INVESTIGATING THE EFFECT OF INFRASTRUCTURAL DEVELOPMENT ON ECONOMIC GROWTH IN UGANDA

Abstract

Aim: The study used quarterly time series data to investigate the effect of infrastructural development on Economic Growth in Uganda.

Place and Duration of Study: the study utilized data for the period between 2005-2020 obtained from the 2022 World Bank's World Development Indicators (WDI) and the African Development Bank for African Infrastructure Development Index (AIDI).

Methodology: The study used the Autoregressive Distributed Lag (ARDL) model to analyze the relationship between infrastructure development and Economic Growth in Uganda.

Results: The findings from the study indicated a positive relationship between AIDI and Economic growth in Uganda. Overall improvement in AIDI considering the four infrastructure components creates an enabling environment for other factors of production to operate effectively and efficiently hence spurring economic growth in the country.

Conclusion: The findings therefore implies that investment in infrastructure should consider all the four infrastructure components that comprise the AIDI namely, Transport, Electricity, ICT and Water and Sanitation for Uganda to be able to fully benefit from its investment in infrastructure in both the short and long run.

Key words: *Economic Growth, ARDL Model, African Infrastructure Development Index (AIDI), Infrastructure Development*

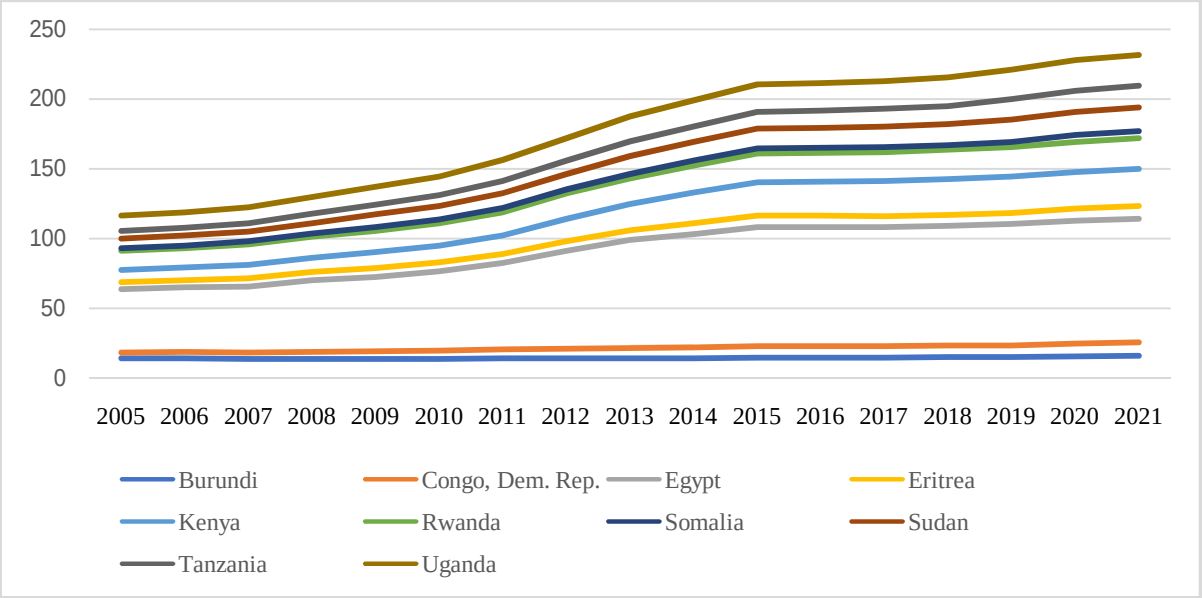
1.0 Introduction

The African Development Bank (AfDB) took the responsibility of developing an index for infrastructure development in Africa called the African Infrastructure Development Index (AIDI)[1] which is used to trace the progress of advancement of the infrastructure on annual basis. According to the Bank, AIDI scores improved for virtually all African Countries between 2018 and 2020 with the global index Computed for the entire continent rising from 28.44 to 29.63. As expected, performance indices for the top ten countries increased from 36.79 – 94.32 in 2018 to 35.50 – 96.73 in 2020. In general, the progress stems from improvements in the sector indices for water and sanitation and for Information, Communication and Technology (ICT). However, the improvement in the scores for the ten bottom-ranked countries remains weaker. For these countries, the range of indices decreased from 3.62 – 12.50 in 2018 to 4.53 – 12.60 in 2020.

Figure 1 below indicates Uganda ranked better in comparison to select countries within the region and the trend exhibits a positive trajectory and this could be attributed to investments in the infrastructure over time.

[1] The AIDI is based on four major components: (i) Transport; (ii) Electricity, (iii) ICT, and (iv) Water & Sanitation.

Figure 1: African Infrastructure Development Index for East African Countries



Source: African Infrastructure Development Index, 2019

Uganda through its Vision 2040 desires to transform the country from a peasant to a modern and prosperous country within 30 years ***(beginning 2010)***. However, the primary source required for the attainment of Uganda's Vision 2040 objective is increased domestic productivity and for this to occur, the country must create sufficient domestic physical capital to stimulate desired economic growth.

Therefore, for Uganda to attain the desired growth, the Government prioritized infrastructure development through its five-year National Development Plans (NDP) namely NDPI – FY 2010/11 – FY 2014/15, NDPII -FY 2015/16 – FY 2019/20 and NDPIII FY 2020/21 – FY 2024/25 with the aim of achieving an economic growth rate target of about 8.2 percent[2] per annum during the 2040 vision period [1].

"Also there appears to be a consensus in the research that for a country to progress in its Sustainable Development Goals (SDGs), there is a need for improvements in infrastructure quality and economic growth is a necessity because it affects citizens' lives positively especially in the area of poverty reduction" [2].

"World Bank notes that fixed capital formation is a major contributor, catalyst and determinant of a country's economic growth. Gross Fixed Capital Formation (GFCF)[3] is required for augmenting a country's economic productivity [3] in which agrees with the predictions of Romer (1986) and Lucas (1988) Growth Models that stipulate that increased growth rates can be

[2]Uganda. (2013). Uganda Vision 2040: A Transformed Ugandan Society from a Peasant to a Modern Prosperous Country within 30 Years.

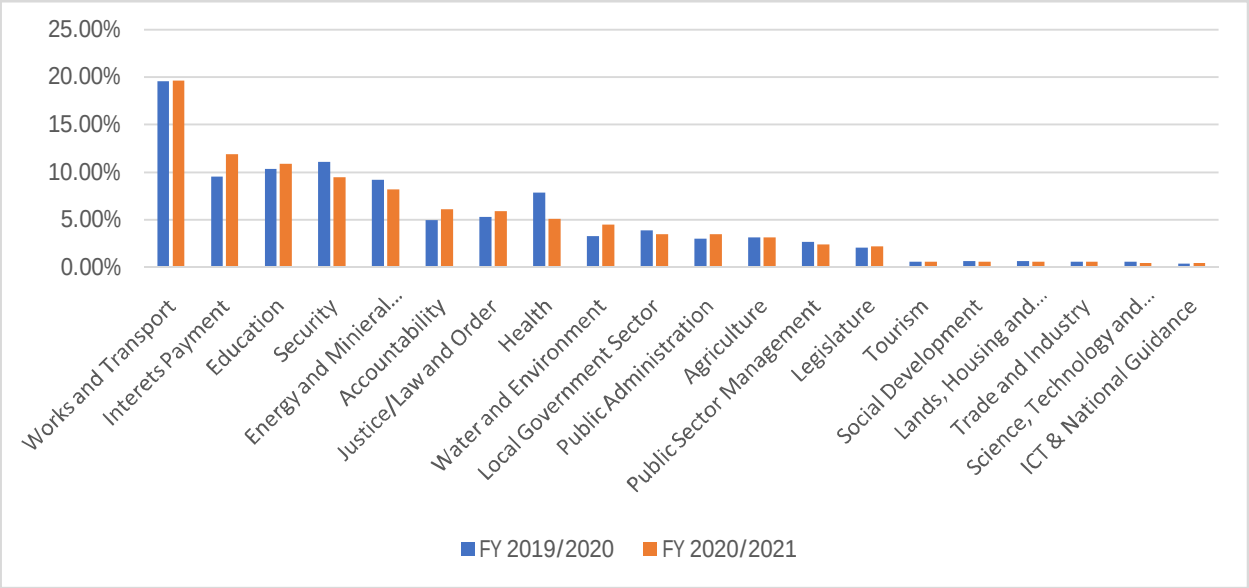
[3] According to the World Bank GFCF refers to fixed assets accumulation such as land improvements, equipment, machinery, construction of roads and railways, building of schools among others.

achieved by increasing capital accumulation". "Also, the building of schools leads to improved educational enrolment rate which will enhance the quality of human capital" [4]. Likewise, investment in infrastructure makes a significant contribution towards growth by increasing the factor productivity of land, labour and capital in the production process.

Also, a study by [5] explained "capital formation as "proportion of present income saved and invested in order to augment future output and income." This definition supports the importance of savings as an integral element needed for creating GFCF and enhancing economic growth. Therefore, it can be concluded that a country with low gross domestic marginal propensity to save is likely to have poor capital formation which potentially impedes economic growth and vice versa".

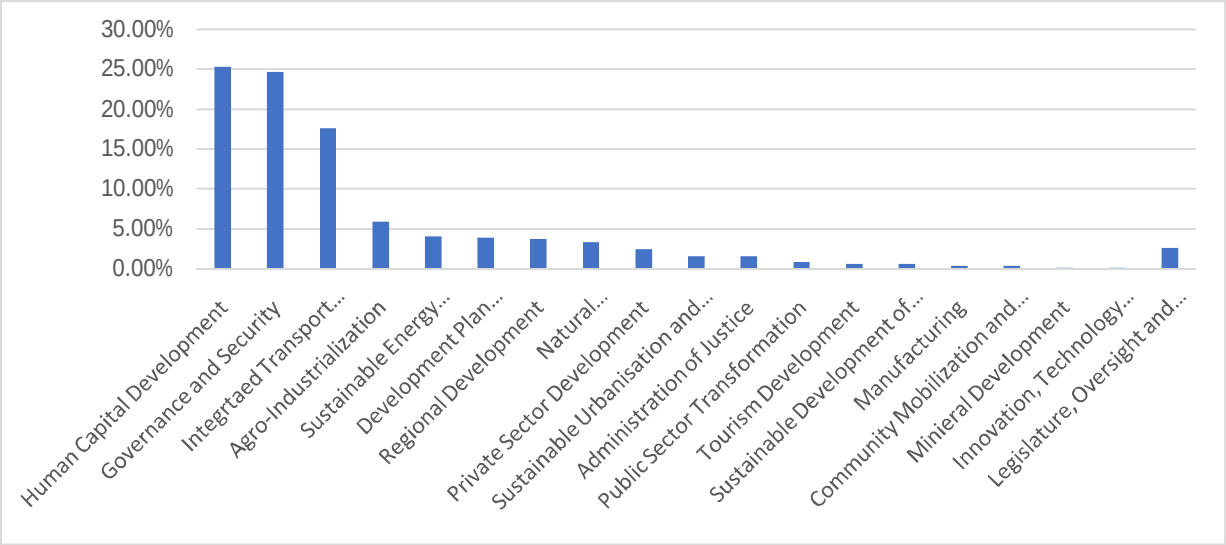
The government of Uganda in a bid to return to higher growth rates and move the country towards middle-income status focused on addressing infrastructure bottlenecks by building hydropower plants, a modern road network, and railway in addition to the oil fields developed with a consortium of companies. Attention has as well been paid to social spending on health and education as this is needed to ensure that all Ugandans can seize the opportunities offered by infrastructure and regional integration in the East African Community (**See figures 2 and 3).**

Figure 2: Key Sector Budget Allocations in Uganda (FY 2019/20 and FY2020/21)



Source: **Ministry of Finance, Planning and Economic Development**

Figure 3: Percentage Programme Budget Allocations for FY 2022/2023 in Uganda

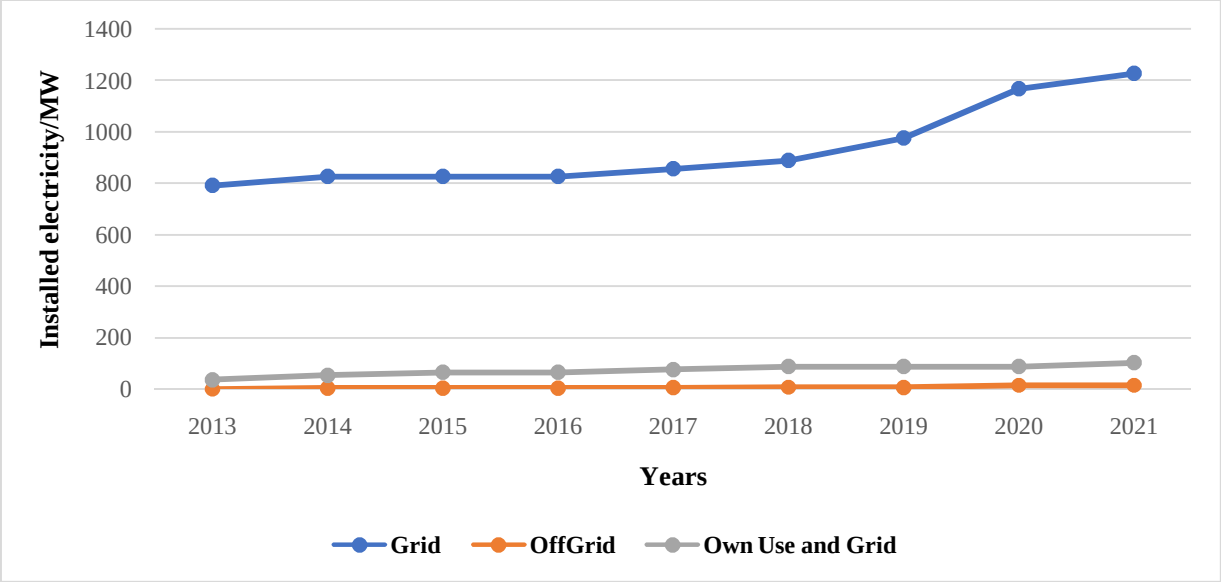


Source: **Ministry of Finance, Planning and Economic Development**

Investment in energy infrastructure has raised the country's electric power generation capacity from 984 MW as at the end of December 2018 to 1,346.6MW in 2021 this after the Karuma hydro-electric power plant became operational in 2019. As a result, national access to electricity has increased to 28 percent in FY2020/21 up from 25 percent in FY2018/19.

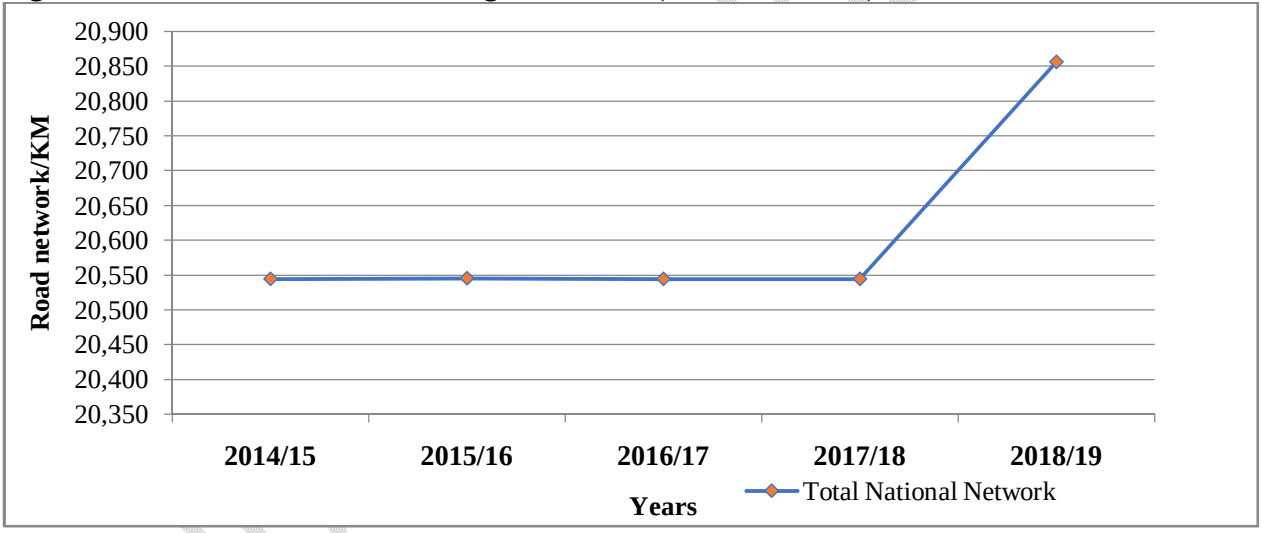
According to the Electricity Regulatory Authority (ERA), the electricity consumption per capita has also improved from below 80KWh in 2013/14 to 215KWh in FY 2020/21. Nonetheless, it is significantly lower than Africa's Average of 578KWh and the world's average of 2,472KWh per Capita (ERA, 2021). The low electricity consumption is due to the high cost of electricity. Whereas the cost of electricity reduced to an average of 8.3 US cents per kilowatt-hour (kWh) by December 2020 from 16.6 U. S cents in 2013, it is still unaffordable by majority of Ugandans [6].

Figure 4: Uganda's Electricity Installed Capacity by Purpose/Connection in Megawatts (MWs)



Source: ERA

Figure 5: National Road Network in Uganda in Km (2014/15-2018/19)



Source: Uganda National Roads Authority

Government of Uganda continues to increase spending on infrastructure with a view of improving economic growth and ease the burden on citizens. Specifically, efficient transportation and communication should be available, people should enjoy quality basic healthcare delivery with minimal effort and there should be food security; but ironically, this is not the case. The problem is that the economic growth recorded has not translated into improved welfare as expected. For instance, Uganda failed to achieve its lower middle income status target by end of NDP II. By end of the NDP II tenure in 2019/20, Uganda GDP per capita was US$ 910 in FY2019/20 below the planned target of US$ 1,039. This problem is of concern to this study because the trend has to be reversed if Uganda is to achieve it growth and development objective by 2040. **Thus, the aim of this study is to investigate the effect that infrastructural**

development has had on economic growth in Uganda over the period 2005-2020. This is because understanding the relationship between infrastructure and economic growth is important in the context of Uganda considering the need to close the country's infrastructure gap as efficient infrastructure attracts centers of production and consumption, gives greater access to markets and education centers and also timely access to health care facilitated by transport can prevent maternal deaths and lower infant mortality rates among other advantages.

This paper therefore contributes to the literature on infrastructure and economic growth specifically for Uganda using the African Infrastructure Development Index (AIDI) computed by the African Development Bank.

The rest of the paper is organized as follows; section two examines both theoretical and empirical evidence on economic growth and infrastructural development. Section 3 describes the data and the empirical methodology employed in this study. Section 4 presents empirical findings. Section 5 Concludes and gives policy recommendations.

2.0 Literature Review

2.1 Empirical Review

Different studies in the literature argue that infrastructure development leads to economic growth while others are against this argument and find contrary effects of infrastructure development on economic growth especially in developing countries like Uganda.

[7] looks "at both economic and social infrastructure. He also uses both the Pesaran, Shin and Smith autoregressive distributed lag (PSS ARDL) approach to test the direction of causality and a Vector Error Correction Model (VECM) model to examine the relationship between his two measures of infrastructure, private investment and Gross Value Added (GVA). By including the private investment variable, he allows for the possibility that the infrastructure-growth relationship is direct or indirect, via private investment".

[8] evaluated "the infrastructural development and Economic growth Nexus in Nigeria using time series data for the period 1983 to 2013using the Ordinary Least Squares (OLS) and Granger Causality econometric Techniques. The OLS results show that a positive and significant relationship exists between infrastructural development (proxied by GFCF) and economic growth in Nigeria (proxied by GDP) and thus recommends that it is worthwhile for the Nigerian government and policymakers to implement policies geared towards the development of infrastructure. This would result in increasing economic efficiency, productivity and also attract potential FDI inflow in to the country. However, the Granger Causality test reveals that there is no mutual correlation or causality between both variables in Nigeria for the period under review".

Findings by [9], also indicate that "infrastructure development especially transport infrastructure is of great importance to the tourism sector as the provision of tourism services to the

international market is entirely dependent on transport infrastructure, while provision to the local market is severely constrained in the absence of such infrastructure". "Relatedly, transport infrastructure guarantees growth and development as it facilitates mobility of both people and goods" [10].

[11], investigated "the role of infrastructure in promoting economic growth in China for the period 1975 to 2017 using the Generalized Method of Moments (GMM) and the ARDL Model. Their results reveal that infrastructure stock, labour force, public and private investments have played an important role in economic growth in China and more importantly that infrastructure development in China has significant positive contribution to growth than both private and public investment. Further, there is a unidirectional causality from infrastructure development to output growth justifying China's high spending on infrastructure development since the early nineties".

[12] investigated "the impact of economic infrastructure on long term economic growth in Botswana using the VECM and the OLS. Results of the VECM and OLS show that long term economic growth is explained by both measures of infrastructure (electricity distribution and maintenance of roads). The impact of the former was more pronounced than the impact of the later. However, evidence supports the infrastructure led growth hypothesis for Botswana".

[13] while using "the simultaneous Equation Modelling and the OLS, they investigate the effect of infrastructure development and economic growth in Nigeria. Results from the OLS indicate that infrastructure is an integral part of Nigeria's economic growth. Undermining infrastructure development therefore undermines the growth and development of the Nigerian economy. The study thus recommends that if the real sector which is the engine of growth is to propel Nigerian growth and development, infrastructure should be given qualitative and adequate attention".

"Using a granger causality approach, [14] investigated the relationship between economic growth and infrastructure expenditure in Kenya for the period 1980 to 2013. Their findings showed that there is a bilateral causality between economic growth and infrastructural development in Kenya".

[15] investigated "the effect of government spending on infrastructure and economic growth in Nigeria using both secondary and primary data for the period1980 to 2016. The study findings indicate that government spending on transportation and communication, education and health has significant effects on economic growth in Nigeria, while spending on agriculture and natural resources infrastructure has an opposite effect on economic growth in Nigeria".

2.2 Data and Methodology

This study makes use of Quarterly (Q) time series data from 2005Q1 to 2020Q4. The datasets consist of observations for Gross Domestic Product (GDP), Labour Force (LF), Gross Fixed Capital Formation (GFCF) obtained from the World Development Indicators (WDI) World Bank data, Uganda Infrastructure Development Index (AIDI), Transport Composite Index, Electricity

Composite Index and ICT Composite Index obtained from the African Infrastructure Development Index data compiled by the African Development Bank.

3.2.1 Variable Definition and Measurement

Gross Domestic Product (GDP); GDP is the monetary value of goods and services produced in a country in a given period of time usually a year. It is a measure of economic growth which is measured by the annual GDP growth rates.

Labour Force (LF); this is the total labour force of the country and this variable is used as provided for in the cobb-Douglas production function.

Gross Fixed Capital Formation (GFCF); this represents the infrastructure variable and this study uses the annual growth rate of the gross fixed capital formation.

African Infrastructure Development Index (AIDI); The Africa Infrastructure Development Index (AIDI) is produced by the African Development Bank. The AIDI serves a number of key objectives, principally: (i) to monitor and evaluate the status and progress of infrastructure development across the continent; (ii) to assist in resource allocation within the framework of African Development Fund (ADF) replenishments; and (iii) to contribute to policy dialogue within the Bank and between the Bank, RMCs and other development organizations. Therefore, the study adopts the AIDI as a measure for the infrastructure index for Uganda.

Transport Composite Index (TCI); this is comprised of the total Paved Roads (KM per 10,000 inhabitants) and the total Road Network (per KM^2 of exploitable land area) in a given country.

Electricity Composite Index (ECI); is the total electricity production of a given country, including the energy imported from abroad. This includes both private and public energy generated. The indicator is measured in millions of kilowatt-hours produced per hour and per habitant.

Information, Communication and Technology (ICT) Composite Index (ICT_I); this is comprised of the subscriptions to mobile telephone and the internet with a large international bandwidth.

3.0 Materials and Methods

3.1 Theoretical Framework

Theoretical Review

The quality of infrastructure matters for economic growth and development as it reduces costs, promotes integration, enhances factor mobility and the country can take advantage of opportunities for investment in human capital. The endogenous growth model by [16], shows that the flow of productive expenditure by the government contributes to the level of current production of the entire economy. The production function framework has been used to explain

the connection between investment and economic growth. Infrastructure can be included as an additional factor of production by incorporating it in the neoclassical growth model. Factors of production are captured well by the general cobb-Douglas production function [17] which can be shown as;

$Y = f(K, L, Infrastructure)$ t =1

$Y_t = f(K_t, L_t, Infrastructure_t)$……..…. (1)

Where;

- *Y-economic growth*
- *t-time*
- *K-Capital*
- *L-Labor*

Equation one shows that economic growth (Y_t) is a dependent on the level of capital (K), Labour force (L), and the level of infrastructure development. Infrastructure can have a long run effect on economic growth which is subject to the model of growth, neoclassical or endogenous, employed in generating data. According to the exogenous growth model, shocks to infrastructure are perceived to have only transitory effects on growth which is only true in cases where long term growth is driven by technical progress. The endogenous growth model argues that any shocks to infrastructure have an effect of increasing the steady-state level of output [18].

Finally, we estimate the following equations to empirically examine the effect that infrastructural development has had on economic growth in Uganda over the period 2005-2020.

$GDP_t = \beta_0 + \beta_1 AIDI_t + \beta_2 TCI_t + \beta_3 ECI_t + \beta_4 LF_t + \beta_5 ICT\_CI_t + \beta_6 GFCF_t + \varepsilon_t$……. (2)

The expected sign of ($\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$,) is >0; *t* is 64 Quarters namely 2005 Q1 – 2020Q4.

Where ε is the error term which has got zero mean, is normally distributed and independent of the explanatory variables [19]. The error term is vital in capturing the impact of any other important variables that could not have been captured in the model. Other variables remain as defined prior.

The study makes use of the F-test to determine the overall significance of the model and the long run relationship among the variable. The F-test poses two critical asymptotic bounds for there is no cointegration if the bounds is low and we accept that there is cointegration if the bound is high. If the long run cointegrating relationship exist, then an error correction model has to be estimated. The ARDL error correction model is as illustrated in equation (3)

$y_t = \alpha + \sum_{i=1}^{p} \gamma_i \, y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_j} x_{j,t-i}' \beta_i + \varepsilon_t$……. (3)

Where;

yt= GDP indicator

$xj,-i$= The independent variable including the AIDI variable

εt is the error term

Some of the explanatory variables may have no lagged term in the model (q1=0).

The stability of the model is tested for using the Breush-Godfrey serial correlation LM test and the Ramsey Reset test.

4.0 Results and Discussions

4.1 Descriptive statistics

Due to data inadequacies among the different variables used in study over the study period, the total of observations (quarters) used in study reduced from 64 to 61 for the quarterly period 2005Q1 – 2020Q4. Table 1, shows a summary of 61 observations and it shows that economic growth (GDP) had the highest quarterly average while the lowest quarterly average was on ICT Composite index. All the variables are not normally distributed with a kurtosis of less than 3. All the variables were negatively skewed except for the Electricity Composite Index and the Labour force. In summary, all the variables do not conform to normal distribution but display positive skewness (i.e., the distribution has a long right tail) for LNQECI and LNQLF and negative skewness (the distribution has a long-left tail) for LNQGDP, LNQAIDI, LNQGFCF, LNQICT_CI and LNQTCI. The Jarque Bera probability for all the variable results is less than 5 % implying that they are normally distributed

Table 1: Summary Descriptive statistics

	LNQGDP	LNQAIDI	LNQECI	LNQGFCF	LNQICT_CI	LNQLF	LNQTCI
Mean	24.05456	2.773351	0.147506	22.61789	-0.552410	16.33876	2.141862
Median	24.08318	2.831072	0.113236	22.68349	1.422599	16.32878	2.195101
Maximum	24.43118	3.089628	0.358575	23.02693	2.446737	16.59544	2.315365
Minimum	23.55065	2.400731	-0.133424	21.98778	-7.245635	16.08353	1.852813
Std. Dev.	0.248130	0.240405	0.127032	0.274158	3.400842	0.159623	0.161452
Skewness	-0.316699	-0.264538	0.185899	-0.383619	-0.803966	0.121948	-0.850895
Kurtosis	2.046900	1.457883	2.095079	2.342455	1.981343	1.791302	2.204253
Jarque-Bera	3.328548	6.755870	2.432669	2.595090	9.208735	3.864441	8.970311
Probability	0.189328	0.034118	0.296314	0.273202	0.010008	0.144826	0.011275
Sum	1467.328	169.1744	8.997843	1379.691	-33.69703	996.6646	130.6536
Sum Sq. Dev.	3.694113	3.467666	0.968224	4.509758	693.9436	1.528767	1.564001
Observations	61	61	61	61	61	61	61

4.2 Correlation

We tested the variables for multicollinearity using the correlation matrix. The correlation matrix presented in table 2 describes the statistical correlation among the variables.

Table 2: Correlation Matrix

Probability	LNQGDP	LNQAIDI	LNQECI	LNQGFCF	LNQICT_CI	LNQLF	LNQTCI

LNQGDP	1.000000						
LNQAIDI	0.976670***	1.000000					
LNQECI	0.704553***	0.701563	1.000000				
LNQGFCF	0.993757***	0.962295***	0.717314***	1.000000			
LNQICT_CI	0.944218***	0.949577***	0.596898***	0.938395***	1.000000		
LNQLF	0.985799***	0.968888***	0.765432***	0.975866***	0.889904***	1.000000	
LNQTCI	-0.886200***	-0.850830***	-0.811633***	-0.880355***	-0.726283***	-0.941795***	1.000000

Source: Computed by Author using EVIEWS 10

Note: * Significant at 1%, ** Significant at 5%, * Significant at 10%.**

The results as presented in table 2 show that the variables are highly correlated. This therefore prompted the study to test for test for correlation at first difference. Results of the correlation analysis at first difference in Table 3 shows that the variables are not highly correlated at first difference implying that there is no multicollinearity at first difference.

Table 3: Correlation Analysis in first difference

Probability	DINQGDP	DLNQAIDI	DLNQGFCF	DLNQECI	DLNQICT_CI	DLNQLF	DLNQTC
DINQGDP	1.000000						
DLNQAIDI	0.703054***	1.000000					
DLNQGFCF	0.556004***	0.468854***	1.000000				
DLNQECI	0.004047*	0.011902*	0.539410***	1.000000			
DLNQICT_CI	0.456833***	0.411149***	0.168001	0.132786	1.000000		
DLNQLF	0.097716	0.115080	0.167237	0.134150	-0.015132	1.000000	
DLNQTC	0.359603***	-0.004450*	0.206929	0.072857	0.083772	-0.317338**	1.000000

Source: Computed by Author using EVIEWS 10

Note: * Significant at 1%, ** Significant at 5%, * Significant at 10%.**

4.3 Unit Root Test/Order of Integration

To test for stationarity or non-stationarity of the variables, the Augmented Dickey Fuller (ADF) Test and the Phillip Perron (PP) tests were applied to ascertain the order of integration of the variables of the series to avoid spurious results. Table 4 shows Unit Root test Results for Variables at levels (I (O)) and first different (I (1)) for both the ADF and PP Unit root tests.

Table 4: Unit Root Test Results at both levels and First Difference

	Levels – I (0)		First Difference – I (1)	
Variable	**ADF-Test**	**PP-Test**	**ADF-Test**	**PP-Test**
DINQGDP	-2.35698	-2.466286	-5.474137***	-7.461888***
DLNQAIDI	-2.503951	-2.543828	-7.462066***	-7.461858***
DLNQGFCF	-2.532362	-3.078838*	-5.827735***	-7.468082***
DLNQECI	-3.299547*	-3.520084*	-7.628085***	-7.628087***
DLNQICT_CI	-5.221085***	-5.279410***	-8.233968***	-24.76308***
DLNQLF	-0.890742	-1.055660	-7.529973***	-7.529973***
DLNQTC	-2.934430*	-3.134358*	-7.553890***	-7.553890***

Source: Computed by Author using EVIEWS 10 Note:

***** Significant at 1% ** Significant at 5% * Significant at 10%.**

From Table 4 above, both the ADF and PP show that all the variables are stationary at first difference i.e. I (1). Next, we use autoregressive-distributed lag (ARDL) model developed by [20] to find out long-run relationship among the relevant variables.

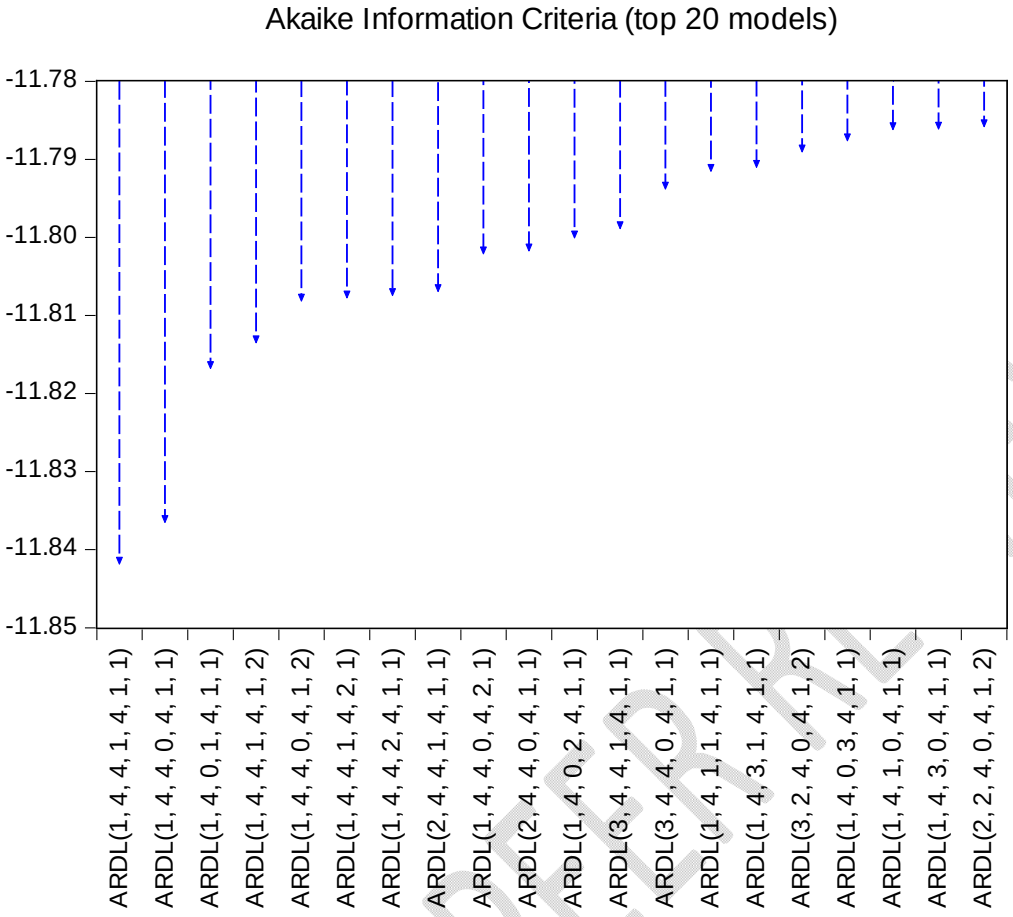
4.4 Autoregressive Distributed Lag (ARDL) Model

The study uses the ARDL model which has been scientifically designed to cater for scenarios where variables are stationary at different levels.

4.4.1 Lag Selection

Before running the final regression, we need to determine ARDL model with appropriate lags for each variable. The ARDL is denoted by ARDL (p, q_1, q_2, q_3, q_4, q_5, q_6), where in this particular case, p is the lag of dependent variable - GDP and q_1 to q_6 are the respective lags of the explanatory variables AIDI, ECI, ICT_CI, TC, GFCF, and LF respectively. Results of the selected model using the Akaike information criteria (AIC) suggested ARDL (1,4,4,1,4,1,1) as the best model out of the top 20 evaluated models since it portrays the lowest AIC value where the dependent variable (GDP) is to enter the model with lag 1 while other explanatory variables enter with (1,4,4,1,4,1,1) lags respectively (**see figure 6**).

Figure 5: Model Selection Summary Graph



Source: Authors Computation using EViews 10

4.4.2 Cointegrating Relationship

From the Bound F-test procedures, the cointegration test results (See table 6) show the F-statistics value of 10.81440, which is above the upper bound (I1) value of 3.28 at 5 percent level. Therefore, we reject the null hypotheses that there is no long-run relationship among the variables and conclude that there is cointegration among the variables in the long run and this implies that there is a long run relationship among the variables.

Table 5 presents the results of the long run cointegrating vector coefficients of the infrastructure and Economic Growth while Table 7 shows the short run results.

Table 5: ARDL Bound F-Test for Cointegration

F-Bounds Test		**Null Hypothesis: No levels relationship**		
Test Statistic	Value	Signif.	I (0)	I (1)
			Asymptotic: n=1000	
F-statistic	10.81440	10%	1.99	2.94
k	6	5%	2.27	3.28
		2.5%	2.55	3.61
		1%	2.88	3.99

Actual Sample Size	56		Finite Sample: n=60	

Source: Authors Computation using EViews 10

Table 6: ARDL Error Correction and Short Run Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DLNQAIDI(-1))	-0.496178	0.061193	-8.108400	0.0000
D(DLNQECI(-1))	-0.010317	0.002674	-3.858457	0.0005
D(DLNQGFCF)	-0.027434	0.014588	-1.880577	0.0689
D(DLNQICT_CI)	0.004183	0.000314	13.32649	0.0000
D(DLNQLF)	0.460680	0.065644	7.017868	0.0000
D(DLNQTC)	0.110374	0.007381	14.95314	0.0000
CointEq(-1)*	-0.729492	0.071236	-10.24045	0.0000

Source: Authors Computation using EViews 10

Based on the estimated cointegrating vector and after normalizing the variables by Economic Growth, the long run equilibrium equation can be written as;

GDP=0.001949+0.7572QAIDI+0.0046QECI-0.0081QGFCF+0.0010ICT-CI+0.2006QLF+0.0700QTC……. (3)

Table 7: Results of the Normalised Cointegrating Long run Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLNQAIDI	0.757178	0.090645	8.353191	0.0000
DLNQECI	0.004590	0.007615	0.602740	0.5508
DLNQGFCF	-0.008067	0.013714	-0.588249	0.5604
DLNQICT_CI	0.001017	0.001044	0.973937	0.3372
DLNQLF	0.200622	0.076812	2.611861	0.0134
DLNQTC	0.069957	0.016364	4.275092	0.0002
C	0.002	0.000647	3.012115	0.0050

Source: Authors Computation using EViews 10

4.4.3 Diagnostic tests

The study used the Breusch Godfrey Serial Correlation LM Test and the Ramsey RESET Test to test the reliability of the model used for analysis.

From the Breusch Godfrey Serial Correlation LM Test, the results indicate that there is no heteroskedasticity or no serial correlation in the model since the probability of F-Statistics and the Chi-Square the probability is greater than 0.05 as shown in table 8 below.

Table 8: Breusch-Godfrey Serial Correlation LM Test:

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.195251	Prob. F (2,31)	0.8236
Obs*R-squared	0.696646	Prob. Chi-Square (2)	0.7059

Source: Authors Computation using EViews 10

Results of the Ramsey RESET Test also show that the model is free from specification errors given that the probabilities are above 0.05 as shown in table 9 below.

Table 9: Ramsey RESET Test

Ramsey RESET Test	

	Value	df	Probability
t-statistic	1.012435	32	0.3189
F-statistic	1.025026	(1, 32)	0.3189
F-test summary:			
	Sum of Sq.	**df**	**Mean Squares**
Test SSR	3.22E-07	1	3.22E-07
Restricted SSR	1.04E-05	33	3.15E-07
Unrestricted SSR	1.01E-05	32	3.14E-07

Source: Authors Computation using EViews 10

4.5 Discussion of Results

From the short-run results, the Error Correction Term is negative and statistically significant. The ECT term is -0.729 with an interpretation that about 72.9 percent of the disequilibrium is corrected for in the next quarter.

Results from the analysis show that without any investment in infrastructure, the GDP growth is maintained at 0.002 on a quarterly basis. The paper discusses results that are significant based on the probability for the different coefficients.

Effect of African Infrastructure development Index on Economic Growth;

From the long run results, the AIDI has a positive relationship with economic growth. Overall improvement in AIDI considering the four infrastructure components creates an enabling environment for other factors of production to operate efficiently hence spurring economic country in the country. See table 7 for further details. Therefore, Uganda's should continue with investment in the combined infrastructure to maintain the growth resulting from the AIDI.

Labour Force and Economic Growth;

Labour Force also has a positive relationship with economic growth and is significant therefore this shows that an increase in labour force of Uganda positively impacts on economic growth in the long run. Considering the short run results, an increase in Uganda's Labour force leads to 0.461 growth in the country's GDP on a quarterly basis.

Transport Composite Index and Economic Growth;

The transport composite index also has a positive effect on economic growth and the result is significant with a probability of 0.0002. Also, the short run result for Transport Composite index has a significant positive effect on economic growth on a quarterly basis.

The ICT Composite index is significant in the short run a sign that an improvement in the ICT Composite index leads to economic growth by 0.004 percent on a quarterly basis.

Electricity Composite index however has a negative and significant results in the short run a sign that an improvement in the index in the short run has a negative effect on economic growth.

This could be on the grounds that an investment in electricity generation and distribution in the short run requires hug investments and time for the power to be distributed.

5. Conclusion and Recommendations

5.1 Conclusion

The central objective of this study was to investigate the effect of infrastructural development on Economic Growth in Uganda through empirical analysis using quarterly data for the period between 2005-2020. The findings of the study indicated that an improvement in AIDI leads improvement in Uganda's economic growth in the long run. This implies that investment in infrastructure should consider all the four components that comprise the AIDI i.e., Transport, Electricity, ICT and Water and Sanitation.

5.2 Recommendations

Given the AIDI significant contribution to Uganda's Economic Growth, as Uganda Plans on investments in Infrastructure, considerations should be geared towards investment in all the Four infrastructure components i.e., Transport; Electricity, ICT, and Water & Sanitation that comprise the AIDI since the results show that investing for instance in Electricity or ICT alone has no significant relationship with Economic Growth but rather investment in all the four infrastructure components significantly contributes to Uganda's economic growth.

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