



## **Foreign Direct Investments into Eastern Africa Region: The Infrastructure Development Nexus**

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### **ABSTRACT**

Infrastructure development is an essential element in economic growth and development. Good infrastructure fosters low transaction costs hence making production efficient and attracting foreign direct investments. However, there has not been adequate scholarly focus on how infrastructure development can affect the flow of foreign direct investments hence this paper sought to fill this gap. This paper utilized panel data from 12 eastern Africa countries from 2004 through 2017. Data on Infrastructure development variables was obtained from the Africa Development Bank's, Africa Infrastructure Development Index, that of control variables from the World Development Indicators kept by the World Bank and that of Foreign direct investments from UNCTAD. Due to the presence of heteroscedasticity in sample data, the study opted for a Generalized Least Squares (GLS) estimation method. The study established a significant relationship between infrastructure development and foreign direct investment inflows into the eastern Africa region. However, only Africa Infrastructure Index and Electricity Composite Index were positive while Transport Composite Index, ICT Composite Index and Water Supply and Sanitation Index were negative. Reasons being, Transport, ICT, water and sanitation are considered as social development factors. One of the control variables, total tax and contribution rate was negative indicating a unit increase in tax leads to a decrease in foreign direct investments whereas market size was positive and significant. The study recommends to policy makers to allocate resources into infrastructure development as an enabler of production efficiency, appraise the tax system to ensure a balance is stroked between taxing of investment returns and generating adequate tax revenue from multinationals and enhance its markets through multilateral and preferential trade agreements and regional integration agreements.

**Keywords:** Africa Infrastructure Development Index, Transport Composite Index, Electricity Composite Index, ICT Composite Index, Water Supply and Sanitation Index, Foreign Direct Investments

**JEL Classifications:** C33, F21, H4, R4

### **1. INTRODUCTION**

Africa's development is pegged on adequate industrialization. But insufficient infrastructural development in power, water and transport services has been blamed for a lagged pace in industrializing Africa. Infrastructure affects productivity and output directly as an input and as part of GDP formation, hence influencing economic growth and inclusive social development. It also affects it indirectly through reduction of cost of doing business hence improving on efficiency (Africa Development Bank, 2018). Therefore, African nations should deliberately invest

in infrastructure development in order to meet United Nations (2015) sustainable development goals (SDGs) number 6 (clean water and sanitation), number 7 (affordable and clean energy) and number 9 (industry, innovation and infrastructure) and Africa Union Commission's (2015) agenda 2063.

Africa Development Bank (2018) estimates that the African continent needs about USD 130-170 billion annually to be able to meet its infrastructure development needs. However, it is confronted with an infrastructure-financing gap of about USD 67.6-107.5 billion. This lag in infrastructure development can be traced back to

the 80s and 90s when governments cut allocations to infrastructure due to the structural adjustment programs agreed upon under the Washington consensus. Although Africa has tried to accumulate capital from the year 2000, the pace has been dawdling to bridge the gap. This therefore, calls African countries to adopt a smarter way of accelerating their investments in infrastructure.

For that reason, Africa needs to attract private capital from both domestic sources and external sources to enable it hasten construction of critical infrastructure so compulsory to unleash its potential (Bosire, 2019). External financing can either be in the form of portfolio investment or direct investments (Epaphra and Massawe, 2017). Direct investments were the most preferred source of external investments between 2013 and 2017, accounting for about 39% and making it an important source (UNCTAD, 2018). This is because, foreign direct investments come with benefits like, enhancement of trade logistics, enrichment of knowledge and skills for locals, augmentation of new information and technology that promotes industrial development and in turn generate employment and production efficiency that kindles industrial competitiveness (KNBS, 2015). Nevertheless, for nations to attract foreign direct investments, they must meet some necessary conditions such as the size and quality of market, Quality of Infrastructure, availability of natural resources and strategic assets and the possibility of attaining efficiency in production (Masipa, 2018).

Despite this enormous need for foreign direct investments in Africa, trends indicate that Africa as a continent has been lagging behind in attracting FDIs. UNCTAD (2020) indicate that in 2019, overall inflows into the world increased by 3%, 5% into the developed economies, 18% into Europe, 10% into Latin America and the Caribbean and 59% into transition economies. On the other hand, Asia recorded a 5% decline and Africa recorded a 10% decline in FDI inflows (Figure 1). This is despite the fact that Africa is richly endowed with natural resources which have been proven to be significant in the attraction of FDIs. For instance, Africa holds at least 30% of the world's mineral deposits, at least 8% of the worlds confirmed oil deposits and

at least 7% of natural gas deposits. This is indeed an indictment for African nations and the prospects of meeting aspirations of sustainable development goals and those of Africa agenda 2063 remain slim. Therefore, this paper seeks to interrogate factors that influence the flow of foreign direct investments into the eastern Africa region but with a bias to infrastructural development variables.

When loosely interpreting raw data, it indicates a minimal influence of infrastructure on the flow of foreign direct investments (Figure 2). For example, Seychelles that has the best infrastructure in Africa with an index of about 95, only attracted about USD. 125.54 million in foreign direct investments in 2019. On the other hand, Ethiopia that has recorded an index of 10.13 managed to attract foreign direct investments amounting to USD. 2516.23 million in the same year. However, literature has indicated a significant effect of infrastructure development on the flow of foreign direct investments. For instance, Africa Development Bank (2018), indicate that, apart from good infrastructure raising the total factor production by reducing transaction costs, it also affects the change of costs of investment, the robustness of private capital and the demand for and supply of goods and services. Good infrastructure fosters a better and efficient use of factors of production like land, labour and other tangible capital assets, which will in return enhance economic growth and development.

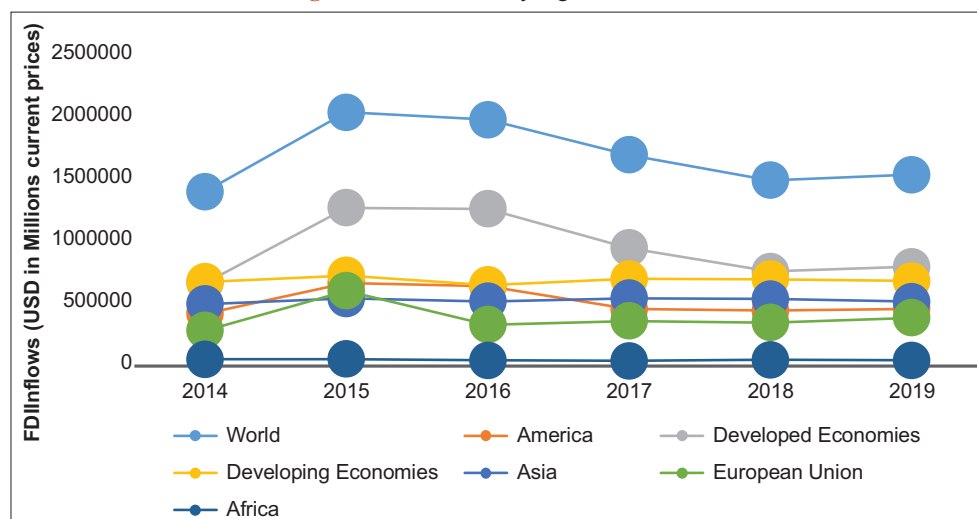
## 2. LITERATURE REVIEW

This section analyses previous scholarly works around the field of infrastructure development and foreign direct investments and conceptualizes a framework to guide this study.

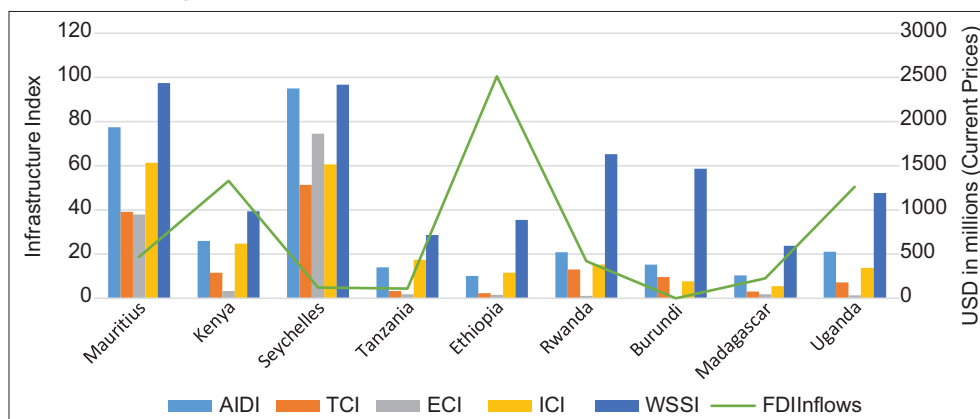
### 2.1. Theoretical Framework

Theories are basically a set of propositions, assumptions and facts that assist scholars comprehend reasons behind some specific behaviors from certain phenomena (Kombo and Tromp, 2009). For purposes of this paper, the eclectic theory is dissected.

Figure 1: FDI inflows by region, 2012-2019



Source: UNCTAD, 2020

**Figure 2:** Infrastructure index and FDI inflows from selected countries

Source: Africa Development Bank, 2020 and UNCTAD, 2020

### 2.1.1. The eclectic theory

After carefully analyzing scholarly works of Kindleberger (1969) and Hymer (1976), Dunning (1977) included the location theory to the oligopolistic and internalization theories to come up with a threefold eclectic theory, hence its name O-L-I paradigm (Ownership, Location and Internalization). For firms to possess a competitive edge, they must have some specific and exclusive advantages over others. These are what is referred to as ownership advantages and in most cases are monopolistic. These advantages help firms to create efficiency and also curve a market for themselves. They include but not limited to trademarks, patents, advancements in information and communication technologies and economies of scale. Location advantages also help the firm to build on their production efficiency hence reduced costs. They include, the size of the market, availability of factors of production, transportation and communication. Then political advantages help to make the business environment conducive for all forms of investors. They include, business focused regulations that aim at developing the private sector and also advancement of the social sector of the economy. Then firms are expected to capitalize on these advantages to profitably expand their internal capacity as opposed to exporting or leasing them (Dunning, 1973; Dunning, 1980; Boddewyn, 1985; Shin, 1998; Tang et al., 2015). According to Makoni (2015) all the three set advantages must be successfully met the flow of Foreign Direct Investments. Nevertheless, after careful scrutiny of this proposition, previous scholars have poked holes into this theory citing specific reasons as to why it does not hold water. For example, Nayak and Choudhury (2014) claims that the theory is unable to meet its operational practicality due to the reason that it incorporates many parameters. Secondly, Shin (1998) claims that least developed nations hardly possess firm specific ownership advantages like trademarks, patents and technological advancements and therefore, the applicability of this theory within least developed countries becomes a challenge. Finally, although Boddewyn (1985) has hugely praised this theory, he has some reservations. He claims the theory is unable to justify the surges in succeeding FDIs.

## 2.2. Empirical Literature

Bakar et al. (2012), conducted a study on the impact of infrastructure on foreign direct investment, the case of Malaysia and established a positive and significant influence of infrastructure

on the flow of foreign direct investments into Malaysia. Other variables in the model, Market Size, Trade openness, and Human Capital also tested important in the attraction of foreign direct investments into Malaysia. The paper used Ordinary least squares estimation method on time series data ranging from 1970 through 2010. In conclusion the study recommended to the government of Malaysia to put policies in place that will foster development of infrastructure.

Ahmed et al. (2015), analyzed the impact of infrastructure on foreign direct investment in Malaysia and found out that infrastructure is a significant determinant of foreign direct inflows into Malaysia. Other factors like GDP and Exchange rate were also found to be significant. The study used autoregressive distributed lag (ARDL) bound test on time series data ranging from 1980 through 2013. The paper concludes that infrastructure development is necessary in driving the cost of production down hence improving the competitiveness of a nation in the attraction of foreign direct investments.

Ngangue (2016), did a study on infrastructure factors of foreign direct investment attraction in developing countries and established that development in electricity supply has a positive and significant influence on foreign direct investments but developments in telephone infrastructure had a negative influence. Other variables like market size, openness and GDP also appeared to have a positive impact on FDI inflows. The study utilized panel data from 55 countries for a period ranging from 1990 through 2014. In conclusion, the paper recommended to governments to promote trade openness and expand the development of electricity supply.

Wekesa et al. (2016), conducted a study on the effects of infrastructure development on foreign direct investment in Kenya and found out that a good transport infrastructure, telecommunications infrastructure, water supply and waste management infrastructure are important determinants of FDI inflows into Kenya. Other variables like exchange rate, economic growth and trade openness were also found to be significant. The study made use of multiple regression analysis on time series data spanning from 1970 through 2013. The paper then recommends for governments to enhance the development of infrastructure to attract more foreign direct investments.

Armah and Fosu (2018), did a study on infrastructure and foreign direct investment inflows in Ghana and established a positive and significant relationship between FDI and economic infrastructure and social infrastructure. Other variables like market size, trade openness and agglomeration also had a positive and significant relationship with FDI. The study used 2 stage least square estimation method on time series data ranging from 1975 through 2012. Then the paper recommended for enhanced investments in infrastructure in order to attract more foreign direct investments into Ghana.

Ogunjimi and Amune (2017), conducted his study on the impact of infrastructure on foreign direct investments in Nigeria and established that electricity production and supply had a significant influence of FDI in the long run. However, other infrastructural variables like tractor and telephone lines were not significant. The study used time series data ranging from 1981 through 2014 and Autoregressive distributed lag (ARDL) framework in estimating the model. On conclusion, the study recommended for the enhancement of investments into the generation and supply of electric power.

Koyuncu and Unver (2016), analyzed the impact of infrastructure on FDI Inflows using 7 infrastructure indicators and ascertained that these infrastructure variables (Fixed Telephone, fixed broadband, railways, mobile cellular, air transport, railway lines and linear shipping connectivity) causes a positive influence on FDI Inflows. Other variables in the model, trade openness, domestic credit, and urbanization rate also have positive and significant effects on FDI. However, population growth and inflation were found to be insignificant. The paper made use of panel data from 187 countries from 1990 through 2014.

### 2.3. Conceptual Framework

This paper heavily relied on data generated by the Africa Development Bank through its Africa Infrastructure Development Index (AIDI). The index was developed in 2003 and standardized to lie between 0 and 100. The higher the value the better a country's readiness in achieving its infrastructure requirements (Africa Development Bank, 2018). The index serves to monitor and evaluate the status of infrastructure development across Africa, help in resource allocation and contribute to policy dialogue (Africa Development Bank, 2013). The Index consists of five semi indicators;

- The African Infrastructure Development Index (AIDI): Based on the four other semi indexes; Transport Composite Index, Electricity composite index, ICT composite index and the Water supply and sanitation composite index (Africa Development Bank, 2013).
- The Transport Composite Index (TCI): Measured by total paved roads (km per 10,000 inhabitants) and total road network in km (per km<sup>2</sup> of exploitable land area (Africa Development Bank, 2013).
- The Electricity Composite Index (ECI): Measured by generation by kWh per inhabitant (Africa Development Bank, 2013).
- The ICT Composite Index (ICI): Measured by total phone subscriptions (per 100 inhabitants), Fixed-line telephone subscriptions (% population), mobile cellular subscriptions (% population), Number of internet users (per 100 inhabitants),

Fixed (wired) broadband internet subscribers (per 100 inhabitants), and International internet bandwidth (Mbps) (Africa Development Bank, 2013).

- The Water Supply and Sanitation Composite Index (WSSI): Measured by improved water source (% of population with access) and improved sanitation facilities (% of population with access) (Africa Development Bank, 2013).

For purposes of this study, indicators of Infrastructure development were opted for as independent variables and foreign direct investment inflows as dependent variables. Total tax and contribution rate and market size were selected as control variables. The study intends to test for both direct relationships and controlled relationships as portrayed in Figure 3.

## 3. METHODOLOGY

This section explains the blue print adopted to ascertain the relationship between infrastructure development and foreign direct investment flows into the eastern Africa region.

### 3.1. Data Sources

This study extensively relied on secondary data obtained from UNCTAD for FDI inflows and the Africa Development Bank for Africa Infrastructure Development Index (AIDI), Transport Composite (TCI), Electricity Composite Index (ECI), ICT Composite Index (ICI) and Water Supply and Sanitation Index (WSSI). In addition, data for Market Size and Total Tax and Contribution Rate was obtained from the world development Indicators domiciled at the World Bank. This data was collected from the year 2004 to the year 2017 for 12 eastern Africa countries (Kenya, Tanzania, Uganda, Rwanda, Burundi, Comoros, Djibouti, Eritrea, Madagascar, Mauritius, Seychelles and Ethiopia).

### 3.2. Data Diagnostic Tests

These tests were opted for in order to ensure test data complies with basic assumptions of regression models. To check for data normality, the study made use of Shapiro and Wilk (1965) test and to test for data non stationarity, the paper made use of Im et al. (1997). The study also used Variance Inflation Factors to test for Multi-collinearity, White's general test to check for heteroscedasticity, Woodridge test for autocorrelation and correlation analysis to show the direction and extent of association.

### 3.3. Model Specification

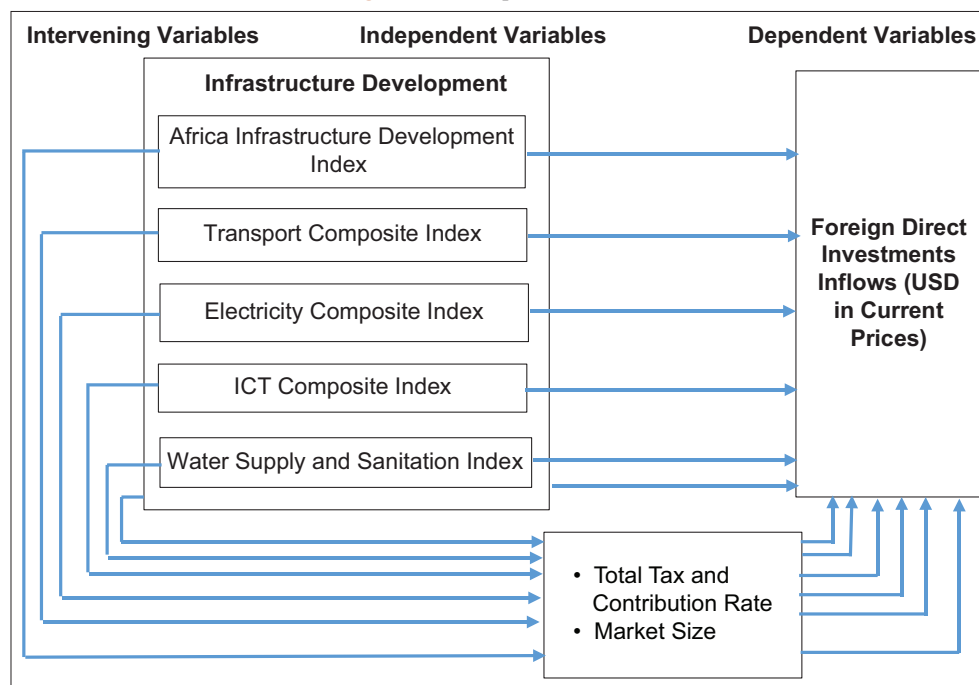
For the purpose of this paper, Foreign Direct Investment Inflows (FDIInflows) was adopted as a dependent variable, Africa Infrastructure Development Index (AIDI), Transport Composite (TCI), Electricity Composite Index (ECI), ICT Composite Index (ICI) and Water Supply and Sanitation Index (WSSI) as independent variables and Market Size and Total Tax and Contribution Rate as control variables. Therefore, equation 1 shows the linear function and equation 2 defines it into a regression function after including the panel data properties.

$$\text{FDIInflows} = f(\text{AIDI}, \text{TCI}, \text{ECI}, \text{ICI}, \text{WSSI}, \text{TTCR}, \text{MS}) \quad (1)$$

$$\text{FDIInflows} = \alpha + \beta_1 \text{AIDI}_{it} + \beta_2 \text{TCI}_{it} + \beta_3 \text{ECI}_{it} + \beta_4 \text{ICI}_{it} + \beta_5 \text{WSSI}_{it} + \beta_6 \text{TTCR}_{it} + \beta_7 \text{MS}_{it} + \varepsilon_0 \quad (2)$$



Figure 3: Conceptual framework



Where;

FDIInflows = Foreign Direct Investment Inflows

AIDI = Africa Infrastructure Development Index

TCI = Transport Composite Index

ECI = Electricity Composite Index

ICI = ICT Composite Index

WSSI = Water Supply and Sanitation Index

TTCR = Total Tax and Contribution Rate

MS = Market Size

$\alpha$  = Constant associated with Regression models

$\beta_1$ - $\beta_7$  = Coefficient estimates for independent variables

$i$  = represents various countries in the panel

$t$  = represents various time periods in the panel.

Table 1: Summary statistics test results

Variable	Obs	Mean	Std. Dev.	Min	Max
Country Code	168	6.5	3.462373	1	12
Year	168	2010.5	4.04318	2004	2017
FDI Inflows	168	447.5526	619.2313	0.0315939	3988.953
AIDI	168	21.69349	21.77487	0.6486858	94.10853
TCI	168	13.49603	14.14885	1.07124	52.65052
ECI	168	8.846141	16.87672	0.0543931	74.47051
ICI	168	5.007858	10.53922	0.0004057	60.73619
WSSI	168	50.17242	25.31172	7.259399	97.55667
TTCR	168	60.66429	63.95794	9	280.2
MS	168	1.40e+10	1.83e+10	9	8.17e+10

drawn may neither be accurate nor reliable (Ghasem and Zahediasl, 2012).

## 4. DATA DIAGNOSTICS, ANALYSIS AND FINDINGS

### 4.1. Summary Statistics

According to the results exhibited in Table 1, the study contained 12 countries from the year 2004 to 2017, making a total of 168 observations for each variable under study. This study adopted the use of means to show arithmetic averages for each observation and a standard deviation to show variations from the mean.

### 4.2. Normality Tests

$H_0$ : Sample data are not significantly different from a normal population

$H_a$ : Sample data are significantly different from a normal population

Most of the statistical procedures are anchored on the assumption that the population from which the sample is drawn follows a Gaussian distribution. Therefore, it necessitates researchers to test for data normality. Otherwise, inferences

This study employed Shapiro and Wilk (1965) test to check for normality. According to Razali and Wah (2011), originally this test was restricted to  $n < 50$  but was later modified by Royston (1995) to accommodate any  $n$  in the range  $3 \leq n \leq 5000$ . Thus, according to the results from Table 2, we reject the null hypothesis and conclude that the sample data are significantly different from a normal population.

### 4.3. Stationarity Tests

$H_0$ : All panels contain unit roots

$H_a$ : Some panels are stationary

Panel data combine both the properties of time series and cross sectional. Time series data can either be stationery (mean and variance are constant over time) or non-stationery. In statistics, non-stationery data is discouraged as it may produce spurious results. Therefore, to test for non-stationarity, this study made use of Im et al. (1997) test which is anchored on the Augmented Dickey-Fuller procedure.

Table 3 brings out results from IPS unit root tests both at level and at 1<sup>st</sup> difference (constant and trend). At level, some

**Table 2: Shapiro-Wilk test for normal data and VIF test results**

Variable	Shapiro-Wilk W test for normal data					Test for Multi-collinearity	
	Obs.	W	V	z	Prob>z	VIF	1/VIF
FDI Inflows	168	0.70618	37.686	8.276	0.00000	1.92	0.522036
AIDI	168	0.73201	34.373	8.067	0.00000	1.37	0.73203
TCI	168	0.7584	30.989	7.83	0.00000	1.34	0.747525
ECI	168	0.55347	57.274	9.231	0.00000	1.22	0.822893
ICI	168	0.52079	61.465	9.392	0.00000	1.06	0.946118
WSSI	168	0.93043	8.923	4.991	0.00000	1.02	0.976618
TTCR	168	0.59812	51.546	8.991	0.00000	1.01	0.993996
MS	168	0.74316	32.943	7.97	0.00000	Mean VIF	1.27

**Table 3: Im-Pasaran-Shin test results**

Variable	Level				1 <sup>st</sup> difference			
	Constant	P-value	Constant+Trend	P-value	Constant	P-value	Constant+Trend	P-value
FDI Inflows	-1.8137	0.0349	-2.6532	0.0040	-6.0227	0.0000	-6.5414	0.0000
AIDI	6.6139	1.0000	-1.7927	0.0365	-3.3416	0.0004	-3.1333	0.0009
TCI	-0.0934	0.4628	1.4342	0.9242	-2.0434	0.0205	-3.3608	0.0004
ECI	3.9931	1.0000	0.2665	0.6051	-3.398	0.0003	-4.2245	0.0000
ICI	5.5636	1.0000	-2.1549	0.0156	-6.5355	0.0000	-6.8611	0.0000
WSSI	3.0726	0.9989	-1.2089	0.1133	-4.8626	0.0000	-5.0039	0.0000
TTCR	-8.04	0.0000	-7.7555	0.0000	-9.0008	0.0000	-7.1207	0.0000
MS	4.0426	1.0000	-1.0623	0.1441	-4.8533	0.0000	-5.296	0.0000

variables exhibited signs of non-stationarity with and without trend specifications. However, after differencing the variables they all turned stationary at 1<sup>st</sup> differencing both with and without time specifications. Therefore, we reject the unit root null hypothesis at 1<sup>st</sup> differencing and conclude that all panels are stationary.

#### 4.4. Multi Collinearity Tests

Multi collinearity in statistics inflates parameter variances hence misidentification of predictors, which are key in a statistical model (Dorman et al., 2012). This study made use of variance inflation factors (VIF) as proposed by Glauber and Farrar (1964). Test results from Table 2 indicate a mean VIF of 1.27 and that all variables had their VIFs <2. Therefore, we conclude that sample data was free from collinearity problems.

#### 4.5. Test for Heteroscedasticity

$H_0$ : Homoscedasticity

$H_a$ : Unrestricted heteroscedasticity

The study employed White's general test of heteroscedasticity as proposed by White (1980). According to the test results displayed in Table 4, ( $\chi^2(35) = 61.48$ ,  $P = 0.0037$ ) which is significant at 0.05 alpha level. Thus, reject the null hypothesis and conclude unrestricted heteroscedasticity. Linear models assume homoscedasticity; otherwise, OLS estimates will be inefficient to explain the association and biased standard errors will lead to indecorous inferences (Klein et al., 2016). Generalized least squares (GLS) also known as weighted least squares is an antidote to heteroscedasticity problems. This study therefore, embraced GLS in estimation.

#### 4.6. Test for Autocorrelation

$H_0$ : No first order autocorrelation

$H_a$ : First order autocorrelation exists

**Table 4: Cameron and Trivedi's decomposition of IM-test results**

Source	$\chi^2$	df	P
Heteroscedasticity	61.48	35	0.0037
Skewness	11.14	7	0.1327
Kurtosis	9.61	1	0.0019
Total	82.23	43	0.0003

Serial correlation makes estimation of standard errors problematic and causes inefficiencies in regression models. Therefore, it is important to test for its presence. For purposes of this study, Woodridge test for autocorrelation was preferred and results exhibited in Table 5. The study assumed absence of first order autocorrelation, which was confirmed by the test ( $P = 0.2019$ ) > 0.05 alpha level hence fail to reject the null hypothesis and conclude absence of serial correlation.

#### 4.7. Correlation Analysis

Correlation analysis helps to ascertain how two or more variables relate with each other, the direction, and strength of such relationship (Gogtay and Thatte, 2017). For purposes of this study, we employ pairwise Pearson's correlation approach as proposed by Pearson (1896). According to the test results from Table 6, its only MS that has a positive and significant relationship with FDIInflows at 0.05 alpha level. (0.2395,  $P = 0.0026$ ). ECI and TTCR (0.0028,  $P = 0.9726$  and 0.0009,  $P = 0.9914$  respectively) have a positive but not significant relationship with FDIInflows. Other variables like; AIDI, TCI, ICI and WSSI (-0.0555,  $P = 0.4917$ ; -0.0508,  $P = 0.5287$ ; -0.0661,  $P = 0.4120$  and -0.0083,  $P = 0.9176$  respectively) have a negative and non-significant relationship with FDIInflows.

#### 4.8. GLS Regression Analysis

Having recorded some traces of heteroscedasticity in the sample data, the study opted for a generalized least squares

(GLS) estimation method which has abilities of correcting for heteroscedasticity. From the analysis Table 7 was generated.

4.8.1. Relationship between FDIInflows and AIDI

This relationship is exhibited by both model 1 and model 2 in Table 7. According to the test results from model 1, FDIInflows has a significant relationship with AIDI at 0.05 alpha level (Wald  $\chi^2$  (1) = 7.08, P = 0.0078). The coefficient of determination ( $R^2 = 0.040$ ) indicate a 4% possibility of AIDI explaining the variations of FDIInflows into the eastern Africa Region. The coefficients of AIDI indicate a negative but significant relationship between FDIInflows and AIDI (-5.7197, P = 0.008). Therefore, the study concludes that AIDI is a significant determinant of FDIInflows into eastern Africa. Equation 3 is thus fitted.

$$FDI = 571.6329 - 5.7197AIDI \tag{3}$$

Sig = 0.008  
 $R^2 = 0.040$   
 Wald  $\chi^2$  (1) = 7.08, P = 0.0078

Where;  
 FDIInflows = Foreign Direct Investment Inflows  
 AIDI = Infrastructure Development Index

Test results from Model 2, indicate a controlled relationship between FDIInflows and AIDI, with TTCR and MS. Evidently, a controlled model indicate a significant association between FDIInflows and AIDI (Wald  $\chi^2$  (3) = 268.62, P ≤ 0.01) at 0.05 alpha level. The coefficient of determination ( $R^2 = 0.6152$ ) indicating that under a controlled model AIDI has abilities of explaining up to 61% of the variations in FDIInflows. whereas the coefficients of AIDI and TTCR (-1.0628, P = 0.456; -0.5668, P = 0.247) were negative and non-significant whereas and that of MS (2.57e-08, P ≤ 0.01) is positive and significant. Therefore, we conclude, AIDI is a significant determinant

of FDIInflows even within a controlled environment. Hence equation 4 is fitted.

$$FDI = 144.8748 - 1.0628AIDI - 0.5668TTCR + 2.57e-08MS \tag{4}$$

Sig = 0.456 0.247 <0.01  
 $R^2 = 0.6152$   
 Wald  $\chi^2$  (3) = 268.62, P ≤ 0.01

Where;  
 FDIInflows = Foreign Direct investment inflows  
 AIDI = Infrastructure Development Index  
 TTCR = Total Tax and Contribution Rate  
 MS = Market Size.

4.8.2. Relationship between FDIInflows and TCI

Model 3 in Table 7 exhibit test results from the association between FDIInflows and TCI, whereas model 4 in Table 7 indicate test results the association within a controlled environment. According to the results from model 3, there exist a significant relationship between FDIInflows and TCI (Wald  $\chi^2$  (1) = 13.85, P = 0.0002) at a 0.05 alpha level. The coefficient of determination ( $R^2 = 0.0706$ ) indicating that TCI can explain only about 7% of the variations of FDIInflows. The coefficients of the variable TCI (-12.078, P ≤ 0.01) indicate a negative but significant relationship. From this, we deduce that TCI is a determinant of FDIInflows into the eastern Africa region and fit equation 5.

$$FDI = 610.5576 - 12.078TCI \tag{5}$$

Sig = ≤0.01  
 $R^2 = 0.0706$   
 Wald  $\chi^2$  (1) = 13.85, P = 0.0002

Where;  
 FDI = Foreign Direct Investment Inflows  
 TCI = Transport Composite Index.

On the same length, according to the results from model 4, which is controlled with TTCR and MS, we deduce that TCI has

Table 5: Wooldridge test for auto correlation results

Wooldridge test for autocorrelation in panel data	
F(1,11)	1.842
Prob>F	0.2019

Table 6: Correlation analysis matrix

	FDI Inflows	AIDI	TCI	ECI	ICI	WSSI	TTCR	MS
FDI Inflows	1.0000							
AIDI	-0.0555	1.0000						
TCI	0.4917	0.3262*	1.0000					
ECI	-0.0508	0.0000	0.0000	1.0000				
ICI	0.5287	0.4426*	-0.0576	0.4750	1.0000			
WSSI	0.0028	0.0000	0.4752*	0.0634	0.1594*	1.0000		
TTCR	0.9726	0.0000	0.4319	0.0468	0.0468	0.0399	1.0000	
MS	-0.0661	-0.1269	0.0474	-0.1763*	0.0277	0.6209	0.0128	1.0000
	0.4120	0.1146	0.5567	0.0120	-0.0332	0.6209	0.8743	
	-0.0083	-0.0550	-0.0217	0.8816	0.6809	0.0726	-0.0376	1.0000
	0.9176	0.4950	0.7877	0.0167	0.0167	0.3678	0.6411	
	0.0009	-0.0110	0.0513	-0.1269	0.0167	0.3678	0.6411	
	0.9914	0.8917	0.5251	0.1143	0.8362	0.3678	0.6411	
	0.2395*							
	0.0026							

Table 7: GLS regression results

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
AIDI	-5.7197 0.008	-1.0628 0.456									34.9139 0.108	14.2744 0.327
TCI			-12.078 0.000	-1.7811 0.426							-46.0073 0.017	-28.6697 0.027
ECI					-5.4533 0.051	-0.0102 0.996					5.6546 0.659	12.0949 0.174
ICI							0.0017 1.000	-4.5101 0.112			-14.09197 0.255	-16.1483 0.051
WSSI									-8.9972 0.000	-1.1816 0.360	-11.62997 0.024	-0.4338 0.902
TTCR		-0.5668 0.247		-0.5577 0.251		-0.4946 0.325		-0.6130 0.204		-0.5107 0.286		-0.0264 0.959
MS		2.57e-08 0.000		2.55e-08 0.000		2.60e-08 0.000		2.61e-08 0.000		2.53e-08 0.000		2.61e-08 0.000
_const	571.6329 0.000	144.8748 0.031	610.5576 0.000	147.308 0.029	495.7935 0.000	112.6434 0.063	447.544 0.000	140.6672 0.009	898.966 0.000	182.6576 0.048	915.119 0.000	155.863 0.124
Obs	168	168	168	168	168	168	168	168	168	168	168	168
Wald $\chi^2$	(1) 7.08	(3) 268.62	(1) 13.85	(3) 268.82	(1) 3.79	(3) 267.18	(1) 0.00	(3) 273.71	(1) 26.28	(3) 269.35	(5) 40.72	(7) 300.29
Prob > $\chi^2$	0.0078	0.0000	0.0002	0.0000	0.0514	0.0000	0.9997	0.0000	0.0000	0.0000	0.0000	0.0000
R <sup>2</sup>	0.040	0.6152	0.0706	0.6154	0.0221	0.6140	0.0000	0.6197	0.1353	0.6159	0.1951	0.6413
Adjusted R <sup>2</sup>	0.0347	0.6082	0.0762	0.6084	0.0162	0.6069	-0.0060	0.6127	0.1300	0.6088	0.1703	0.6256
Homoscedastic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Correlation	No	No	No	No	No	No	No	No	No	No	No	No

a significant relationship with FDIInflows at 0.05 alpha level (Wald  $\chi^2$  (3) = 268.82,  $P \leq 0.01$ ). The coefficient of determination ( $R^2 = 0.6154$ ) indicating that under the controlled environment, TCI can explain about 61% of the variations of FDIInflows into the eastern Africa region. The coefficients of the variables TCI and TTCR (-1.7811,  $p = 0.426$  and -0.5577,  $P = 0.251$ ) indicate a negative and insignificant relationship. Whereas the coefficients of MS (2.55e-08,  $P \leq 0.01$ ) indicate a positive and a significant relationship. We therefore conclude that TCI is a significant determinant of FDIInflows into the eastern Africa region. Thus fit equation 6.

$$FDI = 147.308 - 1.7811TCI - 0.5577TTCR + 2.55e-08MS \quad (6)$$

Sig = 0.426 0.251 <0.01  
 $R^2 = 0.6154$   
 Wald  $\chi^2$  (3) = 268.82,  $P \leq 0.01$

Where;

FDI = Foreign Direct Investment Inflows  
 TCI = Transport Composite Index  
 TTCR = Total Tax and Contribution Rate  
 MS = Market Size.

#### 4.8.3. Relationship between FDIInflows and ECI

From Table 7, this relationship is shown by model 5 which is direct and model 6, which is controlled. According to the test results from model 5, there exists a significant relationship between ECI and FDIInflows (Wald  $\chi^2$  (1) = 3.79,  $P = 0.0514$ ) at a 0.05 alpha level. The coefficient of determination ( $R^2 = 0.0221$ ) explains just about 2% of the variations of FDIInflows. And the coefficients of the variable ECI (-5.4533,  $P = 0.051$ ) indicates a negative but significant relationship between FDIInflows and ECI. Therefore, we conclude that ECI is a significant determinant of FDIInflows into the eastern Africa region. Thus fit equation 7.

$$FDIInflows = 495.7935 - 5.4533ECI \quad (7)$$

Sig = 0.051  
 $R^2 = 0.0221$   
 Wald  $\chi^2$  (1) = 3.79,  $P = 0.0514$

Where;

FDIInflows = Foreign Direct Investment Inflows  
 ECI = Electricity Composite Index.

When controlling this relationship for TTCR and MS, the results are presented in model 6 which indicate a significant relationship between ECI and FDIInflows (Wald  $\chi^2$  (3) = 267.18,  $P \leq 0.01$ ) at 0.05 alpha level. The coefficient of determination ( $R^2 = 0.6140$ ) which means ECI can explain about 61% of the variations in FDIInflows. The coefficients of the variables; ECI (-0.0102,  $P = 0.996$ ) and TTCR (-0.4946,  $P = 0.325$ ) have a negative and insignificant relationship while that of MS (2.60e-08,  $P \leq 0.01$ ) indicate a positive and significant relationship. Therefore, we make a conclusion that ECI, significantly influence the flow of FDI into the eastern Africa region. Equation 8 fits.



$$\text{FDIInflows} = 112.6434 - 0.0102\text{ECI} - 0.4946\text{TTCR} + 2.6\text{e-}08\text{MS} \quad (8)$$

Sig =	0.9960	0.325	<0.01
R <sup>2</sup> =	0.6140		
Wald $\chi^2$ (3)	267.18, P ≤ 0.01		

Where;

FDIInflows = Foreign Direct Investment Inflows

ECI = Electricity Composite Index

TTCR = Total Tax and Contribution Rate

MS = Market Size.

#### 4.8.4. Relationship between FDIInflows and ICI

Both model 7 and model 8 in Table 7 explain the test results for this relationship. While model 7 is a direct relationship, model 8 is a controlled relationship. Model 7 indicate a non-significant relationship between FDIInflows and ICI (Wald  $\chi^2$  (1) = 0.00, P = 0.997) at 0.05 alpha level. The coefficient of determination (R<sup>2</sup> = 0.0000) which indicates that ICI does not have any abilities to explain the variations in FDIInflows. The coefficients of the variable ICI (0.0017, P = 1.000) is positive but not significant. Therefore, we conclude that ICI does not influence the flow of FDI into the eastern Africa region. Hence equation 9 fits.

$$\text{FDIInflows} = 447.544 + 0.0017\text{ICI} \quad (9)$$

Sig =	1.000
R <sup>2</sup> =	0.000
Wald $\chi^2$ (1)	0.00, P = 0.9997

Where;

FDIInflows = Foreign Direct Investment Inflows

ICI = ICT Composite Index

On the other hand, model 8 indicate a significant relationship between ICI and FDIInflows (Wald  $\chi^2$  (3) = 273.71, P ≤ 0.01) at 0.05 alpha level. The coefficient of determination (R<sup>2</sup> = 0.6197) indicating that ICI has abilities to explain up to 62% of the variations of FDI flows into the eastern Africa region. The coefficients of the variables ICI (-4.5101, P = 0.112) and TTCR (-0.6130, P = 0.204) are negative and not significant while that of MS (2.61e-08, P ≤ 0.01) is positive and significant. Therefore, we conclude that ICI significantly influence the flow of FDIInflows into the eastern Africa region when controlled. Thus, equation 10 fits.

$$\text{FDIInflows} = 140.6672 - 4.5101\text{ICI} - 0.6130\text{TTCR} + 2.61\text{e-}08\text{MS} \quad (10)$$

Sig =	0.1120	0.204	<0.01
R <sup>2</sup> =	0.6197		
Wald $\chi^2$ (3)	273.71, P ≤ 0.01		

Where;

FDIInflows = Foreign Direct Investment Inflows

ICI = ICT Composite Index

TTCR = Total Tax and Contribution Rate

MS = Market Size.

#### 4.8.5. Relationship between FDIInflows and WSSI

This relationship is explained by models 9 and 10 in Table 7. Model 9 is a direct relationship while model 10 is a controlled relationship. According to the test results from model 9, WSSI has a significant relationship with FDIInflows (Wald  $\chi^2$  (1) = 26.28, P ≤ 0.01) at 0.05 alpha level. The coefficient of determination (R<sup>2</sup> = 0.1353) indicating that WSSI can only explain about 13% of the variations if FDIInflows. The coefficients of the variable WSSI (-8.9972, P ≤ 0.01) indicating a negative but significant relationship. Therefore, we conclude that WSSI influences the flow of FDI into the eastern Africa region. Equation 11 fits.

$$\text{FDIInflows} = 898.966 - 8.9972\text{WSSI} \quad (11)$$

Sig =	≤0.01
R <sup>2</sup> =	0.1353
Wald $\chi^2$ (1)	26.28, P <0.01

Where;

FDIInflows = Foreign Direct Investment Inflows

WSSI = Water Supply and Sanitation Index

On the other hand, from the test results exhibited in model 10, WSSI still has a significant relationship with FDIInflows (Wald  $\chi^2$  (3) = 269.35, P ≤ 0.01) at 0.05 alpha level. The coefficient of determination (R<sup>2</sup> = 0.6159) which indicates that WSSI has abilities to explain up to 61% of the variations in FDIInflows. The coefficients of the variables WSSI (-1.1816, P = 0.360) and TTCR (-0.5107, P = 0.286) indicate a negative and non-significant relationship but that of MS (2.53e-08, P ≤ 0.01) indicate a positive and a significant relationship. We therefore conclude that WSSI is a significant determinant of FDI into the eastern Africa region. Equation 12 fits.

$$\text{FDIInflows} = 182.6576 - 1.1816\text{WSSI} - 0.5107\text{TTCR} + 2.53\text{e-}08\text{MS} \quad (12)$$

Sig =	0.3600	0.286	<0.01
R <sup>2</sup> =	0.6159		
Wald $\chi^2$ (3)	269.35, P ≤ 0.01		

Where;

FDIInflows = Foreign Direct Investment Inflows

WSSI = Water Supply and Sanitation Index

TTCR = Total Tax and Contribution Rate

MS = Market Size.

#### 4.8.6. Relationship between FDIInflows and Infrastructure development (Overall models)

This relationship is exhibited by model 11 and model 12 in Table 7. Model 11 is a direct relationship whereas model 12 is a controlled relationship. According to test results from model 11, there exist a significant relationship between infrastructure development and FDIInflows (Wald  $\chi^2$  (5) = 40.72, P ≤ 0.01) at 0.05 alpha level. The coefficient of determination (R<sup>2</sup> = 0.1951) an indication that infrastructure development can explain up to 19% of the variations in FDIInflows in a direct relationship. The coefficients of variables AIDI (34.9139, P = 0.108) and ECI (5.6546, P = 0.659) are positive but not significant at 0.05 alpha level. But those of TCI (-46.0073, P = 0.017) and

WSSI (-11.62997,  $P = 0.024$ ) are negative but significant at 0.05 alpha level. That of ICI (-14.09197,  $P = 0.25$ ) is negative and insignificant. Therefore, we conclude that Infrastructure development has a significant influence on FDIInflows into the eastern Africa region. Equation 13 fits.

$$\text{FDIInflows} = 915.119 + 34.9139\text{AIDI} - 46.0073\text{TCI} + 5.6546\text{ECI} - 14.09197\text{ICI} - 11.62997\text{WSSI} \quad (13)$$

Sig = 0.108 0.017 0.659  
0.255 0.024

$$R^2 = 0.1951$$

$$\text{Wald } \chi^2(5) = 40.72, P \leq 0.01$$

Where;

FDIInflows = Foreign Direct Investment Inflows

AIDI = Africa Infrastructure Development Index

TCI = Transport Composite Index

ECI = Electricity Composite Index

ICI = ICT Composite Index

WSSI = Water Supply and Sanitation Index.

On the other hand, the controlled model 12 indicate a significant relationship between infrastructure development and FDIInflows (Wald  $\chi^2(7) = 300.29$ ,  $P \leq 0.01$ ) at 0.05 alpha level. The coefficient of determination ( $R^2 = 0.6413$ ) an indication that infrastructure development has abilities of explaining up to 64% of the variations in FDIInflows into the eastern Africa region. The coefficients of variable MS ( $2.61e-08$ ,  $P \leq 0.01$ ) is positive and significant, whereas AIDI ( $14.2744$ ,  $P = 0.327$ ) and ECI ( $12.0949$ ,  $P = 0.174$ ) are positive but not significant. Those of TCI ( $-28.6697$ ,  $P = 0.027$ ) and ICI ( $-16.1483$ ,  $P = 0.051$ ) are negative but significant where as those of WSSI ( $-0.4338$ ,  $P = 0.902$ ) and TTCR ( $-0.0264$ ,  $P = 0.959$ ) are negative and non-significant. We therefore conclude that infrastructure development has a significant influence on the flow of FDI into the eastern Africa region. Thus equation 14 fits.

$$\text{FDIInflows} = 155.863 + 14.2744\text{AIDI} - 28.6697\text{TCI} + 12.0949\text{ECI} - 16.1483\text{ICI} - 0.4338\text{WSSI} - 0.0264\text{TTCR} \quad (14)$$

Sig = 0.327 0.027  
0.174 0.051 0.902 0.959

$$+ 2.61e-08\text{MS}$$

$$< 0.01$$

$$R^2 = 0.6413$$

$$\text{Wald } \chi^2(7) = 300.29, P \leq 0.01$$

Where;

FDIInflows = Foreign Direct Investment Inflows

AIDI = Africa Infrastructure Development Index

TCI = Transport Composite Index

ECI = Electricity Composite Index

ICI = ICT Composite Index

WSSI = Water Supply and Sanitation Index

TTCR = Total Tax and Contribution Rate

MS = Market Size.

## 5. CONCLUSIONS AND POLICY IMPLICATIONS

Anchoring on the findings from the previous section, this paper makes the following conclusions and policy recommendations.

### 5.1. Conclusions

The main aim of the paper was to find out the relationship between infrastructure development and the flow of foreign direct investments. The paper relied on data from 12 eastern Africa region countries for the periods running from 2004 to 2017. Due to heteroscedasticity problems, the paper adopted a Generalized Least Squares (GLS) estimation method, and ran models to test for both direct relationships and also controlled relationships.

From direct relationship models, it was established that 4 models (Africa Infrastructure Development Index, Transport Composite Index, Electricity Composite Index and Water Supply and Sanitation Index) significantly influence the flow of foreign direct investments into the eastern Africa region. But, ICT Composite Index was found to be a non-significant influencer of Foreign Direct Investments.

Similarly, from the controlled models, it was established that all the 5 models (Africa Infrastructure Development Index, Transport Composite Index, Electricity Composite Index, ICT Composite Index and Water Supply and Sanitation Index) influence the flow of foreign direct investments into the eastern Africa region significantly. Although from the overall model, Africa Infrastructure Development Index and Electricity Composite Models positively influence foreign direct investments. On the other hand, Transport Composite Index, ICT Composite Index and Water Supply and Sanitation Index are negative. This is partly because Transport, ICT, Water supply and Sanitation are considered as social development indicators. The control variables, Total Tax and Contribution Rate tests insignificant. Although it must be noted that a unit increase in total tax and contribution rate leads to a decrease in foreign direct investments. On the other hand, Market size tested significant.

Controlled models exhibited a better explanatory value on the variations in FDIInflows than direct models, an indication that Infrastructure development acts as an enabler of production efficiency that in turn attracts FDIInflows. Therefore, it is prudent to invest in Infrastructure development to enable firms reduce their transaction costs hence boosting their profits and ultimately enhancing economic growth and social development. Finally, this paper moves to support the proposition that FDI follows not only the size of the market but also production efficiency.

### 5.2. Policy Recommendations

This paper establishes that infrastructure development is not only essential in building efficiencies necessary for firm production but also it triggers economic growth and social development. Therefore, it is of great import for governments to allocate resources into infrastructure development. However, exercise great caution when using debt from foreign development partners. This is because they create a debt burden and constrain future

capital investments especially when these funds are not prudently appropriated in projects that increase the productive capabilities of a nation. This then calls for innovative ways of financing infrastructure. For example, attraction of private financing from both institutional investors and foreign direct investments into infrastructure projects will go a long way. However, a well stakeholder engaged legal and regulatory frameworks that reflect best international standards on public private partnerships (PPP) should be formulated, in order to enhance the attractiveness and bankability of these projects.

Energy is a fundamental factor in not just manufacturing but also social development. A good economy needs a substantial amount of energy to sustain its growth and development. Electricity consumption has been found to correlate well with economic well-being of a nation. Therefore, nations should endeavor to enhance their levels of electricity generation and reliability in supply. This should be followed by lowering tariffs to support both households in increasing their consumption and manufacturing in order to support economic growth and development.

One-unit increase in total tax and contribution rate leads to a decrease in foreign direct investments into the eastern Africa region. Evidently, taxation is one of the impediments to the mobility of capital across borders. Therefore, policy makers are advised to regularly appraise the tax burden on investment returns against the need to collect enough tax revenues from multinationals for the production of public goods and devise adequate tax incentives to promote more foreign investments. These incentives may be in the form of reduced corporation income tax rate, tax holidays, and tax credits. Other incentives include investments allowances, reduced tariffs and reduced tax on dividends and interest paid abroad. Similarly, the entire tax administration process should be evaluated to ensure compliance costs from unwarranted complexity, absence of transparency and unpredictability in the tax system are minimized.

The benefits of economies of scale and lower fixed costs per unit of output provided for by larger host markets enables horizontal foreign direct investments. Therefore, policy makers should endeavor to enhance their markets through adoption of trade liberalization protocols such as multilateral and preferential trade agreements, and regional integration agreements. These agreements will not only stimulate intra-regional trade but also enhance efficiencies in resource allocation hence economic growth for member countries.

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