, N. V., Skender, H. P., & Mirkovic, P. A. (2018). The macroeconomic effects of transport infrastructure on economic growth: The case of Central and Eastern E.U. member states. *Economic Research*, 31, 1953-1964.

Liu, Q., & Luo, C. (2019). The impact of government integrity on investment efficiency in regional transportation infrastructure in China. *Susutainability*, 11, 1-13.

Opawole, A., Jagboro, G. O., Babatunde, S. O., & Opawole, M. O. (2013). Critical factors in road infrastructure development in Osun state, south western Nigeria. *International Journal of Development and Sustainability*, 2(1), 240-253.

Ostrom, E., Dietz, T., Dolsak, N., Stern, P. C., Stonich, S., & Weber, E. (2002). *The drama of the commons*. Washington, DC: National Academic Press.

Pesaran, H., & Smith, R. (1995). Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics*, 68, 79-113.

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of American Statistics Association*, 94, 621-634.

Puvanachandran, V. M. (1986). Factors influencing the provision of urban transport infrastructure. *Transportation*, 13, 295-317.

Randolph, S., Bogetic, Z., & Hefley, D. (1996). *Determinants of public expenditure on infrastructure: Transportation and communication*. The World Bank. Europe and Central Asia.

Sami, J., Pascal, F., & Younes, B. (2013). Public road transport efficiency: A stochastic frontier analysis. *Journal of Transportation Systems Engineering and Information Technology*, 13(5), 64-71, http://dx.doi.org/10.1016/S1570-6672(13)60123-3.

Tatari, A., Khorasani, G., Yadollahi, A., & Rahimi, M. (2013). Investigation transportation infrastructure in developing countries. *International Journal of Chemical, Environmental & Biological Sciences*, 1(1).

Välilä, T., Kozluk, T., & Mehrotra, A. (2017). Financing of transportation investment: A macroeconomic perspective.

Wang, L., Xue, X., Zhao, Z., & Wang, Z. (2018). The impacts of transportation infrastructure on sustainable development: Emerging trends and challenges. *International Journal of Environmental Research*, 15(1172).

Wanmali, S., & Islam, Y. (1995). Rural services, infrastructure, and regional development. *The Geographical Journal*, 161(2), 149-166.