Journal of Economics and Sustainable Development www.iiste.org
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.9, No.10, 2018

Impact of Government Expenditure in Transport Infrastructure on Gross Domestic Product in Kenya

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Abstract
The government of Kenya has continued to increase her expenditure on infrastructure over the years. This has accentuated the need for empirical investigation on the impact of government expenditure on transportation infrastructure on GDP in Kenya from 1964 to 2015. The study used the Keynesian theory that government expenditure contributes to economic growth of the country. The data was tested for unit roots using the Augmented – Dickey Fuller test and cointegration was performed before granger causality test was done to test for direction of causality among the variables. The Johansen Maximum Likelihood test was applied which showed that there exists a long run relationship between government expenditure on transport infrastructure and GDP in Kenya. Granger Causality test revealed that causality runs from GDP to transport expenditure. The study concluded that government expenditure on transport infrastructure has a significant impact on GDP in Kenya.
Keywords: Government Expenditure, Gross Domestic Product, Transport Infrastructure, Cointergration, Granger Causuality.

1.1 Introduction

The government of Kenya has continued to increase her expenditure in the economy over the years. The approved government expenditure on infrastructural sector since 2003 witnessed an upward trend as the country embarked on massive infrastructure development as enshrined in the Sessional Paper of 2002 on Strategy for Poverty Reduction (ROK, 2002). This period saw increased Physical infrastructure development, upgrading and maintenances. Mega state of art projects such as the Thika Super Highway and Fiber Optic Cable installation were initiated in the country.

Accelerating transport infrastructure development supports the government's Vision 2030 and enhances Kenya's regional competitiveness and economic growth. This is because the development of such infrastructure is central to any countries' economic growth and development. Hence the quantity and quality of available infrastructure and their accessibility to the supposed beneficiaries could be regarded as indices of development. Among other things, the availability of such infrastructure (functional ones) in an economy has significant effect on the quality of life of the people living there. Samli (2011) asserts that one of the factors considered in assessing the development of a region or a country is the quality of life measured by accessibility to the basic necessities of life and to basic infrastructure such as a well developed transport network.

The basic premise of the empirical studies is that public investment in physical infrastructure can raise private output and productivity in both direct and indirect ways. Directly, public infrastructure services are thought of as intermediate inputs that enter into a firm's production process just in the same way as private inputs such as labour and private capital. For the indirect effect on private sector production, it arises from the role of public infrastructure in augmenting the productivity of other private inputs. For example, improvements in transport infrastructure could reduce workers' commuting time and costs of transporting inputs from source to production areas and outputs from places of production to areas of need (Akinyosoye, 2010).

According to the Africa Infrastructure Country Diagnostic Report (2010), Kenya spends about US$1.6 billion (about 9 percent of its GDP) a year on infrastructure. This expenditure on the Infrastructure sector contributed to about half a percentage point to the country's annual GDP growth over the last decade. The report indicates that for the country to meet its most pressing infrastructural needs and catch up with other developing countries, Kenya requires a sustained expenditure of US$4 billion a year (or about 20 percent of its GDP), over the next decade. The World Bank analysis shows that Kenya's per capita growth rate can be increased by three percentage points if infrastructure financing is increased to the average of a middle income country (which is about 20 percent of the countries' GDP).

2.1 Empirical Literature Review

Taylor-Lewis, (1993) using data for the G7 countries over the period 1970- 87 found that the contribution of public physical infrastructure to output were insignificant. Canning estimated an aggregate production function for a panel set of 77 countries using annual cross country data for the period 1960 - 1990 in a Cobb-Douglas function found that the elasticity of output with respect to physical capital was positively significant at around 0.37. However he observed no significant impact of electricity generating capacity, or transportation structure on economic growth. Canning and Bennathan, (2000) sampled 89 countries using a Cobb Douglas function found positive and statistically significant rates of return for the paved roads and electricity.

Onakoya, (2012), using a multivariate approach for Nigeria found that transport infrastructure was not statistically significant in explaining the output of agriculture but was significantly related to the outputs of the oil, manufacturing and service sectors. Since the outputs of these sectors are positively related to the output of the infrastructure, with three of the four sectors being significant, it can be summarized that the investment in infrastructure had both direct and indirect impact on Nigeria's economic growth.

Muthui, (2013), studied the impact of public expenditure components on economic growth in Kenya 1964-2011 using the Keynesian model found out that public expenditure allocation to infrastructure on GDP growth was positive and felt immediately.

Seetanah, (2006) using a sample of 38 Sub-Saharan African countries over the period 1980-2000. The study found that output elasticity of transport infrastructure was positive and statistically significant with an output elasticity of 0.226.

2.2 Data Collection Procedure

The data was collected from the various issues of Kenya National Bureau of Statistics (KNBS) and the World Bank.

2.3 Data Analysis

A process is said to be stationary if its probability distribution remains unchanged as time proceeds since the data generation process does not change. If the series are intergrated of the same order and cointergrated, then estimate results and statistical inferences would be non spurious (Granger, 1988).

Because this study used time series data, it was important to establish the stationarity of the data or what order they are integrated to make sure that the results obtained are not spurious. Augmented Dickey Fuller (ADF) test due to Dickey and Fuller (1981) was used to examine each of the variables for the presence of unit roots. The test formula for ADF test is shown in the equation below;

$\Delta Y_t = \alpha_0 + \alpha Y_{t-1} + \sum_{i=1}^{n} \alpha_1 \Delta Y_{t-1} + \varepsilon_t$……………………………………………….. (1)

Where:

Y is a time series, t is a linear time trend, Δ is the first difference operator, α_o is a constant, α is the coefficient of the previous observation, Y_{t-1} is the immediate previous observation, ΔY_{t-1} is the differenced lagged term, α_1 is the parameter to be determined, n is the optimum number of lags on the dependent variable and ε is the random error term.

Here the significance of α_1 would be tested against the null that $\alpha_1 = 0$. Thus if the hypothesis of non-stationarity cannot be rejected, the variables are differenced until they become stationary, that is until the existence of a unit root is rejected.

2.4 Testing for Co-integration

Cointegration can be seen when economic variables share a common stochastic trend and their first differences are stationary. Cointegration is a technique used to test for existence of long-run economic relationships (co-movement) between two or more variables in a non stationary series (Gujarati, 2004).

To test the data for co integration the study employed the maximum – likelihood test procedure established by Johansen (1991). Specifically if Y_t is a vector of n stochastic variables, then there exists a p-lag vector auto regression with Gaussian errors of the following form: Johansen's methodology takes its starting point from the vector auto regression (VAR) of order P given by:

$Y_t = \lambda + \Delta_1 y_{t-1} + \ldots + \Delta\rho\, y_{t-p} + \varepsilon_t$………………………………….…… (2)

Where Y_t is an nx1 vector of variables that are integrated of order commonly denoted (1) and ε_t is an nx1 vector of innovations

This VAR can be rewritten as;

$\Delta y_t = \lambda + \eta_{yt-1} + \sum_{i-1}^{p-1} \tau_i \Delta y_{t-1} + \varepsilon_t$……………………………………(3)

Where:

$\Pi = \sum_{i-1}^{p} A_{i-1}$ and $\tau_i = - \sum_{j-i+1}^{p} A_j$

To determine the number of co-integration vectors, Johansen (1990) suggested two statistic tests. The first one is the trace test (λ trace). This tests the null hypothesis that the number of distinct cointegrating vectors is less than or equal to q against a general unrestricted alternatives q = r the test calculated as follows:

λ trace (r) = $-T\sum_{i-r+t} ln\,(1 - \lambda_t)$ ………………………………… (4)

Where T is the number of usable observations and the λ_t are the estimated eigen value from the matrix.

The second statistical test is the maximum eigen value test (λ max) that is calculated according to the following formula:

λ max (r, r + 1) = - T In (1 – λ r + 1) --------------------------------------- (5)

This tests the null hypothesis that there are r co-integrating vectors against the alternative that there r + 1 co-integrating vector.

2.5. Estimation of Vector Error Correction Model (VECM)

The purpose of the error correction model is to indicate the speed of adjustment to restore equilibrium in the model; from the short-run equilibrium to the long-run equilibrium state. The vector error correction model (VECM) has cointegration relations built into the specification so that it restricts the long run behavior of the endogenous variables to converge to their cointegrating relationship, while allowing for short-run adjustment dynamics. The dynamic specification of the VECM allows the deletion of the insignificant variables, while the error correction term is retained.

When a considered cointegration rank of a system is known and the corresponding restriction imposed, the Vector Error Correction Model (VECM) is expected as in equations (6) and (7) below;

$$\Delta Y_t = a_1 + \beta_1 ECT_{t-1} + \sum_{i=1}^{n} \delta_i \Delta Y_{t-1} + \sum_{i=1}^{n} \Omega_i X_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots\ldots(6)$$

$$X_t = a_2 + \beta_2 ECT_{t-1} + \sum_{i=1}^{n} \mu_i \Delta Y_{t-1} + \sum_{i=1}^{n} €_i X_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots\ldots(7)$$

Where:

(ECT_{t-1}) is the error correction term lagged one period which is equivalent to

($e_t = Y_t - \alpha - \beta X_t$), this represents the disequilibrium residual of a co-integration equation (Engle, 1987).

2.6 Granger Causality Test

Granger causality shows whether the past values of independent variable can be able to predict current or future values of the dependent variable and tests for the causal direction. It's also used to test for exongineity and enables the study to know whether the study should estimate the model using simultaneous or single equation (Muthui, 2013). In this study, it's predicted that government expenditure on transport infrastructure predicts the county's GDP. On the same breath the GDP levels can as well influence the government expenditure on transport infrastructure leading to the model suffering from simultaneous bias. The Granger causality test equations are of the form (Granger, 1988):

$$\text{Ln } Y_t = \beta_o + \sum_{t-1}^{n} \beta_{1i} \text{ Ln } Y_{t-1} + \sum_{t-1}^{n} \beta_{2i} \text{ Ln } GE_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

and

$$\text{Ln } GE_t = \alpha_o + \sum_{t-1}^{n} \alpha_{1i} \text{ Ln } Y_{t-1} + \sum_{t-1}^{n} \alpha_{2i} \text{ Ln } GE_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Where:

In Y_t is the natural logarithm of GDP, Ln GE_t is the natural logarithm of government expenditure on infrastructural sectors, ε_t and $\mu_t$are white noise error terms.

Then null hypothesis for equation (8) is that In Y does not Granger cause In GE. This hypothesis will be rejected if the coefficients of the lagged Y's (Summation of β_2 as a group) are found to be jointly significant (different from zero).

The Null hypothesis for equation (9) is that In GE does not granger cause In Y. This hypothesis would be rejected if the coefficient of the lagged GEs (summation α_2 as a group) is found to be jointly significant. If both of these null hypotheses are rejected, then a bidirectional relationship (feedback system) is said to exist between the two variables.

2.7 Specification of the Econometric Model

The study defined the Gross Domestic Product as a function of infrastructural sub sectors; Transport (EXTRA), Energy (ENE) and Housing and Public Works (EXHPW) as shown below;

$$RGDP_t = \beta_0 \, EXTRA_t^{\beta 1} EXENE_t^{\beta 2} EXHPW^{\beta 3}{}_t e^{\varepsilon t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

Equation (12) is put in linear form by taking the natural logarithms on both sides as shown in equation (13). The respective coefficients would then represent the output elasticity with respect to each independent variable.

$$LnRGDP_t = Ln\beta o + \beta_1 LnEXTRA_t + \beta_2 LnEXENE_t + \beta_3 LnEXHPW + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

3.1 Results for Stationarity Tests

The Augmented Dickey Fuller (ADF) test was used to test for unit roots. Table 3.1 presents the results of Augmented Dickey Fuller (ADF) Test both in levels and first difference.

Table 3.1 ADF Results for Stationarity Tests

Variable	**Level**	**Prob.**	**First Difference**	Prob.
Gross Domestic Product	-0.051	0.9541	-5.488	0.0000
Government expenditure on transport	-0.963	0.7667	-6.393	0.0000
Government expenditure on Housing and Public works	-0.745	0.8348	-10.970	0.0000
Government expenditure on Energy	-1.431	0.5676	-9.242	0.0000

Note: Critical values at 1%, 5% and 10% level of significance are -3.614, -2.944 and 2.606 respectively

From table 3.1 on the results of ADF Test indicates that all variables are non-stationary at level. The hypothesis of a unit root cannot be rejected at the level for each of the study variables. This is not shocking indeed as time series data are generally believed to be non-stationary. The results for the test at first difference for all the variables show that the null hypothesis of unit root was rejected at 1%, 5% and 10% level of significance. This means that all variables are integrated of order one i.e. I(1) and therefore permits tests for cointergration.

3.2 Result of Cointegration

The study used the Johansen and Juselius (1990) Maximum Likelihood Method to investigate the existence of a long-run relationship between the variables. The result of the cointegration condition is presented in table 3.2

Table 3.2 Results of Maximum Likelihood Cointegration Test

Maximum Rank	**Parms**	**Trace Statistics**	**5% Critical Values**
0	36	47.5349	47.21
1	43	18.1338*	29.68
2	48	5.7168	15.41
3	51	0.4464	3.76
4	52		

From table 3.2 showing the results of maximum likelihood Cointegration, the trace statistic values indicate that there is one co-integrating equation at the 5 percent level of significance which led to the rejection of the hypothesis of no co-integration. This implies that there is long run relationship between Government expenditure on physical infrastructure and GDP in Kenya.

3.3 Results for Estimation of VECM

In order to capture the extent of cointegration among these variables, the Vector Error Correction Methodology (VECM) proposed by Johansen (1991) was utilized. The results for the VECM cointergration coefficient are presented in table 3.3 below.

Table 3.3 Results for the VECM Cointergration Coefficient

Beta	**Coef.**	**Std. Err.**	**Z**	**P>z**	**95% Conf.**	**Interval**
Gross Domestic Product	1	.	.	.	.	.
Government Expenditure on Transport	2.7465	0.3999	-6.87	0.000	-3.5303	-1.9627
Government Expenditure on Housing and Public Works	-1.7532	0.3529	4.97	0.000	1.0615	2.4449
Government Expenditure on Energy	-0.0045	0.1866	0.02	0.981	-0.361	0.3703
Constant	0.1675	.		.	.	.

From table 3.3 one co-integrating equation exists with a positive constant term of 0.1675 If the variables under this study are held constant GDP can still grow at 0.1675 percent. A 1 percent change in transport expenditure leads to 2.74 percent change in GDP having a positive relationship. This relationship is significant at 5% level of significance.

3.4 Results for Granger Causality Tests

The study checked for long term relationship between the variables and the direction of causality using the Pair wise Granger Causality Wald Test.

3.4 Results for Pair wise Granger Causality Wald Test

Null Hypothesis	**chi2**	**Df**	**Prob> chi2**
Government Expenditure Transport Does Not Granger Cause GDP	4.9903	3	0.173
ALL Do Not Granger Cause GDP	51.254	9	0.000
GDP Does Not Granger Cause Government Expenditure on Transport	22.021	3	0.000

The results from table 3.4 show that causality moves from GDP towards transport expenditure. This means that GDP has information that can help predict values of transport expenditure. This is significant at 5% level leading to rejection of null hypothesis of no causality and accepting the alternative hypothesis that GDP Granger causes the expenditure in transportation. Therefore as the GDP of the country expands it causes changes in the transportation sector.

Causality also moves from all the variables jointly towards GDP. This means that combined government expenditure on transport, energy and housing and public works can be used to predict future values of GDP and this is statistically significant at 5% .

3.5 Summary of the Study

The general objective of this study was to investigate the impact of government physical infrastructure expenditure on GDP in Kenya. The specific objectives of this study were to investigate the impact of government expenditure on transport, energy and housing and public works on GDP. To achieve the objectives of the study, explicit yearly data for the period 1964 to 2015 was collected from Kenya National Bureau of Statistics (KNBS) and the World Bank for the various components of the physical infrastructural sector that were considered under the study and GDP. Stationary tests were carried out to stabilize the data. All the variables were integrated of order one. This called for the use of Johansen's maximum likelihood method in the vector error correction model to estimate the parameters and conduct the inference. The variables were finally tested for Granger prirewise causality to check on the direction of causuality. The results from the study showed that government expenditure on transport has long run significant relationship to the GDP in Kenya.

From Keynesian theory, public spending is widely seen as having an important role in supporting economic growth. This study concludes that Increased budgetary expansion by the government in transport infrastructure and other sectors of the economy is key to increasing the aggregate demand in the economy thus boost the Gross Domestic Product (GDP).

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