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THE ROLE OF INFRASTRUCTURAL DEVELOPMENT IN ENHANCING THE PROGRESS OF ECONOMIC GROWTH IN ETHIOPIA: THE CASE OF THE ELECTRICITY POWER AND ROAD INFRASTRUCTURES

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ABSTRACT

The paper reveals the role of electricity power and road infrastructures on real GDP. A time series data from 1975 to 2013 is employed. Moreover, following determination of order of integration of variables, Engle-Granger co-integration test has been undertaken to test the presence of long run equilibrium among the variables involved. The result reveals the existence of long run equilibrium. The study confirms that, broad money supply, electricity power and paved road have a positive and significant effect on real GDP while inflation affects growth negatively both in the short run and long run models. However, gravel road is insignificant both in the long run and short run cases.

Keywords: Infrastructure development, Engle-Granger co-integration, Ethiopia.

INTRODUCTION

The success of economic growth process depends largely on the available resources and an enabling environment. Thus, theoretically, the availability of infrastructure facilities like: energy, water, transportation and communication technologies facilitate the pace of economic growth. It is a styled fact that transport, telecommunications, energy**,** water and health are integral elements for human existence. Thus, bringing a balanced development of an economy is assumed to be unthinkable without adequate infrastructures. Srinivasu and Srinivasa (2013) show that improvement in infrastructure is a prerequisite for the development of any economy.

Literatures are also in line with the importance of infrastructure facilities in inducing long run growth effects.

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For instance, a study by David (2004) demonstrates that telephones, electricity generating capacity and paved roads are vital variables to the growth maximizing condition. Therefore, Spending on modern infrastructures seems laying the foundations for economic growth. Moreover, reports by different scholars such as Risako, (2001), Ibrahim (2011), Yılmaz (2014) and European Union (2014) also confirm a positive relationship between the growth of transport, electricity power generation and economic growth.

Moreover, infrastructure especially Electricity consumption is a limiting factor to economic growth and hence shocks to electricity supply will have a negative impact on economic growth (Attiya, 2013).

However, still the effect of infrastructure on economic growth remains open for empirical investigation because different papers argued the complex relationship between infrastructure and economic growth. Although infrastructure development is important and necessary for industrial take-off and economic growth, the desire for

growth does not necessarily mean higher or increased need for infrastructure and more infrastructures does not necessarily guarantee more economic growth (Abass 2013).

Researchers such as Enu and Havi, (2014) reach in inconclusive result about the real importance of electricity power on economic growth. As to them, power consumption has a positive impact on the long run progress of an economy. However, in the short run, there exists an inverse relationship between electricity consumption and economic growth.

Emissions of pollutants are generally linked to energy use and hence it requires further evidence of investigating the linkages between energy use and economic growth. This is due to the fact that energy is used to transform or move matter and therefore any energy use causes some environmental disruption (David, 2004).

In Ethiopia, where majority of the populations' economic activity is agriculture, road infrastructure is expected to be a vital instrument for facilitating economic growth via making market linkage. Moreover, following the initiation of the government for the encouraging the new enterprises and in transforming low and middle level enterprises in to a large scale business organizations, electricity power production is also assumed to an engine for development of the nation. That is why the Government of Ethiopia has given an emphasis on improvement of the quality and size of road infrastructure. Moreover, Public sector development is a long lasting phenomenon in Ethiopia. For example, a road sector development program (RSDP) has been carried out in different phases since 1997 (Admasu, 2012).

As to the best of the writer's knowledge previous studies show the contribution of total road network (in aggregate level) on the economic growth. Hence, the dynamic effect of combined variables of electricity power consumption and road nature (paved and gravel) on economic growth is still an empirical issue. Moreover, here in this study road sector is classified into paved (asphalt) and gravel because the writer beliefs that the effect of road infrastructure depend on the nature of road structure. Therefore, the study analyzed the impact of road (paved and gravel) and electricity consumption level on economic growth in Ethiopia.

MODEL SPECIFICATION

To investigate the effect of infrastructural development particularly road construction on economic growth, the model is developed based on the endogenous growth framework. The endogenous growth models developed by Lucas-Romer extend the old neo-classical model by emphasizing the role of endogenous factors (i.e., human capital stock and Research and development activities) as the main engines of economic growth (Lucas, 1988).

Accordingly, the cob-Douglas production can be formulated as follows:

$$Y_t = AK_t^{\alpha} H_t^{\beta} L_t^{1-\alpha-\beta} e^{\varepsilon t} \quad \text{.....1}$$

Where,

Y = national out put

A = total factor productivity (technological effect)

K = physical capital

H = human capital and

L = labor force

However, to make the model estimable as well as to obtain elasticity coefficients we have to take natural logarisms for equation (1).

$$lny = lnA + \alpha lnk_t + \beta ln\, h_t + \varepsilon_t \quad \text{..... ...2}$$

It is the argument of different literatures about the relevance of road network to economic growth. Thus, the Cobb-Douglas type functional specification will be augmented with road variable so as to identify its impact on economic growth.

However, researchers like Ibrahim (2011) argued that the effect of road on economic growth might be different depending on different types of roads (i.e. paved and gravel road). Therefore, the writer is inclined to classify the road variables into paved and gravel road in order to see the impact of the difference in road structure on the overall economic growth.

Moreover, based on prior theoretical expectations about the relationship between economic growth and economic variables, some variables, like growth capital formation (proxy for investment), terms of trade (TOT), financial development and policy variable, are included as part of the model.

Incorporating all aforementioned variables, the econometric model is specified as follows:

$$lny_t = \beta_0 + \beta_1 Inf_t + \beta_2 lnRp_t + \beta_3 lnRg_t + \beta_4 lnELE_t + \beta_5 lnFD_t + \varepsilon_t \quad \text{...6}$$

Where, $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, and\ \beta_6$ are the elasticity coefficients

lnY_t - is the log of annual growth in real GDP

$lnFD_t$ – it stands for log of financial development which can be proxied by broad money supply or real interest rate but in developing nations where financial market is not get developed. Thus, for our will take broad money supply (M2) as a proxy to financial development.

$lnELE_t$ - Natural logarism of electricity consumption. It is our expectation that electricity power enhances growth as every economic activities being subject to electricity.

$lnRp_t$ – is log of paved (asphalt) road. It is obvious that road construction is expected to have considerable role in

encouraging both the agricultural and industrial linkages. Asphalt road is expected to have a positive impact on growth. It is also revealed in the study of Ibrahim (2011) that asphalt road has a positive sectoral impact, but gravel roads fail to significantly affect both overall and sectoral GDP growth.

$lnRg_t$ - is log of gravel road. Even though some literatures argued insignificant impact of gravel road, like Ibrahim, our expectation is that something is better to nothing and hence in Ethiopia, where there is no adequate road infrastructure, still gravel road construction is expected to have a positive and significant impact on growth both in the short run and long run production periods. Whereas, macro-economic instability (inflation, Inf) minimizes real value of production and hence it is expected to possess a negative estimate.

ESTIMATION TECHNIQUE

It obvious that most economic variables are likely to be non-stationary but Regression with the presence of non- stationary variable may produce a spurious regression (Gujjirati, 1994). Thus, the first task of a researcher has to be identifying the order of integration of a variable. Accordingly the Augmented Duck fuller test of unit root is conducted to check the stationarity of macro variables and to identify their order of integration.

Following, test of unit root, if variables are non-stationary, the next task will be test of co-integration. Which means that linear combination of non-stationary series may be co-integrated in the long run. Therefore, among those co-integration test mechanisms, this paper employees Engle-Granger co-integration test approach. This approach is preferable to other techniques because it is the most useful method of determining the existence of co-integration in small samples. But the Johansen technique requires large data sample, a luxury for developing economies in general and Ethiopia in particular. Therefore Engle-Granger testing procedure has better sample size properties than the Johansson approach. Thus, given static model of:

$$Y_t = \beta_0 + \sum \beta i X_{it} + \mu_t \text{.....7}$$

Where, X_{it} stands for the ith regressor and summation nation also stand for the sum all explanatory variables involved in the static model; the Engle-Granger co-integration test is undertaken as follows: First we run the static model to obtain the residual and to let the residual subject to unit root test. And hence: if the residual is stationary, I(0), we could conclude there is long run association among variables involved if not there could be no long run equilibrium(Gujjirati,1994). This is because of the fact that though economic variables, individually, are non-stationary their linear relationship may result in stationary and hence insure long run equilibrium. Accordingly, the disequilibrium that might be exist in the short run adjusts itself in the long run via 'error correction mechanism (ECM)' or adjustment speed.

The error correction model is written as:

$$\Delta Y_t = \beta_0 + \beta_i \sum X_{it} + \delta ECM_{-1} + \mu_t \text{ ..... 8}$$

Where, δ – adjustement speed

RESULT AND DISCUSSION PART

Table 1. Unit root test

Augmented Dickey Fuller (ADF) has been conducted to determine order integration of variables as shown below. The result is outcome of ox-metrics software packages and it evokes that all variables are of I(1), stationary after first differencing.

ADF test with trend and intercept, ADF critical values, 5%=-3.53 1%=-4.22		
Variable	Level	Difference
LRGDP	-1.5070	-5.259**
INF	-2.694	-7.715**
LPR	2.374	-3.924*
LGR	-2.296	-5.502**
LM2	-2.673	-6.020**
LELE	-1.550	-5.650**

Note: all variables are in natural logarism form except inflation (because there appear negative values) and hence L- stands for natural logarism.

Table 2. Co-integration test

Since the unit root test indicates non-stationarity of variables involved but still their linear combination may form long run association (stationary). Therefore, existence of long run equilibrium is an empirical issue. Thus, the following table presents unit root test of residuals obtained from the static model. The result confirms the presence of long run equilibrium as the residual (ECM) become stationary. Consequently, we could run both the short run (error correction model) and long run (static) models separately.

Variable	**ADF test, ADF critical values,** 5%=-1.95 1%=-2.63
Ecm	-2.857**

Table 3. Short run model (error correction model)

The table below is self explanatory where by the direction and magnitude impact of explanatory variables is well explained. Moreover, the speed (ECM-1) in which the disequilibrium adjusts within the fiscal year is also

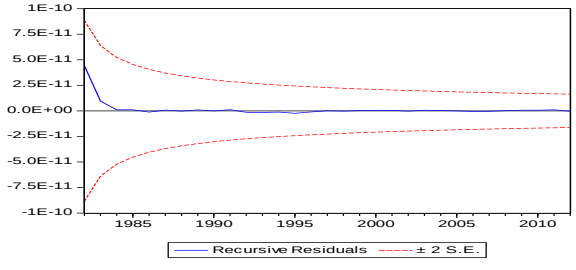
shown clearly. Accordingly, around 5% of the shock or disequilibrium adjusts within the fiscal year and hence it converges to the long run equilibrium.

Dependent variable, DLRGDP, Lag length is determined by Akaike Information Criterion			
Variable	Coefficient	Standard error	T-Ratio[probability]
Constant	-0.013	0.02	-0.65[0.523]
DINF	-0.0032	0.001	-3.13[0.0040]***
DLPR	0.52	0.206	2.52[0.0174]**
DLGR	0.1440	0.2040	0.706[0.4857]
DLM2	0.22	0.086	2.56[0.0149]**
DLELE	0.315	0.079	3.987[0.00252]***
Ecm-1	-0.05	0.01816	-2.57[0.01732]**
Diagnostic tests			
R^2 =0.6811			
Adj.R^2 = 0.671028			
F(7,28) = 3.709 [0.006]**			
AR 1-2 test: F(2,26) = 1.0688 [0.3580]			
ARCH 1-1 test: F(1,34) = 0.069129 [0.7942]			
Normality test: Chi^2(2) = 1.1816 [0.5539]			
Hetero test: F(14,21) = 0.33182 [0.9809]			

Note; (**) and (***) denotes significance at 5% and 1% level of significance. Moreover, diagnostic test shows absence of series problems like autocorrelation (AR), autocorrelation conditional heteroscedasticity (ARCH) and heteroscedasticity problems. The result also passes the normality test.

The adjusted R-squared of approximately 0.68 indicates that 68% of the variation in real GDP is explained by the model. However, the result to be trustworthy and to make econometric inferences, model stability test is a necessary phenomenon. Thus stability test has been conducted by using the cumulative sum of recursive residual (CUSUM) test which is reported in figure 1.1 below. Accordingly, the test provides an evidence of stability in the estimates at the 5 (within ±2.5 standard errors) percent significance level for conventional specification.

Figure 1. Recursive residual(stability test)



The result reveals an evidence for the negative effect of inflation on economic performance of the nation. It may be due to the fact that it leads to the loss of purchasing power. Thus, it affects investments and hence output level of a nation. It is in line with the study of Muhammad (2011) and Faraji (2013) but in contrary to the empirical analysis of Aminu (2012). Road infrastructure is a key for creating conducive environment and facilitating economic activities. Thus, road infrastructure smoothed economic activities via connecting different economic agents in factor and product markets. Moreover, it plays an indispensible role in reducing urban traffic problems. Many literatures like, Shenggen (2004), Abhijit (2009), Jason (2010), Rudra (2013), Edith (2013) and Dr. Srinivasu, (2013), argued the importance of Road infrastructure and it is one of key determining factors for growth. However, our result confirms that the role of road infrastructure depends on the type of the road. Accordingly, paved road (LPR) has a significant and positive impact on growth. While gravel road (LGR) is insignificant and it is not exiting to perceive the non-significant role of gravel road as it may lead time lag for marketing. Therefore, some commodities especially perishable commodities may not have easily accessible to market and hence may have little role for smoothing economic activities. It is also confirmed in the study of Ibrahim (2011).

Generally, though, infrastructure matters for sustainable growth, quality of infrastructure may be a determining factor to raise the productivity of human and physical capital and hence growth. Thus, economic growth is more influenced by quality of roads that is why paved road significantly affects real GDP while gravel road has insignificant role for growth. Moreover, the result evokes the positive effect of financial development which is proxied by broad money supply (LM2). As it presents in many literatures, money supply facilitates economic transactions and hence help to bust aggregate demand which end over's improvement in economic growth.

Improvement in electricity power consumption will cause real gross domestic product to boost. It is evidenced in the work of Enu, (2014) and Yılmaz (2014). The day to day activity of human being is strongly connected with electricity power and hence if there appears inadequate supply of electricity ended it will affect economic activities badly. That is it may result in high unemployment rate, lower production level and hence low Aggregate output level.

Table 4. Long run model (static model)

The long run model shows the long run relationship among economic variables involved in the

model. The result is consistent with the short run but in the long run the time trend itself is powerful to affect economic growth.

Dependent variable, LRGDP, Lag length is determined by Akaike Information Criterion			
Variable	Coefficient	Standard error	T-Ratio [probability]
Constant	-5.75621	3.545	-1.62 [0.1152]
LRGDP-1	0.9503	0.1192	7.97[0.0000]***
INF	-0.00274	0.00128	-2.14 [0.0412]**
LPR	0.3206	0.154	2.082 [0.05887]*
LGR	0.0089	0.188	0.047[0.9627]
LM2	0.233038	0.1064	2.19 [0.0367]**
LELE	0.2567	0.1151	2.23 [0.03285]**
Trend	0.0338108	0.01511	2.24[0.0331]**
Diagnostic tests R^2 =0.9321 Adj.R^2 = 0.9284 F(7,29) = 31.4 [0.000]** AR 1-2 test: F(2,27) = 2.5293 [0.0984] ARCH 1-1 test: F(1,35) = 1.8758 [0.1795] Normality test: Chi^2(2) = 4.2096 [0.1219] Hetero test: F(14,22) = 0.70373 [0.7484]			

Note; (*), (**) and (***) denotes significance at 10%, 5% and 1% level of significance respectively. The result is also, ox-metric software packages. Moreover, diagnostic test shows absence of series problems like autocorrelation (AR), autocorrelation conditional heteroscedasticity (ARCH) and heteroscedasticity problems. The result also passes the normality test.

Consistent with the short run result, In the long run, financial development (M2), electricity power, paved road and time trend all have a positive and significant effect on real GDP. Whereas, gravel road is insignificant to influence growth and, inflation has an adverse impact on growth.

CONCLUSION

The paper analyzed the role of electricity power and road infrastructure (gravel and paved road) on growth. The type of road may have different significance effect and hence we incorporate booth gravel and paved road networks in to our workable econometrics models. Moreover, the Engle-Granger co-integration test shows the existence of long run association among economic variables involved. The result reveals that, financial development, electricity power, paved road have a positive and significant effect on growth while inflation affects real GDP negatively. Moreover, the types of road do matters in our typical studies that is why paved road is more powerful than gravel road.

POLICY IMPLICATION

Since money supply positively affects growth, hence expansionary monetary policy seems powerful to bring economic growth improvement i n a head of. Unlike the Gravel road expenditure on paved road will bring proper growth and hence it is better to give a due emphasis on expanding paved road rather than gravel road. Though, it is not a new agenda for the government, still it is better to focus of power generation stations. However, the progress of economy may be challenged by macroeconomic uncertainty (inflation) and hence, the government has to wise while using expansionary monetary policy as it may have inflationary effects.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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