Tanzanian Economic Review, Vol. 10 No. 1, June, 2020: 111–127

Infrastructure and Economic Growth of Tanzania

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Abstract

This paper examines the correlation between infrastructure and economic growth rate in Tanzania. In particular it uses time series data from 1990 till 2017 on time series models that use infrastructure variables among the explanatory variables. Correction Model (VECM) is involved to examine for the presence of a long-term association in the equation only. Findings show that all variables are integrated of order I(1),and the model are within one or common trend. Further results are that the economic growth rate un-directionally granger causes the infrastructure variables in our model. The long term estimation of the impact of infrastructure on economic growth rate show a 100 percent increase in infrastructure of road coverage raises economic growth by 22.8. Further results show a 100 a percent increase telephone coverage is associated with 17 percent increase in economic growth. In the same way change in railway network corresponds to 13 percent increase in the rate of economic growth. Finally Port handling improvement corresponds to 20 percent increase in economic growth. The paper concludes that infrastructure investment has significant effect on economic growth rates and should strategically be linked within the economic growth objectives.

1 Introduction

This paper set out to investigate the long- and short-run relationship between infrastructure and economic growth in Tanzania over the period 1990-2017. To do so time series statistics is used to estimate the Error Correction Model and examine the long run and short run estimates of the parameters of roads, railways, motorways, telephone and other measurable infrastructure. This composition of infrastructure is important because there are some infrastructures which have large effect than others or those that work through other mechanisms so, lumping them together might obscure their relevance. Rationale of the paper is that relationship between infrastructure and economic growth is very important for various reasons. Firstly, it has been witnessed that over decades economy has progressed very well and become one of the fastest growing economies in Africa South of the Sahara. The vision 2025 is set to ensure that Tanzania becomes a middle income and semi industrialized economy by the year 2025. However, Tanzania has recently reached goal of middle income five years before the set year of 2025. But there is still a need to attain semi industrialization goal. In ensuring the realization of this major national Goal, the Fifth and Sixth Phase Government have made it very explicit that building a semi industrialized economy and middle-income economy is a major Government drive. Hence the Five-Year Development plans of 2016/2021 and 2021/2026 are devoted to making Tanzania an industrial economy (URT, 2016; 2021).

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The role of infrastructure is also expected to feature prominently in support of implementing recent Government policies where review of the way various sectors of the economy has been operating. In particular Government is set to encourage new ways of development maximizing gains from national resources and reducing uncalled for Government Spending. The Government has set priorities in fast growing with big impact sectors such as mining, tourism, energy and infrastructure. It is also witnessed that rural- based agriculture and urban- based service sectors have received high attention from the policy makers and national resource allocation. Already Tanzania has since 1990s benefited from investment in mining sector but during this period a review has been made to ensure increased and realistic benefit. There have been efforts to invest in major projects like Railways, Hydropower and revival of national carrier Air Tanzania. It is expected that such huge investment will require supporting infrastructure and other services to ensure maximum contribution of these investment.

Infrastructure influence on economic growth is also expected to mirror the major components of macroeconomic growth (Angeloudis et.al, 2006). In particular, GDP is classified into three main categories of economic activities, namely: agriculture, forestry and fishing; industries and construction; and services. Overall in 2017, real GDP grew by an average of 7.1 percent. The growth was attributed to the implementation of infrastructure projects including water, energy, road, railway and airport infrastructures in conjunction with the increase in production of some minerals such as diamond and coal and improved agriculture sector performance. Economic activities which recorded highest growth during the period under review include: mining and quarrying (17.5 percent); water supply (16.7 percent); transport and storage (16.6 percent); information and communication (14.7 percent); and construction 14.1 percent. In addition, the rate of growth of agriculture sector which employs about 66.3 percent of the population and account for 20 percent of export earnings increased by 3.6 percent in 2017 compared to 2.1 percent recorded in 2016.

However, the rate of growth of some economic activities decelerated such as financial and insurance services and public administration. Agriculture economic activities which include crops, livestock, forestry and fishing grew by 3.6 percent in 2017 compared to 2.1 percent growth recorded in 2016. The good performance emanated from availability of sufficient rainfall in crop producing areas and adequate pastures and water for livestock. Crop sub-activity grew by 3.7 percent in 2017 compared to 1.4 percent in 2016 and accounted for 17 percent in the overall GDP. In addition, the growth rate of livestock sub-activity was 2.8 percent in 2017 compared to 2.6 percent recorded in 2016 and contributed 6.9 percent in the overall GDP. In this paper we want to see whether the infrastructure had an influence on the observed changes.

Furthermore, transport infrastructure has major role in facilitating flow of goods and services. For instance, economic survey reports indicate that transport and storage activity continued to record a higher growth rate of 16.6 percent in 2017. The growth was attributed to increase in natural gas transportation as well as increase of cargo and passenger transportation services by air, railway and road.

The other infrastructure which has received special attention is information and communication activity which includes services related to production, printing and dissemination of various information through media such as radio, newspapers, television, website as well as telephone communication services grew by 14.7 percent in 2017. The growth was largely on account of expansion of the use of mobile phone services, an increase in airtime sales and expansion of broadcasting and internet services. The share of information and communication services to GDP remained at 2.0 percent for three years consecutively.

Implementation of various Government Development Policies has seen efforts to focus priorities: to accelerate inclusive economic growth to become middle income status; to increase revenue, contain expenditure linkages of public funds, control unnecessary expenditure and enforce public procurement legislations; to improve economic infrastructures such as roads, railways, air and marine transport and energy with the objective of attracting local and international investors; to ensure that minerals and natural resources are utilized effectively for the benefit of the nation; to improve agricultural produce, livestock, and fisheries focusing more on value addition and modernization through training, provision of inputs, and extension services; to improve the quality of education and availability of water and health services. For the purpose of analysis of this paper a direct impact of infrastructure on economic growth of Tanzania.

This has been important in determining the economic justification for increased investment in such major projects. In whatever circumstance there are economic gains from investing in these projects. There are evidences of greatest impact of infrastructure investment in Asian economies. European countries and Northern America have equally substantially changed. The fifth phase Government of Tanzania has invested in major projects such as hydropower, railways, ports ICT and others. To do so the paper intends to use macroeconomic statistics of Tanzania from 1990s till 2017. The nature of macro-econometrics analysis requires estimations that ensure integration of variables. Therefore, the paper empirically analyses the long-run and short-run relationship between. The size of infrastructure and Economic growth in Tanzania over the period of 1990-2017. The Error Correcting Model (ECM) shall be employed to examine the long-run and short-run estimates of parameters. Granger causality test is employed to determine whether infrastructure granger causes economic growth. After this introduction the next section resents an overview of Tanzania infrastructure growth and trends.

2. Stock of Infrastructure in Tanzania and Economic Growth

2.1 Stock of Infrastructure

Tanzania has embarked on the National information and Communication Technology Broadband Backbone (NICTBB) Project [Lange, 2009; Mfungahema, 2006]. The NICTBB roll out began in 2009 aimed at installation of the National fibre optic broadband backbone connectivity which will facilitate fast, reliable and affordable internet connections (Figure 1). In line with the National ICT Policy [2003], currently under review, Tanzania has already built a high capacity state-of-the art.

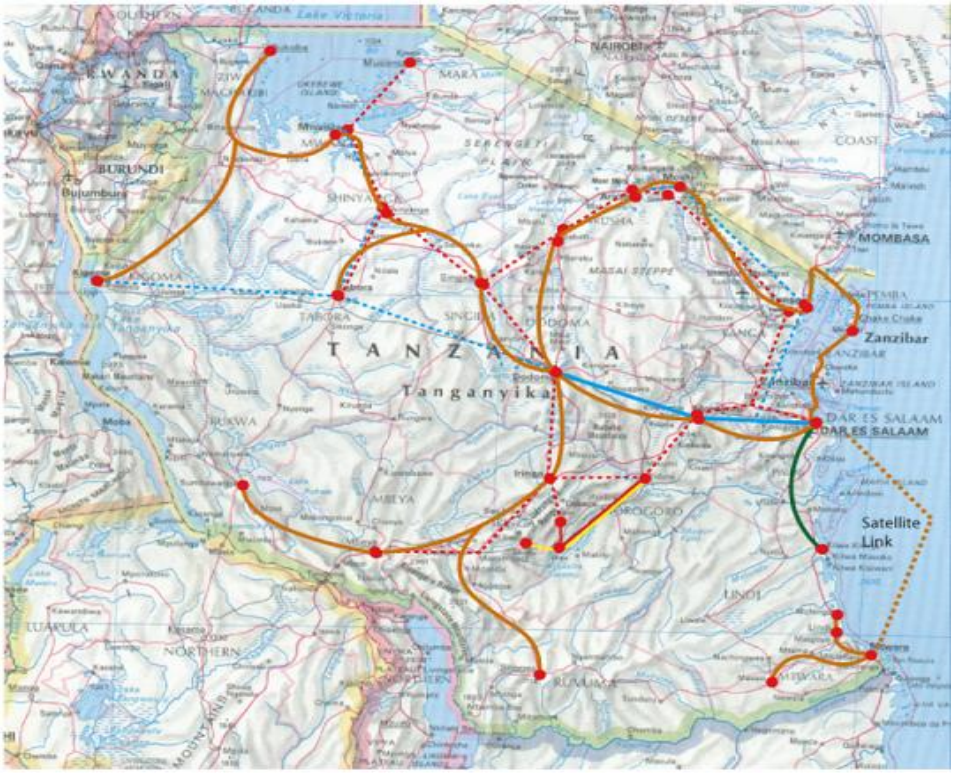

Figure 1: ***National Fibre and Microwave Networks***

In sum, based on the project mentioned above and other initiatives it is well understood that Tanzania is blessed for the required stock of infrastructure necessary for development of digital economy for the following reasons; Tanzania has the highest volume of fibre optics cables and figures of 2018 revealed that Tanzania had fibre optics cables in operation of 29,303 km, followed by Kenya and Uganda with 26,017 km and 9,235 km respectively. Rwanda has 4,707 km and Burundi has 4,600 km of fibre optics cables in operation. This is important pre requisite and can allow development of digital economy by having all major activities in unified traceable cable platforms such as e-health, e-education, e-marketing, e-farming and all forms of e-trading.

The best options are available in all key sectors of the economy from public sectors, Mining, Forest, Fishery, to essential services like health and education. The investment has focused on modernization of railway system, expansion of maritime infrastructure such as Ports, further improvement and strengthening of extension of road coverage and major bridges as well as investment in mega hydropower project. Hence the key objective of this chapter is to assess the economic impact of these efforts. The empirical question addressed is to whether and to what extent witnessed investment will change the economic role of transportation and infrastructure systems form gateways to facilitating economic hub for the Eastern Africa.

The other area of infrastructure investment is in energy. Following completion of a gas pipeline from Mtwara to Dar es Salaam today gas fired electricity contributes 64 percent of electricity production and the ongoing Nyerere Hydropower project will add more volume of electricity. Hence upon completion of the Standard Gauge Railway line from Dares Salaam to Mwanza, port expansion projects of Dar es Salaam, Mtwara and Tanga and the Kigongo Busisi bridge a range of economic activities will image and make Tanzania an integrated hub for the land locked African economies especially those in the eastern side of Africa. The projects impacts are for instance on supporting improved inter-regional trade and economic growth. This is because Tanzania is the only country in East Africa which is naturally blessed and surrounded by 8 countries of Kenya, Uganda, Rwanda, Burundi, Mozambique, Malawi, Zambia and Democratic Republic of Congo through Lake Tanganyika. However, for the reality of economic hub to be witnessed first, Tanzania should encourage setting up of special economic zones such as industrial parts and export processing zones that will produce massively for the local as well as international market. Secondly, business community in the land locked countries should be encouraged to invest inside Tanzania adjacent to Standard Gauge Railways, and within port cities of Dar es Salaam, Tanga and Mtwara for economies of scale. This way there will be more volume of goods and services moving to and from the ports and the markets.

In a similar way, infrastructure in areas like, Information and Technology have been significant. For instance, in 2016/17mobile phone networks had a total of 39,953,860 SIM cards compared to 40,173,783 SIM cards in 2016, equivalent to a decrease of 0.6 percent. In sum Tanzania infrastructure has gradually transformed and be one of the important international hubs. The length of the road network (district, urban and feeder roads) is estimated at 143,279 km, comprising of 9,781 km (paved) and 133,499 (unpaved). Tanzania Government has embarked on major project to modernize Railway system as part of the Dar-es-Salaam -Kigali Railway. This Railway intend to connect Dar es Salaam Port with Mwanza on Lake Victoria, Kigali in Rwanda and Musongati in Burundi. Efforts are also underway to reduce cost of shipping via Dar-es Salaam Port by removing delays in cargo handling, as it suffers from significant capacity constraints – caused by high traffic growth and poor backward linkages with inland transport networks – and congestion. Its demand-to-capacity ratio is the highest in Africa after Mombasa. The Port of Dar es Salaam is due to be expanded, with the port authority's development plan estimated to cost US$400-650 million. Other port projects include the construction of new ports at Bagamoyo, Mwambani in Tanga, Kilwa and Mtwara in the South, Malindi in Zanzibar and Musoma, situated on Lake Victoria. Musoma is an important hub that connects to Jinja and Port Bell in Uganda and Tanzania's rail corridors are key conduits for bulk freight in the region as they ease the pressure on roads.

The rail system consists of two main lines. The central line, which runs from Dar es Salaam to Tabora, has two branches: one to Kigoma in the west along Lake Tanganyika, and one runs from Tabora to Mwanza port on Lake Victoria. The other line runs from Ruvu northward to Korogwe and then branches to Tanga port on the Indian Ocean. The other branch goes north-west to Moshi. It connects to the Kenyan

railway system at Taveta as well as to Kenyan and Ugandan networks by rail ferry on Lake Victoria. Still, not all railway lines are operational and significant further investment is needed. The national railways of Tanzania, the DRC and Zambia signed an agreement in March 2013 to facilitate easier movement of cargo and people between these countries. The first phase of railway construction is being built by a joint venture between YapıMerkezi and Portugal's Mota-Engil. The 1 435 mm gauge single-track electrified line is expected to open in October 2019. Largely following the alignment of the existing metre-gauge route, the new line will be designed for 160 km/h passenger and 120 km/h freight services, with six stations including an inland freight terminal at Ruvu. Freight traffic is estimated at 17 million tonnes/year. In terms of integration still railway has the lowest volume when compared with trucks. TAZARA transported 171,405 tons compared. In terms of performance of Tanzania Railways, in 2017, Tanzania Railway Company transported 351,758 tons of cargo covering a distance of 360,955,000kilometers. Apart from the railways there are oceanic and inland ports which are major gateways for Tanzania. They handle about 15. Million tons of cargo a year. Out of these a total of 4,785,219 tons of consignment is to neighbouring countries.

In terms of air transportation, Tanzania has three major airports in Dar es Salaam, Kilimanjaro and Zanzibar. In addition, there are a number of domestic airports. Tanzania has one of the largest domestic air transportation markets in Sub-Saharan Africa, but high demand leads to capacity constraints, especially at Dar es Salaam airport. Indeed, the airport is currently operating beyond its design capacity in terms of the numbers of passengers it accommodates. In contrast to its vibrant domestic air transport market, its international market is one of the smallest in Sub-Saharan Africa. Tanzania's appeal as a tourist destination would benefit greatly from the increased availability of direct intercontinental flights.

The recent economic survey of 2020 revealed that country's road network has a total of 86,472 kilometres. The network consists of 12,786 kilometres of trunk roads which connects regions and neighbouring countries; 22,214 kilometres of regional roads connecting districts and towns; and 51,472 kilometres of roads connecting districts and villages. In 2017, Tanzania Railway Company transported 351,758 tons of cargo covering a distance of 360,955,000 kilometres compared to 209,203 tons transported in 2016 which covered a distance of 230,204,000 kilometres, equivalent to an increase of 68.1 percent. Tanzania Port Authority has a rated capacity of 4.1 million (dwt) of dry cargo and 6 million (dwt) of bulk liquid cargo. handled 15. million tons of cargo. TAZARA transported 171,405 tons compared. In 2016/17, a total of 4,785,219 tons of consignment to neighbouring countries were handled at Dar es Salaam port compared to 4,839,467 tons in 2015/16, equivalent to a decrease of 1.1 percent. As of December 2017, mobile phone networks had a total of 39,953,860 SIM cards compared to 40,173,783 SIM cards in 2016, equivalent to a decrease of 0.6 percent. As of December 2017, a total of 28,560 kilometres of the National ICT Infrastructure Backbone were constructed, including 7,560 kilometres constructed by the Government and 21,000 kilometres by telecommunications service providers.

In sum Tanzania infrastructure has gradually transformed and be one of the important international hubs. The length of the road network (district, urban and feeder roads) is estimated at 143,279 km, comprising of 9,781 km (paved) and 133,499 (unpaved). As Tanzania's main gateway port, Dar es Salaam handles around 90% of the country's international cargo. It is also the gateway to the landlock countries of Zambia, the Democratic Republic of Congo, Malawi, Rwanda, Burundi and Uganda. An ongoing project is the Dar es Salaam Maritime Gateway Project. Funded by the World Bank, this will include infrastructure upgrades to enable the port to handle post-panamax-plus vessels. Tanzania Government has embarked on major project to modernize Railway system as part of the Dar-es-Salaam -Kigali Railway. This Railway intend to connect Dar es Salaam Port with Mwanza on Lake Victoria, Kigali in Rwanda and Musongati in Burundi.

2.2 Trends and Dynamics of Tanzania Economic Growth

GDP is classified into five main categories of economic activities, namely: agriculture, forestry and fishing; industries and construction; and services. Overall in 2017, real GDP grew by an average of 7.1. The growth was attributed to the implementation of infrastructure projects including water, energy, road, railway and airport infrastructures in conjunction with the increase in production of some minerals such as diamond and coal and improved agriculture sector performance. Economic activities which recorded highest growth during the period under review include: mining and quarrying (17.5 percent); water supply (16.7 percent); transport and storage (16.6 percent); information and communication (14.7 percent); and construction 14.1 percent. In addition, the rate of growth of agriculture sector which employs about 66.3 percent of the population and account for 20 percent of export earnings increased by 3.6 percent in 2017 (Figure 2 and Table 1).

Agriculture economic activities which include crops, livestock, forestry and fishing good performance emanated from availability of sufficient rainfall in crop producing areas and adequate pastures and water for livestock. Crop sub-activity grew by 3.7 percent in 201 and accounted for 17 percent in the overall GDP. In addition, the growth rate of livestock sub-activity was 2.8 percent in 2017 compared to 2.6 percent recorded in 2016 and contributed 6.9 percent in the overall GDP.

In 2017, transport and storage activity continued to record a higher growth rate of 16.6 percent compared to 11.8 percent in 2016. The growth was attributed to increase in natural gas transportation as well as increase of cargo and passenger transportation services by air, railway and road. The share of transport and storage activity to GDP remained at 4.3 percent for four years consecutively. Information and communication activity which includes services related to production, printing and dissemination of various information through media such as radio, newspapers, television, website as well as telephone communication services grew by 14.7 percent in 2017 compared to 13.0 percent in 2016. The growth was largely on account of expansion of the use of mobile phone services, an increase in airtime sales and expansion of broadcasting and internet services.

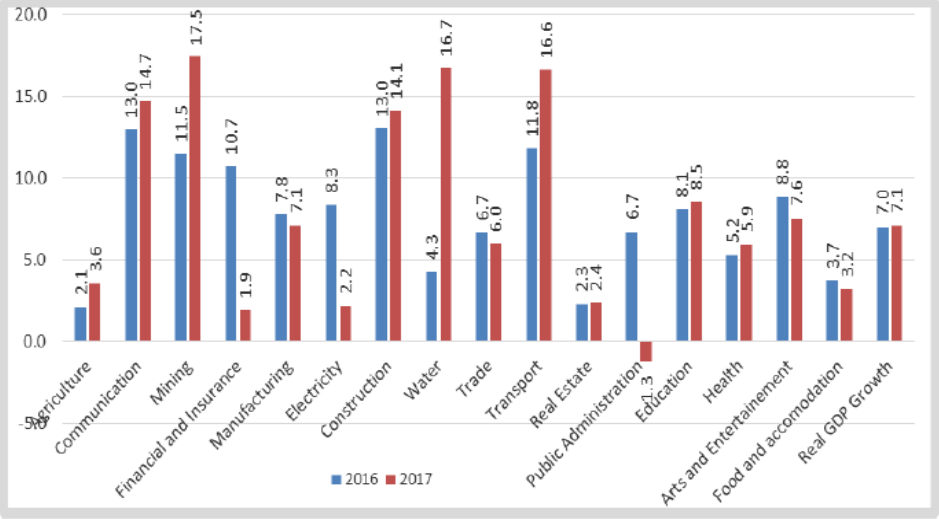

Figure 1: ***Average Sector Growth Rates of Main Economic Activities***

Source: From Tanzania Economic Survey (2019)

Table 1: Percentage Share of GDP Growth Contribution by Economic Activity

Economic Activity	2012	2013	2014	2015	2016	2017	2018
Agriculture Forestry and Fishing	26.55	26.79	25.80	26.75	27.11	28.76	28.25
Crops	14.12	14.39	14.00	14.07	15.20	16.59	16.21
Livestock	7.43	7.65	6.75	7.59	7.57	7.18	7.61
Forest	2.79	2.81	3.00	3.10	2.86	2.79	2.67
Fishing	2.17	1.89	2.01	1.95	1.78	1.89	1.72
Agriculture support services	0.01	0.04	0.04	0.03	0.03	0.03	0.03
Mining and quarrying	4.93	4.28	3.75	4.30	4.89	4.38	5.08
Manufacturing	9.44	9.11	9.12	7.86	7.81	7.67	8.05
Electricity supply	0.84	0.75	0.99	0.85	0.44	0.35	0.27
Water supply sewerage Waste management	0.45	0.44	0.45	0.41	0.10	0.44	0.44
Construction	9.75	10.85	10.83	11.07	11.32	12.21	13.01
Wholesale and Retail trade Repair	10.35	9.68	9.71	9.27	9.10	9.13	9.12
Transport and Storage	0.01	7.19	7.47	7.31	6.97	6.65	6.18
Accommodation and Food services	2.01	1.80	1.61	1.51	1.41	1.35	1.28
Information and Communication	2.06	4.96	1.94	1.78	1.61	1.54	1.51
Financial and insurance activities	4.11	3.18	4.38	4.11	4.86	4.03	3.73
Real estate	3.70	3.50	3.29	3.13	2.92	2.81	2.75
Professional Scientific and Technical activities	0.15	0.48	0.53	0.55	0.57	0.61	0.63
Administrative and Support services activities	2.00	2.09	2.32	2.31	2.16	255	2.66
Public Administration and Defence	4.62	1.95	4.81	4.82	4.17	4.20	3.96
Education	2.11	2.37	2.15	2.66	2.17	2.41	2.38
Human health and Social work activation	1.62	1.53	1.49	1.50	4.42	1.12	1.40
Arts Entertainment and Recreation	0.28	0.27	0.27	0.26	0.26	0.27	0.29
Other service activities	0.76	0.76	0080	0.76	0.77	081	0.80
Activities of Households and Employers	0.22	0.20	0.20	0.19	0.17	0.17	0.17
All economic activities	**92.56**	**92.50**	**92.24**	**91.66**	**91.75**	**91.76**	**92.14**
Taxes on product	7.44	7.50	7.76	8.31	8.25	8.24	7.86
GDP at market prices	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: National Bureau of Statistics

3. Methodology

3.1 Theoretical Framework and Model Specification

The literature on economic growth is vast and policy-oriented studies, in particular, have flourished in the past decade (see Temple, 1999 and Ahn and Hemmings, 2000 for surveys). Another class of growth models relaxes the assumption of diminishing returns to reproducible factors. Some authors add human to physical capital to derive a concept of "broad" capital characterized by constant or even increasing returns to scale (*e.g.* Lucas, 1988; Rebelo, 1991). Others introduce externalities to the accumulation of physical capital whereby private returns to scale may be diminishing, but social returns can be constant or increasing – due to either learning by doing (*e.g.* Romer, 1986; Young, 1991) or R&D (*e.g.* Romer, 1990; Grossman and Helpman, 1991; Aghion and Howitt, 1992). With constant (or increasing) returns to ("broad") capital, the long-term rate of growth becomes endogenous, in the sense that it depends on investment decisions which, in turn, could be influenced by policy and institutions.

Some of these endogenous growth models imply "conditional" convergence, while others do not, depending on assumptions about the specification of the production function and the evolution of broad capital accumulation (see Barro and Sala-i-Martin, 1995; Durlauf and Quah, 1999 for reviews). In neo-classical growth models, the long-run rate of growth is exogenously determined by either the savings rate (the Harrod–Domar model) or the rate of technical progress (Solow model). However, the savings rate and rate of technological progress remain unexplained. Endogenous growth theory tries to overcome this shortcoming by building macroeconomic models out of microeconomic foundations. Households are assumed to maximize utility subject to budget constraints while firms maximize profits. Crucial importance is usually given to the production of new technologies and human capital. The engine for growth can be as simple as a constant return to scale production function (the AK model) or more complicated set ups with spill-over effects (spill-overs are positive externalities, benefits that are attributed to costs from other firms), increasing numbers of goods, increasing qualities, etc.

Often endogenous growth theory assumes constant marginal product of capital at the aggregate level, or at least that the limit of the marginal product of capital does not tend towards zero. This does not imply that larger firms will be more productive than small ones, because at the firm level the marginal product of capital is still diminishing. Therefore, it is possible to construct endogenous growth models with perfect competition. However, in many endogenous growth models the assumption of perfect competition is relaxed, and some degree of monopoly power is thought to exist. Generally, monopoly power in these models comes from the holding of patents. These are models with two sectors, producers of final output and an R&D sector. The R&D sector develops ideas that they are granted a monopoly power. R&D firms are assumed to be able to make monopoly profits selling ideas to production firms, but the free entry condition means that these profits are dissipated on R&D spending. It follows that based on the empirical literature models that analyses growth are based on a simple exogenous growth framework proposed by Mankiw, Romer and Weil (1992), MRW hereafter. The model is based on a human capital augmented production function where human capital is treated as an 'additional' factor of production to capital, population and technology.

This can systematically be deduced as follows;

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} (A(t)L(t))^{1-\alpha-\beta}$$

Where Y, K, H, A and Lrepresents GDP; total capital; human capital; the level of technology and the labor force, respectively. With$\alpha + \beta < 1$the production function $\alpha + \beta < 1$ exhibits decreasing returns to scale to all capital.

Capital accumulation functions are given below as follows;

$$k(t) = (S^K)y(t) - (n + g + \delta)k(t)$$
$$h(t) = (S^H)y(t) - (n + g + \delta)h(t)$$

where: n, and g are the growth rates of labour and technology, respectively, $\delta$is the depreciation rate andS^K andS^H are constant shares of output invested in capital and human capital respectively.

$$\text{In}(\frac{Y_t}{L_t}) = \text{In}(A_0) + gt + \frac{\alpha}{1-\alpha}\text{In}(S_t^K) + \frac{\beta}{1-\alpha}\text{In}(h_t) - \frac{\alpha}{1-\alpha}\text{In}(n_t + g + \delta)$$

Given the production function and capital accumulation functions, MRW derive their basic specification. This is the basis for the approach taken in this paper, where as a first step infrastructure stock (inf) is assumed to be a factor of production. Appropriately, an equivalent equation can be derived:

$$\text{In}(\frac{Y_t}{L_t}) = \text{In}(A_0) + gt + \frac{\alpha}{1-\alpha}\text{In}(S_t^K) + \frac{\beta}{1-\alpha}\text{In}(inf_t) - \frac{\alpha}{1-\alpha}\text{In}(n_t + g + \delta)$$

This equation is then used to estimate the long run levels relationship, with human capital also an important control variable.

3.2 Specification of the Model

Based on the above derivations our model reduces into the following functions;

$$Grt = F(Infrt, T)$$

Where T is time, Y is economic growth rate, $Infrt$ is a set of infrastructure.

We can specify a simple production function as follows:

$$Grt_t = LnA_t + \beta_1 Infrt_t + \beta_2 T + \varepsilon_t$$

where,

Grt_t is the economic growth rate
LnA_t is intercept
$Infrt$ is a set of infrastructure variables of road network, railway, port handling capacity, ICT and other variables.

The stationarity of the variables employed in this study is checked using the Augmented Dickey Fuller test (ADF) and confirmed using the Philip Peron test (PP). The Johansen Cointegration test is employed to check the long-run relationship between our variables. The Vector Error Correction Model (VECM) is involved to examine for the presence of a long-term association in the equation only. If a cointegrating association is recognized from the Johansen test, a Vector Error Correcting Model (VECM) is used to model the long-run causation and the short-run dynamics. The purpose of the VECM is to show the speed of corrections from the short-run equilibrium to the long-run equilibrium state. The greater the coefficients, the higher the speed of correction of the model from short-run to long-run.

3.3 Data

The study has used secondary time series data from the year 1990 to 2017 from Bank of Tanzania, National Bureau of Statistics, Ministry of Infrastructure and Construction and Ministry of Finance and Planning. Other sources of data were World Bank and International Financial Statistics. Time series were used because they capture the dynamics as they allow time consideration while tracing the history.

4. Estimation Results

In this section the paper provides empirical estimates of the models described in the section 3 above. As indicated before nature of the data used are time serried statistics from the National Bureau of statistics for the period of 1990 till 2017. The data is likely to have the problem of random walk deficiency and unit root. The results of the paper begin with estimation of Augmented Dickey Fuller test as a screen for the order of integration of our variables. These results are displayed in the table 1 below. As indicated the findings in table 1 gives the paper a proof that all variables of economic growth rates, Road coverage, telephone subscription, Railway Network, Port Handling are integrated of order I(1) . Therefore we proceed in table 2 to examine the long run relationship of our variables.

Table 1: Augmented Dickey Fuller (ADF)Unit Root Test

	At level	First Difference
Variables		
Economic Growth Rate	0.023	0.0000***
	(3.67)	(8.34)
Road Coverage	0.08	0.0002***
	(3.00)	(6.29)
Telephone Subscription	0.400	0.0071**
	(1.70)	(4.06)
Railway Network	0.24	0.0002***
	(3.98)	(5.22)
Port Handling	0.003	0.0000****
	(4.52)	(4.96)

Note: ***, **, * indicates rejection of the null hypothesis of Unit Root Test at 1%, 5% and 10% levels of significance

After testing for the testing for the unit root we proceed in Table 2 to test for the long run relationship between the economic growth rates, Road coverage, telephone subscription, Railway Network, Port Handling. Specifically we use Johansen's test is used to examine long-run association between the economic growth rate as a dependent and the telephone subscription, Railway Network, Port Handling as independent variables. Based on the estimates indicated in the Table 2 below our results indicate the possibility of the presence of unique co-integrating relationship among the variables under consideration at 5% level of significance. Such results suggest that the included variables in the model are within one or common trend. To the extent this happens it implies that there is a prevailing association among the economic growth rates, telephone subscription, Railway Network, Port Handling hence we do not have spurious regression tragedy.

Table 2: Johansen Test for Unrestricted Cointegration Rank Test (Trace)

Hypothesized NoofCE(s)	Eiqenvalue	Trace Statistics	0.05 Critical Value	Prob*
None	0.7882	56.8211	50.2917	0.0005***
Atmost1	0.856	26.7122	32.9162	0.0501*
Atmost2	0,4142	7.24711	12.9521	0.3128
Atmost3	0.1102	2.12211	4,91223	0.1623

Note: Trace test indicates 1 cointegration) at the 0.05 level and * denotes rejection of the hypothesis at the 0.05 level.

It will be recalled that in the Tables 1 and 2 have assessed the unit roots and cointegration. Based on the findings that that all variables of economic growth rates, Road coverage, telephone subscription, Railway Network, Port Handling are integrated of order I(1), and that indicate there is a possibility of the presence of unique co-integrating relationship among the variables under consideration at 5% level of significance, we proceed in table 3 by assessing the causality of the variables. Such estimation is facilitated by estimating Granger Causality. The estimates are summarized in the table below. As it can be seen in the table infrastructure variables which independence neither uni-directional nor bi-directional causality.

Table 3: **Granger Causality Test**

Variables	P-value
Economic Growth Rate does not Granger Cause Road Coverage	0.28101
Road Coverage does not Granger Cause Economic Growth	0.13725
Economic Growth Rate Does not Granger Cause Telephone Subscription	0.54301
Telephone Subscription Does not Granger Cause Economic Growth Rate	0.21100
Economic Growth Rate Does not Granger Cause Railway Network	0.14886
Railway Network Does not Granger Cause Economic Growth	0.56555
Economic Growth Does not Granger Cause Port Handling	0.33351
Port Handling Does not Granger Cause Economic Growth	0.38871

Note: **, *** denote rejection of the hypothesis at the 0.05 and 0.10 levels

Estimation of the results are proceeded by estimating the Error Correction Model. Looking at the table above, the results of Error Correction Model confirms that the estimated model is a best match for a good fit. This is based on the negative value of and strongly significant at 5% confirming its convenience. Furthermore, 0.6732 coefficient estimate signifies that there is association of co- integration among the included variables. The coefficient on the error correction term (ECM) denotes that 67.32% of the disequilibrium initiated by earlier converge to the long-run equilibrium in the present year.

Table 4: Short-run Analysis, Error Correction Mechanism

Variables	Coefficient	T Statistics	P-value
D[Economic Growth Rate(-1)]	0.2446	1.1732	0.3512
D[Road Coverage(-1)]	0.1986	1.1321	0.2158
D[Telephone Subscription(-1)]	0.1697	0.9121	0.4522
D[Railway Network(-1)]	0.1567	1.0022	0.4126
D[Port Handling(-1)]	0.1876	1.000	0.3672
ECM(-1)	-0.6732	-4.1234	0.00054***

Note: ***, **, * indicates rejection of the null hypothesis at 1%, 5% and 10% levels of significance

Table5: Estimated Results for the Long Run

	Coefficient	T Statistics
Road Coverage	0.1702	2.7801
Telephone Subscription	0.1600	2.0071
Railway Network	0.1319	2.4500
Port Handling	0.2001	3.0000

Note: ***, **, * indicates rejection of the null hypothesis at 1%, 5% and 10% levels of significance

The long term estimation of the impact of infrastructure on economic growth are indicated in the table above. The corresponding signs of the coefficient estimates positive values indicate that increase in infrastructure tend to have greater influence on observed rate of economic growth. All coefficient estimates are statistically significant. Interoperation of these variables is that, a 100 increase in infrastructure of road coverage raises economic growth by 22.8. Further results show a 100 a percent increase telephone coverage is associated is associated with 17 increase in economic growth. In the same way change in railway network corresponds to 13 percent increase in the rate of economic growth.

Table 6: Stability Test

Diagnostic	Statistics	Interpretation
Heteroscedasticity Test	F-statistics=5.001	Non Heteroscedastic
Breusch-Pagan-Godfrey	Pvalue=0.0412	Rsquared7.761
Breusch-Godfrey Serial	Fstatistics=0.629	No evidence of serial correlation
Corelation LM Test	Pvalue0.7431	
Normality Test	Jarque-Bera Test=0.856	
	Residuals normally distributed P-value=0.7203	

Note: *The diagnostic test and stability tests show that the model passes all diagnostic residual tests and stability

Finally Port handling improvement corresponds to 20 percent increase in economic growth. The diagnostic test as displayed in the table confirm that the model passes all diagnostic residual tests which give confidence of the reported impacts.

5. Conclusion and Recommendations

5.1 Summary of Findings

This paper set out to investigate the long-run and short-run relationship between infrastructure and Economic growth in Tanzania over the period of 1990-2017. To do so time series statistics was used to estimate the Error Correction Model and examine the long run and short run estimates of the parameters of roads, railways, motorways, telephone and other measurable infrastructure. Findings of the results are that that all variables are integrated of order I(1),and the model are within one or common trend. Further results are that the economic growth rate un-directionally granger causes the infrastructure variables in our model. The long term estimation of the impact of infrastructure on economic growth rate show a 100 increase in infrastructure of road coverage raises economic growth by 22.8. Further results show a 100 a percent increase telephone coverage is associated is associated with 17 increase in economic growth. In the same way change in railway network corresponds to 13 percent increase in the rate of economic growth. Finally Port handling improvement corresponds to 20 percent increase in economic growth. The paper concludes that infrastructure investment have significant effect on economic growth rates and should strategically be linked within the economic growth objectives.

Furthermore The paper show that Government has set priorities in fast growing with big impact sectors such as mining, tourism, energy and infrastructure. It is also witnessed that rural based agriculture and urban based service sectors have received high attention from the policy makers and national resource allocation.

Already Tanzania has since 1990s benefited from investment in mining sector but during this period a review has been made to ensure increased and realistic benefit. There have been efforts to invest in major projects like Railways, Hydropower and revival of national carrier Air Tanzania. It is expected that such huge investment will require supporting infrastructure and other services to ensure maximum contribution of these investment. The paper further argues that the infrastructure influence on economic growth is also expected to mirror the major components of macroeconomic growth. In particular, GDP is classified into three main categories of economic activities, namely: agriculture, forestry and fishing; industries and construction; and services.

In terms of infrastructure stocks the paper show that Tanzania's infrastructure quality differs largely between the four major modes of transport. The country is well served by air, particularly domestically, but also has relatively good international connections. Roads are also sufficient for the purposes of trade, but the low levels of rural connectivity could constrain the development of agricultural and mining interests. Rail requires significant investment to adequately serve

domestic and neighbouring markets and connect these with ports and international markets. Finally, the Port of Dar es Salaam is a major determinant of the country's ability to trade, not only from a capacity perspective, but also in terms of clearing shipments through customs appropriately. Overall, Tanzania's infrastructure performs fairly well compared to its African peers, but quality is still poor and has a negative impact on the economy's productive capacity.

Estimated results of the paper are based on exogenous growth framework proposed by Mankiw, Romer and Weil (1992), MRW hereafter. The model is based on a human capital augmented production function where human capital is treated as an 'additional' factor of production to capital, population and technology. Hence infrastructure variables are included in the model among the explanatory variables. The stationarity of the variables employed in this study is checked using the Augmented Dickey Fuller test (ADF). The Johansen Cointegration test is employed to check the long-run relationship between our variables. The Vector Error Correction Model (VECM) is involved to examine for the presence of a long-term association in the equation only. Findings of the results are that that all variables of economic growth rates, Road coverage, telephone subscription, Railway Network, Port Handling are integrated of order I(1).Based on the estimates the included variables in the model are within one or common trend. Further results are that the economic growth rate un-directionally granger causes the infrastructure variables in our model. Error Correction Model confirms that the estimated model is a best match for a good fit. The long term estimation of the impact of infrastructure on economic growth rate show a 100 increase in infrastructure of road coverage raises economic growth by 22.8. Further results show a 100 a percent increase telephone coverage is associated is associated with 17 increase in economic growth. In the same way change in railway network corresponds to 13 percent increase in the rate of economic growth. Finally Port handling improvement corresponds to 20 percent increase in economic growth. The diagnostic test as displayed in the table confirms that the model passes all diagnostic residual tests which give confidence of the reported impacts.

5.2 Recommendations

Major recommendations from this paper are that Tanzania has now the best opportunity ever to become an economic hub for Africa. Investment in infrastructure has not only accelerated economic growth but also opened up new economic avenues. In Digital economy for instance there are international optical fibbers where Tanzania host the Seacom marine cable. The paper has seen how national optical fibber has substantially changed banking services through online banking and enabled financial inclusion which has never been though of using mobile money accounts. The paper recommend an immediate need to support digital economy. Upon completion of standard gauge railway Tanzania will be in a better position to improve marine transportation to service landlocked countries. But more so there is a need to increase economic activities adjacent to the railways such as special economic zones of industrial parks and agricultural parks to ensure full utilization of railway and ports.

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