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THE RELATIONSHIP BETWEEN PAVED ROADS INVESTMENT AND THE WIDER ECONOMIC BENEFITS IN UGANDA

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Abstract: Transport infrastructure investment is fundamental to social and economic development by connecting people to jobs and promoting labour mobility, education, health services and is key to reducing poverty. The impact of transport investment on the wider economic benefits associated with gross domestic product (GDP), employment and poverty is not clear, most especially for developing countries. To this effect, the relationships between paved roads investment and the wider economic benefits (WEBs) were modelled using linear regression analysis with the aid of Statistical Package for Social Sciences (SPSS) software. There is no significant relationship between paved roads investment and GDP growth rate in Uganda. However, a strong relationship between paved roads investment with employment and poverty rates was established. To boost economic growth, the government should continue investing in the transport sector using appropriate and well-researched policies and strategies. In addition, the government should ensure favourable political environment and strengthen institutions and fiscal policies. Finally, the study recommends exploring the use of public private partnerships (PPPs) to finance road infrastructure in Uganda.

Keywords: wider economic benefits, paved roads, transport investment, linear regression analysis, Uganda.

1. Introduction

Transport infrastructure investment is very fundamental to social and economic development by connecting people to jobs and promoting labour mobility, education, health services and markets, and is therefore key to reducing poverty (Deng, 2013; OECD, 2020; World Bank, 2019). The direct benefits of transport investment that are usually achieved include reduced travel time, vehicle operating costs (VOC), increased safety, comfort and reliability (Banister and Berechman, 2001). In addition, there are other wider economic benefits (WEBs) relating to gross domestic product (GDP), employment and poverty (Melecky *et al.,* 2018). The impact of transport investment on wider economic growth is still one of the major unresolved research issues in modern transport and development policy, most especially for developing countries (Banister and Berechman, 2001). Some studies (Badada and Baiqing, 2019; Kwon, 2001; Pradhan and Bagchi, 2013; Martincus *et al.,* 2017; Zhou *et al.,* 2007; Zografos and

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Stephanedes, 1992) have demonstrated positive effects of transport investments on the WEBs. For instance, Kwon (2001) using Indonesian data established that 1% increase in road investment resulted in 0.3% drop in poverty incidence over 5 years. Similarly, a study by Badada and Baiqing (2019) in Ethiopia found that a 1% increase in paved road infrastructure results into a 0.376% increase in GDP. However, the empirical evidence is still weak and disputed as these economic benefits may exist but there is no guarantee (OECD, 2002; Quium, 2019).

According to Ssempala *et al.* (2020), Uganda's debt level that is estimated at 40% of the GDP partly due to continued investment in multi-lane paved road networks is worsening and likely to have a negative impact on the economy in the long run. Road transport infrastructure projects are usually capital intensive and sometimes might not be justified only by the direct benefits. Thus, there is a growing need and tendency prompting transport economists and planners to appraise these mega projects beyond the traditional cost benefit analysis to consider the WEBs (Melecky *et al.,* 2018). Despite this, there is little data and documentation regarding the impact of these investments on the WEBs in developing countries to inform governments and other stakeholders in developing appropriate policies and strategies for the transport sector. Therefore, this study aimed at establishing the relationship between paved roads investment and the WEBs of GDP, employment and poverty rates in Uganda.

1.1 Road Network in Uganda

Uganda has made substantial progress towards developing its road infrastructure specifically in the oil region and around the city of Kampala. This has been achieved through sustained investments in road infrastructure, with the contribution of road investment to the GDP observed to have increased from 2% in 1985 to 13.6% in 2016 (Ibrahim *et al.,* 2020). The country has a total road network of about 144,785km and only 4% is paved while the rest is unpaved (earth or gravel). As a result, Uganda has the least percentage of paved roads network in the East African region (Rwabizambuga, 2018). The total national road network of 20,856km managed by Uganda National Roads Authority (UNRA) comprises of 4,971km and 15,885km of paved roads and unpaved roads respectively. UNRA spends over 85% of its budget on developing roads mainly by upgrading from unpaved to paved, with the rest of its budget spent on major rehabilitations (UNRA, 2019). The development expenditure on roads by the authority that has led to increased paved road network is as shown in Fig. 1.

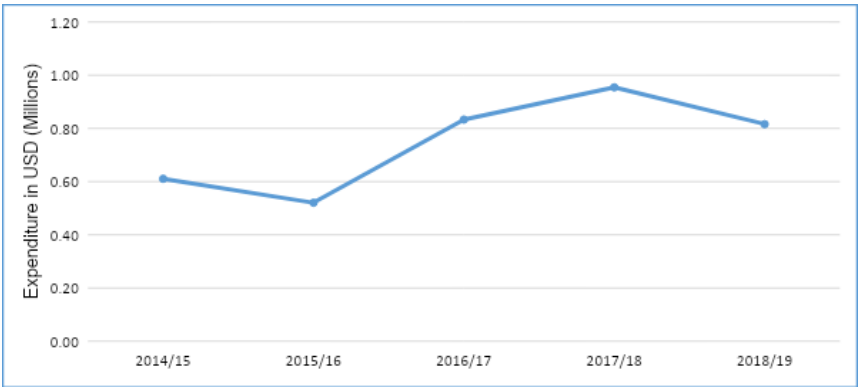

Fig. 1.
UNRA's Road Development Budget
Source: (UNRA, 2019)

Consequently, the condition of the national paved roads network has improved over the years with the percentage of poor roads decreasing from 20% in 2013/14 to 7% in 2018/19 as shown in Fig. 2 below. Furthermore, UNRA with various funding arrangements has planned and implemented a number of projects that have ultimately improved mobility and interconnectivity with the rest of the road network such as the completed Entebbe-Kampala Expressway (57km), Kampala Flyover project funded by Japan International Cooperation Agency (JICA) and Busega-Mpigi express funded by the African Development Bank (AfDB) which are both under construction.

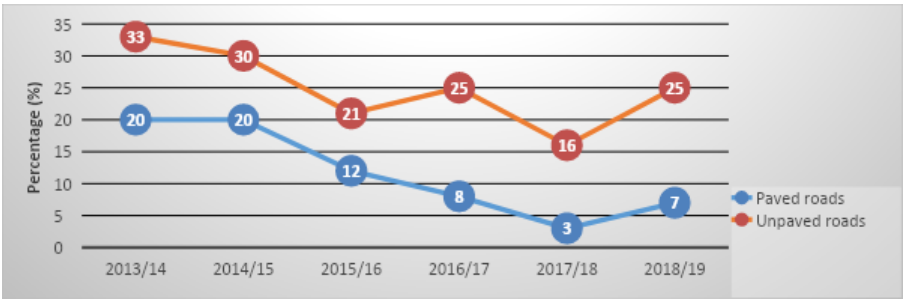

Fig. 2.
Percentage of the National Roads in Poor Condition
Source: (UNRA, 2019)

2. Data and Methodology

In this study, the three measures of economic welfare (GDP, employment and poverty rates) by Roberts *et al.* (2020) are the main indicators in establishing a relationship between paved roads investment and the WEBs. Physical measurement of roads (in kilometres) and the monetary value of transport infrastructure are the two proxies used in the literature to indicate transport investment (Wang *et al.,* 2020; Deng, 2013; Melo *et al.,* 2013). However, with limited data and documentation on the cost of paved roads infrastructure coupled with escalating unit costs of road construction and maintenance in Uganda (Ssebugwawo *et al.,* 2013), the monetary value was found not a good indicator and was thus not used in this study. Therefore, the physical measurement for the paved road length indicates the paved roads investment over the analysis period from 1992 to 2018. Simple linear regression analysis modelled the relationships between paved roads and each of the WEBs of GDP, employment and poverty with the aid of Statistical Package for Social Sciences (SPSS) software. SPSS is a powerful and user- friendly software for manipulating, analyzing and presenting data, and is particularly useful to students and researchers in social and behavioral sciences. A linear regression models the relationship between a single response variable (y) and a single explanatory variable (x). In the study, paved roads were the explanatory variables while GDP, employment and poverty data were the response variables. Paved road length (km) shown graphically in Fig. 3 was obtained from UNRA, Ministry of Works and Transport (MoWT) and Ministry of Finance Planning and Economic Development (MoFPED) in Uganda. The data on GDP, employment (Fig. 4) and poverty (Fig. 5) was obtained from the World Bank development indicators (World Bank, 2020). The data used in the analysis is summarised in Table 1.

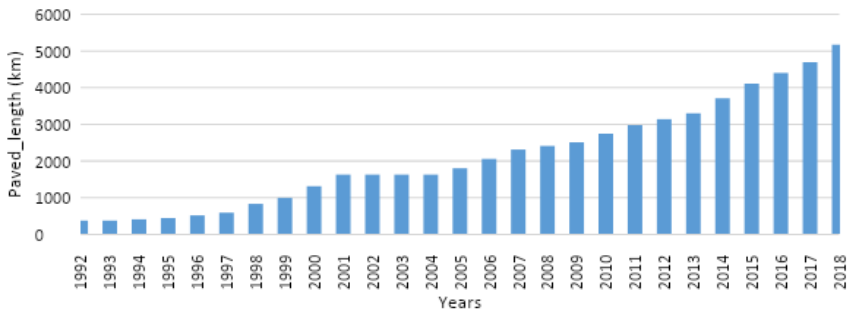

Fig. 3.
The Paved length (km) Network in Uganda
Source: (MoWT, 2017; UNRA, 2019)

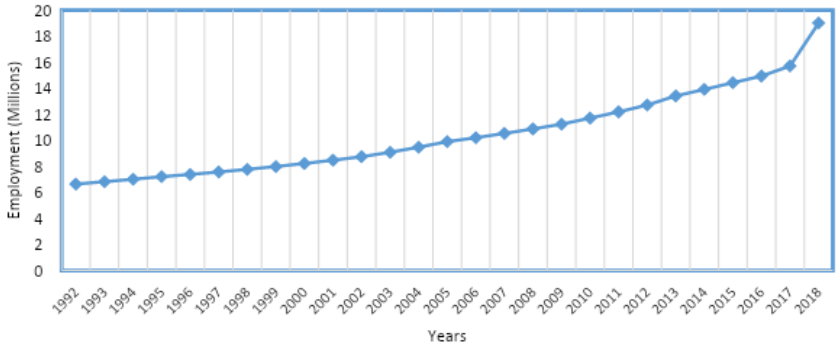

Fig. 4.
The Number of Employed People (ages 15+) in Uganda
Source: (World Bank, 2020)

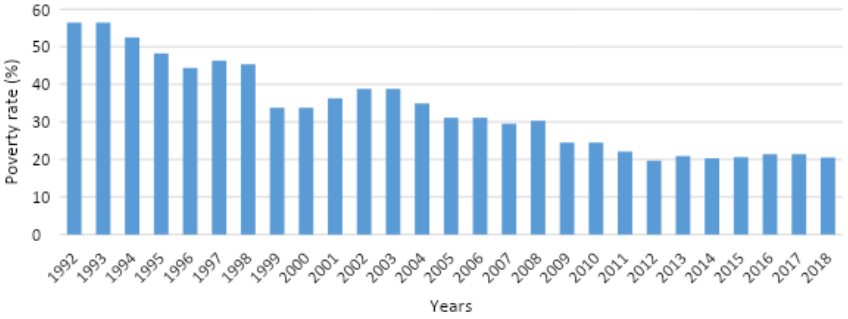

Fig. 5.
Poverty Rates (%) in Uganda
Source: (World Bank, 2020)

Table 1
Summary Statistics of the Input Data

Variables	Minimum	Maximum	Mean	Standard Deviation
Paved roads (km)	376	5,171	2125	1,430
GDP (%)	3.1	11.5	6.5	2.2
Employment (MM)	6.6	19.0	10.5	3.2
Poverty (%)	19.7	56.4	33.5	11.8

Source: Author's compilation

3. Results and Discussion

The study aimed at establishing the relationship between paved roads investment and the WEBs of GDP, employment, and poverty in Uganda. The major limitation to this study is that investment in paved roads does not explicitly account for the changes in GDP, employment and poverty rates. There are other contributing factors such as availability of quality labour force, favorable investment climate and political stability.

3.1. Model 1: Paved Roads (km) and GDP (%)

Table 2, Table 3 and Fig.6 present the results of the first model where GDP was regressed with paved roads.

Table 2
Model Summary for Paved Roads and GDP

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.304	.093	.056	2.2127787

Source: Model output from SPSS

The results from the regression analysis were not significant at the 95% level of confidence since the R-value of 0.304 obtained indicated a weak correlation between the two variables. Furthermore, as shown in Table 2 and Fig. 6, the R^2 value of 0.093 obtained indicated that only 9.3% of the dependent variable (GDP) explains the independent variable (paved roads).

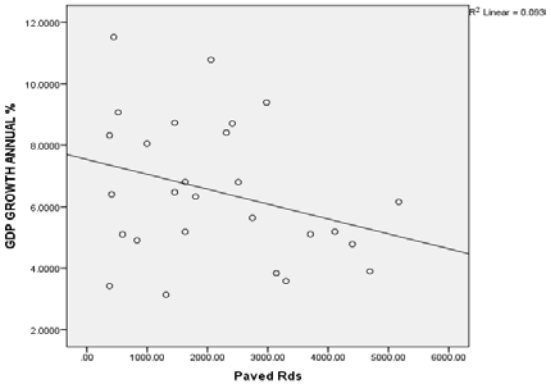

Fig. 6.
Scatter Diagram for Paved Roads and GDP
Source: Output from SPSS

In addition, statistical results in Table 3 showed that the contribution of paved roads to the model was less significant since the P value of 0.123 obtained is greater than 0.05 hence indicating that the model is not a good fit.

Table 3
Model Coefficients for Paved Roads and GDP

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	7.5	.773		9.757	.000	5.948	9.131
Paved roads	.000	.000	-.304	-1.597	.123	-.001	.000

Source: Output from SPSS

Table 3 shows that a unit increase in paved roads increases GDP by a negligible amount. The findings are comparable to those established by Muvawala *et al.* (2020) where a one-percentage point increase in road transport infrastructure investment (1983-2018) increased economic growth by 0.062 percentage points in the long run and a negative impact in the short run using Auto Regressive Distributed Lag (ARDL) modelling. Kayode *et al.* (2013) observed a similar finding in Nigeria (1977-2009) where one unit increase in transport infrastructure investment resulted in 0.003 GDP units. However, the above findings are not in agreement with a study conducted by Mukiibi (2013) using ordinary least squares (OLS) for the period 1980 to 2010 who established that a one percent increase in the number of kilometres for paved road length would result in a 2.8% increase in GDP in Uganda. Similarly, Ibrahim *et al.* (2020) using fully modified OLS for the period 1985 to 2016 found that one unit increase in road infrastructure investment increases GDP growth rate by 0.614 units in Uganda. The discrepancy is due to the different data sets and methodology used. GDP contribution by road infrastructure investment is slowly diminishing over time partly due to increasing unit costs, corruption and inefficiency of government departments in handling procurements and implementation (Ssebugwawo *et al.,* 2013). In addition, Fig.7 shows that the country's economic performance has generally been on the decline in the last ten years which may further support the insignificant impact of paved roads investment on GDP growth rate. The majority of the paved length network is due to upgrading of already existing and established unpaved roads, which are already carrying high volumes of traffic and may only result in reduced travel time and operating costs.

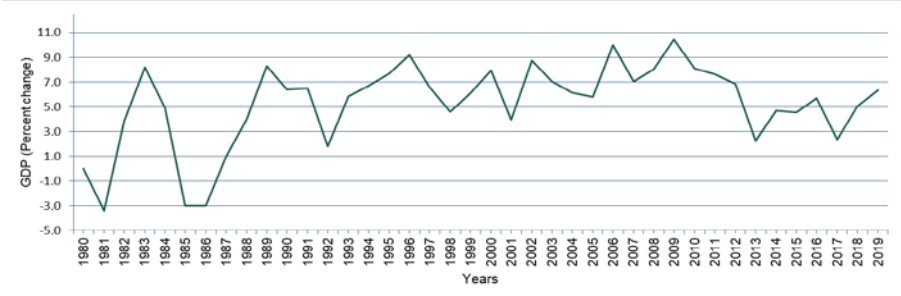

Fig.7.
GDP Growth Rate in Uganda
Source: IMF, 2020

3.2. Model 2: Paved Roads (km) and Employment (Numbers)

In this second model, employment was regressed with paved roads as presented in Table 4, Table 5 and Fig. 8. As shown in Table 4, the results from the regression analysis were significant at the 95% level of confidence since R-value of 0.988 obtained indicated a strong correlation between the two variables. Furthermore, as shown in Table 4 and Fig. 8, the R^2 value of 0.976 obtained indicates that 97.6% of the dependent variable (employment) might be explained by the independent variable (paved roads).

Table 4

Model Summary for Paved Roads and Employment

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.988	.976	.975	500953.504

Source: Output from SPSS

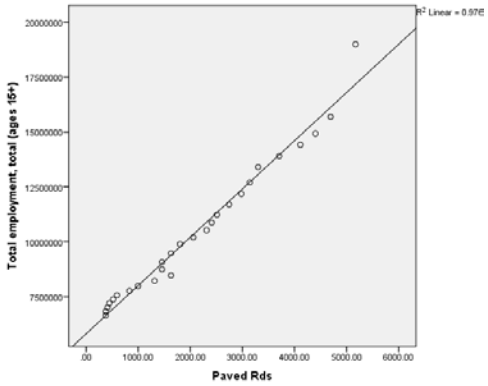

Fig. 8.

Scatter Diagram for Paved roads and Employment
Source: Output from SPSS

Statistical results in Table 5 showed that the contribution of paved roads to the model was very significant since the P value of 0.00 obtained is less than 0.05 hence indicating that the model is a good fit. In Table 5, a positive relationship shows that a unit increase in paved roads increases employment by 2,199. This is in agreement with a study conducted in India where a 10% increase in highways investment and urban road construction created 83,401 and 178,181 jobs in Gujarat and West Bengal respectively (Quium, 2019). The increase in employment rate is possibly due to increased agricultural and commercial activities as connectivity and accessibility are improved. Nonetheless, the above findings are not in agreement with those from a study conducted by Thompson *et al.* (1993) using county level data in Florida which established that road construction did not influence job growth. This seems to be true more especially if road infrastructure facilities already exist in

abundancy and any addition only marginally improves accessibility. However, with the limited road infrastructure in the country, any investment may boost employment opportunities starting with the creation of direct jobs during the implementation phase.

Table 5

Model Coefficients for Paved Roads and Employment

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	5,807,238	174,931.710		33.197	.000	5,446,959.609	6,167,516.811
Paved roads	2,199	68.677	.988	32.025	.000	2,057.913	2,340.798

Source: Output from SPSS

3.3. Model 3: Paved Roads (km) and Poverty Rates (%)

In final model, poverty was regressed with paved roads and the results presented in Table 6, Table 7 and Fig. 9 below. As shown in Table 6, the results from the regression analysis were significant at the 95% level of confidence since R-value of 0.898 obtained indicated a strong correlation between the two variables. Furthermore, as shown in Table 6 and Fig. 9, the R^2 value of 0.806 obtained indicates that 80.6% of the dependent variable (poverty) might be explained by the independent variable (paved roads).

Table 6

Model Summary for Paved Roads and Poverty

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.898	.806	.798	5.2854091

Source: Output from SPSS

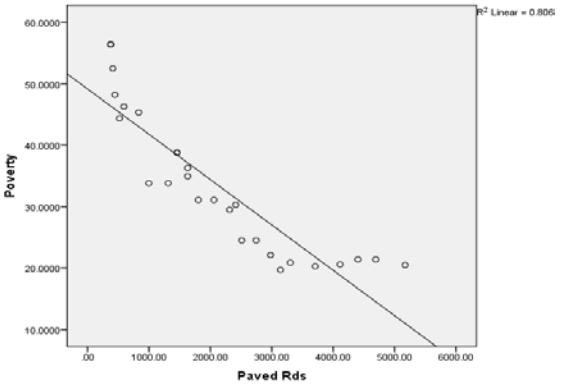

Fig. 9.

Scatter Diagram for Paved Roads and Poverty
Source: Output from SPSS

In addition, statistical results in Table 7 showed that the contribution of paved roads to the model was very significant since the P value of 0.00 obtained is less than 0.05 hence indicating that the model is a good fit. A negative relationship from Table 6 shows that a unit increase in paved roads reduces poverty by 0.007%. This is in agreement with a study conducted by Fan and Zhang (2008) where a one million shillings expenditure on tarmac roads reduced poverty levels by moving 10 people above the poverty line. A person below the poverty line is one whose consumption falls below the estimated US$34 per capita per month, which is equivalent to a dollar per day (Appleton, 2001). Similarly, in a study conducted by Kwon (2001) using Indonesian data established that a 1% increase in road investment resulted in a 0.3% drop in poverty incidence over 5 years. Generally, the above results suggest that improvements in the road infrastructure stimulate agricultural, industrial and other activities thus reducing poverty.

Table 7

Model Coefficients for Paved Roads and Poverty

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	49.164	1.846		26.638	.000	45.363	52.966
Paved Roads	-.007	.001	-.898	-10.186	.000	-.009	-.006

Source: Output from SPSS

4. Conclusion

This study aimed at assessing the impact of paved roads investment on the WEBs relating to GDP, employment and poverty. There is no significant relationship between paved roads investment and GDP growth rate in Uganda. However, a strong relationship between paved roads investment with employment and poverty rates was established. The relationship with employment is stronger than that with poverty rates. The Ugandan government should continue to invest in the transport sector in order to boost economic growth based on well-researched policies and strategies. To boost GDP growth, the governments should ensure favorable political environment and strengthen institutions and fiscal policies. Finally, the study recommends the government to explore the use of public private public partnerships (PPPs) to finance road infrastructure.

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