Road Infrastructure and Economic Growth in Benin Republic

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Abstract: The paper investigates the impact of the contribution of road infrastructure expenditure on economic growth of Benin Republic using Jarque-Berra, White test, Breusch-Godfrey, Cusum and Cusum of squares techniques for the period (1985-2015). Overall the results reveal that gross domestic product, gross capital formation, labor productivity and road infrastructure expenditure play an important role in economic growth in the Benin Republic. More importantly, the study finds that road infrastructure expenditure in the Benin Republic has a significant positive contribution to economic growth in the long run than the short run. It is the same result with the gross capital formation. The labor production has a significant positive contribution to economic growth in long run. On the basis of these results analysis, it is strongly suggested to formulate certain recommendations in the field of economic policy that improves the road infrastructure expenditure as well as gross capital formation for sustainable economic growth in the Benin Republic. A new model has been proposed to the General Directorate of Public Works in effectively monitoring the level of road infrastructure expenditure in terms of growth and poverty reduction objectives

Keywords: road infrastructure, gross domestic product, private investment, labor productivity, economic growth, Benin republic.

INTRODUCTION

Infrastructure is a non-insignificant component of expenses in most economies [1]. It represents 4 percent of the GDP in the developing world [39, 40], which is comparable to their allocations on education. Empirical studies on how infrastructure affects the economy, however, are far scarcer than that on education. Infrastructure investments associated with significant spillovers externalities have been analyzed in the early 40-50s in the theoretical literature on growth and economic development. Their benefits have proved to accrue outside the target of the investment [2-4]. This perspective also matches well with endogenous growth theory developed at the end of the 1970s [5, 6] which considers externalities as the source of endogenous feedback effects on output growth. Self-sustaining growth is a phenomenon identified by the accumulation of four main factors: physical capital, knowledge [7], human capital [5] and public capital [6]. In [8-10] empirical evidence of the connection postulated by Rosenstein-Rodan is econometrically established by linking infrastructure to productivity slowdown in the USA. Studies in this area have been mostly focused on the USA and other developed countries. Shortage of infrastructure investment ever occurred and how such a shortage could be established have been the main issues investigated in [11].

Since the original paper where a linkage between transport infrastructure stock and private sector production is established [9], using Cobb-Douglas (C-D) production function, many empirical studies have been investigated in the same area in various countries in the past few decades. In [12] the link between road capital and economic output in the sector of the production of goods of the economy is studied. It estimated a C-D function and a translog production function using 10 series of provincial data corresponding to the years 1961 to 1994. The main results obtained indicated an elastic output of the order of 0.09 to 0.17. He also investigated the effects of road capital on labor productivity for a second time in Canada using a Cobb-Douglas function and a translog function with aggregate time series data. The results do not differ much from those of Aschauer. For example, the elasticity output of production relative to road capital is 0.47 [13]. In addition, some authors [14-18] use a cost function approach to estimate stock Public capital. All these studies almost relate to a given individual industry, especially manufacturing industry. Their studies largely

converge towards the same conclusion that investment in public infrastructure contributes significantly to reducing the cost of production in the private sector.

The output elasticity of transport capital has been the main concern of the policy results from these studies. In recent reviews, output elasticity results vary from authors: 0.028 [19], 0.239-0.56 [9] or 0.33 [11]. In [20] an analysis of an important component of the benefits of Federal-aid highway infrastructure investments in the United States is presented. They specifically focused on the effects of those investments since 1950 on costs and productivity of firms in the U.S. road freight transport industry. Using a theoretical and statistical model of regional truck firm costs, they found that the rapid growth of highway infrastructure which occurred between 1950 and 1973 had a strong and positive effect on productivity growth in trucking. Furthermore, their studies results indicate the benefits of these investments to be substantial, large enough to justify between one-third and one-half of the cost of the Federal-aid highway system over this period on the basis of benefits to trucking alone. These various studies have triggered a broad debate on the consequences of such conclusion on the level of economic policies and have made important economic questions. As a result of these authors, several studies have analyzed the relationship between public investment in road infrastructure and economic growth. For example, [21] found a positive impact of public investment in infrastructure on growth and a complementary relationship between public and private investment by testing a sample of 87 countries, including 5 countries in Sub-Saharan Africa. In references [22, 23] a significant effect of public investment in road infrastructure on economic growth in a sample of developing countries during the 1980s is revealed. The same result by considering public investments in communication transport is reached in [24]. In developing countries, particularly in Africa, studies on the effects of road infrastructure on economic performance remain limited. However in Nigeria [25] it is found that the deficiency of infrastructure especially for the electricity and transport sector was a major constraint for domestic and foreign companies. Using series of chronological data, it is also showed that the transport infrastructures have the positive impact on the economic growth in Cameroon [26]. The output elasticity of public capital found was 0.36. It is the same as reference [27] where, considering public investments in the broad sense in Benin, output elasticity of the order of 0.34 is found. However, some studies attempt to show that transport infrastructure has no effect on economic growth.

In their study [28], researchers indicate that in Africa the commercial cost of poor transport infrastructure is constantly being raised and that it represents, for example, two-thirds (2/3) of the value added of exports from Uganda. In reference [29] it is pointed out that infrastructure accounts for a wide range of regional disparity in poverty within the country. In Africa, the low level of basic indicators on coverage and performance of the transport sector is, according to some authors, the result of insufficient investment estimated at less than 20% of GDP. The investment ratio in Africa is too low to ensure the replacement and growth of physical and human capital [30]. On the other hand, the problem is situated in the insufficiency of the productivity of the investment [31]. These authors emphasize the low utilization of and lack of skills. Adopting a self-progressive vector approach [32], researchers found that the Keynesian proposition of government expenditure as a policy instrument to encourage and lead growth in the economy is not supported by the data for Ghana, Kenyan, and South Africa. They also found that the hypothesis of public expenditure causing national income is not supported by the data for these African countries. A reciprocal causality between public spending and economic growth in South Korea has been established [33]. The causality between public expenditure and economic growth in 10 OECD countries using cointegration techniques have been examined [34]. The results indicate that total government expenditures, in the sense of Granger, causes economic growth in all sample countries, although there are disparities in the proportion of which public expenditure contributes to explaining changes in growth rates. In addition, using econometric techniques, several studies have demonstrated the link between investment in rural infrastructure and rural poverty. Analyzing the factors explaining market access, the importance of highway infrastructure in reducing transaction costs and improving incomes of Peruvian farmers is showed [35]. The assertion that road density exerts a significant positive effect on the consumption of agricultural households in the poorer regions of China is investigated [36]. They concluded that a 1% increase in road mileage per inhabitant increases household consumption by 0.08%.

Sustainable economic development in developing countries requires a satisfactory level and a balanced distribution of economic growth. Moreover, the analyses made by the World Bank in 1994 and in 2009 agree that it will be truly possible to reduce poverty in Africa with the potential double-digit growth rate and constant development effort. This has enabled various African countries, notably the republic of Benin, to draw up national programs to struggling poverty in order to reduce the scale of the phenomenon. Despite the different national and Community economic reforms applied over the last decades, the recorded of the economic growth is not enough to establish the basis for sustainable economic development capable of supporting regional competition induced by Community reforms and significantly reducing the poverty. The Beninese economy is still weak and its growth seems to have reached a level that it can no longer cross, while the wealth created in recent years seems to be poorly distributed, resulting in increasing inequalities between the various economic actors. Nearly 33.33% of the population continues to live below the global poverty line (144 261 FCFA) and the human development indicator for the country is 0.435 in 2010, ranking it in 134 positions out of the 169 countries World Bank, HDI 2010. In such a context, it is important to know the levers of development, in other

words, the sources of economic growth in order to know how to act on them to optimize the latter. The development of public infrastructure in general and those related to road transport is, therefore, indispensable in terms of operational objectives.

The World Bank in its report back to 1994 devoted to the issue of infrastructure linked the inadequacy of infrastructures as one of the major handicaps to the economic and social development of the developing countries. Infrastructure development increases not only growth opportunities but also helps to ensure that growth is more equitable and diffused. In view of that, it is important to find different ways to improve the contribution of infrastructure to economic growth. The investment appears to be essential at this level in terms of operational objective. In particular, Western countries understood this very early when they opened an era characterized by a dramatic increase in investment in the road sector. Indeed, whatever the road investment is carried out in the micro or macroeconomic plan, it is a powerful creator of income and thus one of the main engines of economic growth.

In the economic literature, the importance of road investments for productivity growth in the public and private sectors is much more emphasized. Indeed, the results of some previous empirical studies, such as [9, 12, 26, 35], largely addressed the link between investments in public infrastructure, Transport infrastructure (especially road transport) and economic growth. This opinion is shared by most economists who find that the growth of Japan after 1945, that of France in the 1960s, and of the newly industrialized countries over the past 25 years have been due to such a dramatic increase in public investment.

The present study has therefore set itself the objective of making its modest contribution by studying an econometric model. This model will explain the growth of gross domestic product by the increase in road infrastructure expenditure. It may serve as an instrument of budgetary policy for the Directorate General of Public Works (DGTP).

METHODOLOGY AND DATA
Source of Data
The data employed for this research are annual and cover the period 1985 to 2015 obtained from World Development Indicators reported by World Bank and Infrastructure Statistics 2011; National Institute of Statistics and Economic Analysis (INSAE); World perspective (www.perspective.usherbrooke.ca) and on the internet

Model specification
The model built for the purpose of testing hypotheses is as follow:

$$Y = \alpha + \beta_1(LMHAT) + \beta_2(LDEP) + \beta_3(LCAP\_PRIV) + \epsilon$$

Where,
Y: Gross Domestic Product
α: Intercept
β: Coefficient
ε: Error term
$\beta_1, \beta_2, \beta_3$ are the coefficient of respective variables.

In the specified model Y (Gross Domestic Product) is dependent variable while labor productivity (LMHAT), road infrastructure expenditure (LDEP) and private investment (LCAP_PRIV) are used as controlled or independent variables.

Hypotheses
H_1: LMHAT has a positive relationship with economic growth
H_2: LDEP has a positive relationship with economic growth
H_3: LCAP_PRIV has a positive relationship with economic growth

Unit Root Tests
The data is checked whether it is stationary or not before conducting any econometric study. If the variables under study are non-stationary then they may lead to unauthentic results so it's important that the series of data is stationary. In this study, the Augmented Dickey-Fuller (ADF) test is applied to check the Stationarity of the variables.

Rule of taking Decision:
If t*> ADF critical value, then do not reject the null hypothesis, i.e., unit root exists.
If t*< ADF critical value, then reject the null hypothesis, i.e., unit root does not exist.

Cointegration Test and Error Correction Modeling

After checking for unit root the test of co-integration can be performed. Cointegration test tells about whether there exists a long-term relationship between the variables. The prerequisite of applying this test is to first check for unit root so that it is decided whether the series is stationary or not. For testing the existence of cointegration between the variables a method developed by Engle-Granger two-step cointegration procedure is used. This test implies two-step cointegration procedure: firstly, the time series properties of each variable are examined by unit root tests. Engle and Granger [37] have shown that if variables Y_t and X_t are cointegrated, the residuals from the equilibrium regression can be used to estimate the error correction model. There are a number of methods for estimating the long-run equation and the short-run error-correction model (ECM). Among them, the EG static long-run regression has become a widely applied method since it was introduced by Engle and Granger. When there is present cointegration between the variables under study then an OLS regression model gives reliable results for long run equilibrium analysis. But for this purpose, all the variables under study should be integrated of the same order for the presence of cointegration. When all these conditions are met then residuals from long run estimate are to be employed as "Error Correction Terms (ECT) for giving explanation about the short-term dynamics

Diagnostic Tests

The diagnostic tests are used to check the validity of the model. For checking that the variance of the residual is homoscedastic or heteroscedastic, the White Heteroscedasticity test is applied on the regression model. By using Jarque-Bera Normality test the model was checked for whether the data is normally distributed or not. The Breusch-Godfrey Serial Correlation LM Test was applied for checking autocorrelation.

Stability Test

The CUSUM and CUSUM of square tests [38] are based on the cumulative sum of the recursive residuals. Their options plot the cumulative sum together with the 5% critical lines. The tests find parameter instability if the cumulative sum goes outside the area between the two critical lines. There are two of the most frequently employed tests for parameter constancy in the context of a linear regression. Their widespread use is due to a large extent to the fact that they are designed to test the null hypothesis of parameter stability against a variety of alternatives. All the necessary computations have been done using Eviews 9 version.

RESULTS AND DISCUSSION

In this section, we present the statistical analysis and research findings obtained by applying the testing alternatives specified in section 2.

Stationarity of Variables: Augmented Dickey-Fuller (ADF) Test:

The results of the unit root test based on ADF are presented in Table-1.

Table-1: Estimated results of unit root test.

Variables	t- statistic(prob.)	Critical values at (5%)	Degree of Integration
LPIB	-3.94(0.0315)	-3.59	I(1)
LDEP	-3.353(0.0771)	-3.56	I(0)
LCAP_PRIV	-3.007(0.1569)	-3.69	I(0)
LMHAT	-7.779(0.0000)	-3.69	I(1)

Source: Computed by authors

Notes: ADF test statistics were computed using regressions with constant, linear trend. The tests were also performed using a maximum lag length of 12, and from this maximum, the appropriate lag length for each of the variables was chosen based on SIC (Schwarz Information Criterion). The brackets () data are probabilities values.

As we can observe from the Table-1, The results indicate that road infrastructure expenditure and private investment variables appear to be stationary in variable levels while Gross Domestic Product and labor productivity variables are non-stationary in their level data and suggest that stationarity is checked at a higher order of differencing. In the present case it is found that when the first differences of the variables are considered, the null hypothesis of unit root is rejected at 5% significance level. Hence, the differences become stationary and consequently the related variables get characterized as integrated of order one, 1 (1).

Cointegration Test Results

As a result of the unit root suggest that all the variables are not integrated at the same level, it means that there is at least one cointegration among them, so this concludes that the there is a possibility of a long-term association between

the variables. To discover the long-term association between variables under study, Engel-Grange Cointegration Test is applied. The summary of the results of the test is shown in Table-2 below:

Table-2: Cointegration test results

Model	Null Hypothesis	Trace statistic	0.5% critical value	Max-Eigen statistic	0.5% critical value
	None *	55.618	47.856	27.488	27.584
	At most 1	28.129	29.797	17.773	21.131
	At most 2	10.356	15.494	8.8522	14.264
	At most 3	1.5043	3.8414	1.5043	3.8414

*denotes rejection of the hypothesis at 0.05 level
**Mackinnon-Haug-Michelis (1999) p-values
Source: Computed by authors

According to the results in Table-2, Trace test indicates 1 cointegration equation at the 0.05 level and Max-Eigen test indicates no cointegration at the 0.05 level. The results of cointegration test indicate that the time series variables (road infrastructure expenditure, economic growth, labor productivity and private investment) are co-integrated and hence, long run max equilibrium relationship may exist among them.

Error Correction Modeling (ECM)

Error Correction Term is a value which corrects the disequilibrium of the system. It represents the rate of adjustment towards equilibrium; this is the restoring force towards equilibrium. It must be significantly and necessarily between -1 and 0. If this occurs then it confirms the existence of a long-term relationship between the All the independent variables should jointly variables under study. In Table-3, the coefficient of RESID01 (-1) is -0.090822 which indicates that the speed of adjustment of the model is moving towards equilibrium after the disequilibrium because of shocks. The ECTt-1 is correcting the equilibrium at -0.090822 % speed annually. The RESID01 (-1) term has a correct negative sign and it's also significant. It proves the existence of a long-term relationship among our variables under study.

Table-3: Results of Error Correction Modeling test.

	Coefficient	Std. Error	t-statistic
RESID01(-1)	-0.090822	0.038023	-2.388577

Source: Computed by authors

Estimates of long run model

Fisher test is used to test the overall significance of the model. The test said that if the F-statistic is greater than the critical value, the null-hypothesis can be rejected and one can conclude that the model provides an overall significance. The test results for estimates of the long model from Table 3 reveal that the model is overall significant.

Table-4: Estimates of the long run model.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LMHAT	0.762949	0.120662	6.323018	0.0000
LDEP	0.087739	0.044767	1.959906	0.0612
LCAP_PRIV	0.061594	0.049705	1.239201	0.2268
C	6.828428	1.708820	3.995990	0.0005
@YEAR=1994	-0.164709	0.068948	-2.388895	0.0248
@YEAR=1995	-0.168588	0.068543	-2.459607	0.0212
R-squared	0.971360			
F-statistic	169.5789			
Fisher test (prob)	0.000000			

Source: Computed by authors

In this Table-4 economic growths is dependent variable and road infrastructure expenditure, labor productivity, and private investment, are independent variables. The R-square is the coefficient of determination and it shows model fitness or model adequacy. If the R square value is 65% it shows that model is moderately adequate and if it is more than 80% it shows that accuracy of the model is very good here. In our case, R square value is 97.13% it shows that model is accurate. The p-value of labor productivity is 0.000 which is less than 0.05 it shows its significance for our model. The p of road infrastructure expenditure value is insignificant which accept our null hypotheses, its p-value is 0.0612 which is greater than 0.05 and in the case of the third variable which is private investment its relationship with economic growth is

positive and its p-value is 0.2268 which is also greater than 0.05 shows its insignificance. Here in Benin economy, all the independent variable have a positive and significant relationship with growth.

$$EG = 6.828428 + 0.762949(LMHAT) + 0.087739(LDEP) + 0.061594 (LCAP\_PRIV)$$

Results from Table 4 suggest that 1% increase in labor productivity causes GDP to rise by 0.762%. While 1 unit proportionate increase in road infrastructure expenditure and private investment causes GDP to surge upward by 0.087% and 0.061% respectively. The positive coefficient of the level of labor productivity can also be justified by the fact that the Beninese economy is still largely dominated by the agricultural sector, that of the small processing units but also by the informal sector which, has increased with the economic crisis in Benin and whose operation requires very little capital but a lot of work factor.

Estimates of the short-run model

Table-5 presents the estimation of the short-run model. As can be seen from the Table-5 the F-statistic is also greater than the critical value. Furthermore, the short run model is also significant. The relationship of the private investment with its economic growth is positive and its p-value is also significant 0.0046 which is less than 0.05. The beta value of labor productivity is positive but its p-value is insignificant which accept our null hypotheses. Its p-value is 0.6402 which is greater than 0.05 and in the case of the third variable which is road infrastructure expenditure, its relationship with economic growth is positive and its p-value is 0.0505 which is greater than 0.05 and shows its insignificance. The results in Table-5 show that 1% increase in labor productivity causes GDP to rise by 0.03%. While 1 unit proportionate increase in road infrastructure expenditure and private investment causes GDP to surge upward by 0.015% and 0.048% respectively. In this model, R-square is 67% which shows that the model is good accurate.

$$EG = 0.033291 + 0.034363 D (LMHAT) + 0.015701 D (LDEP) + 0.048160 D (LCAP\_PRIV)$$

Table-5: Output of the short run model.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LMHAT)	0.034363	0.072543	0.473684	0.6402
D(LDEP)	0.015701	0.007608	2.063846	0.0505
D(LCAP_PRIV)	0.048160	0.015336	3.140361	0.0046
C	0.033291	0.003476	9.578246	0.0000
@YEAR=1987	-0.048680	0.013721	-3.547924	0.0017
@YEAR=1994	-0.047432	0.015032	-3.155477	0.0044
R-squared	0.671642			
F-statistic(prob)	7.840927			
Fisher test	0.000113			

Source: Computed by authors

Diagnostics test results

The validation of the model is done through residuals diagnostics tests (normality test, Heteroscedasticity test, and serial correlation test) and stability tests (CUSUM test and CUSUM of the square test).

The Breusch-Godfrey Correlation Lagrange Multiplier test in Table-6 exhibits probability values of 0.457and 0.341 for F-statistics and observed R-Squared that are significant to accept the null hypothesis that there is no autocorrelation in the residuals generated from the regression model. By this, we understand that the test is valid because it is not victimized by serial correlation throughout the series.

Table-6: Breusch-Godfrey Serial Correlation LM Test.

F-statistic	0.811232	Prob. F(2,21)	0.4578
Obs*R-squared	2.151576	Prob. Chi-Square(2)	0.3410

Significant if the p-value is ≥0.05.
Source: Computed by authors

The Jarque-Bera in Fig-1 exhibits a corresponding probability value of 0.210 which is more than ∂ 0.05 at 95% confidence interval on the basis of which, we fail to reject the null hypothesis rather we accept it and state that the residual is random and it is normally distributed within the series provided.
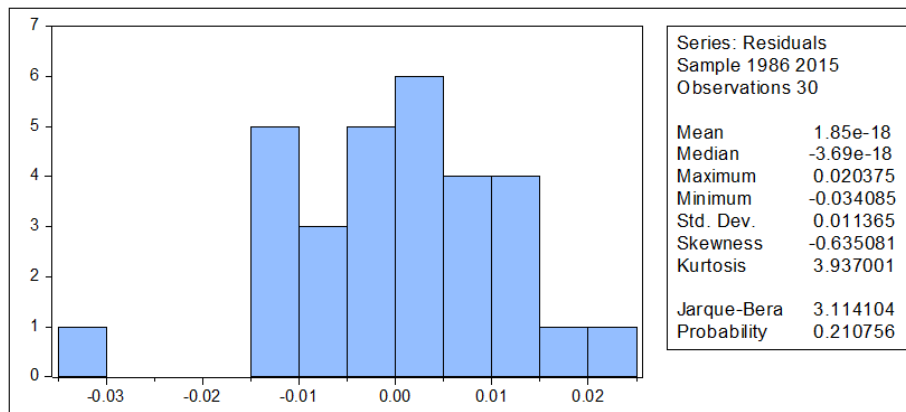
Fig-1: Jarque-Bera (JB) test of normality.

From Table-7, it can be seen that the corresponding p-values for F-statistics and the observed R-Squared are 0.088 and 0.097 respectively that are $> \partial$ 0.05 on the basis of which we cannot reject the null hypothesis rather we accept it against the alternative one and we conclude that the residual is homoskedastic.

Table-7: Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.130741	Prob. F(6,23)	0.0885
Obs*R-square	10.71788	Prob. Chi-Square(6)	0.0975
Scaled explained SS	9.251161	Prob. Chi-Square(6)	0.1599

Significant if the p-value is ≥ 0.05.
Source: Computed by authors

The result of the stability test is shown in Figure-2. As can be seen in Figure-2, the model is showing stability because the "CUSUM" and the "CUSUM of square" are coming within the range of critical lines at five percent significance level.
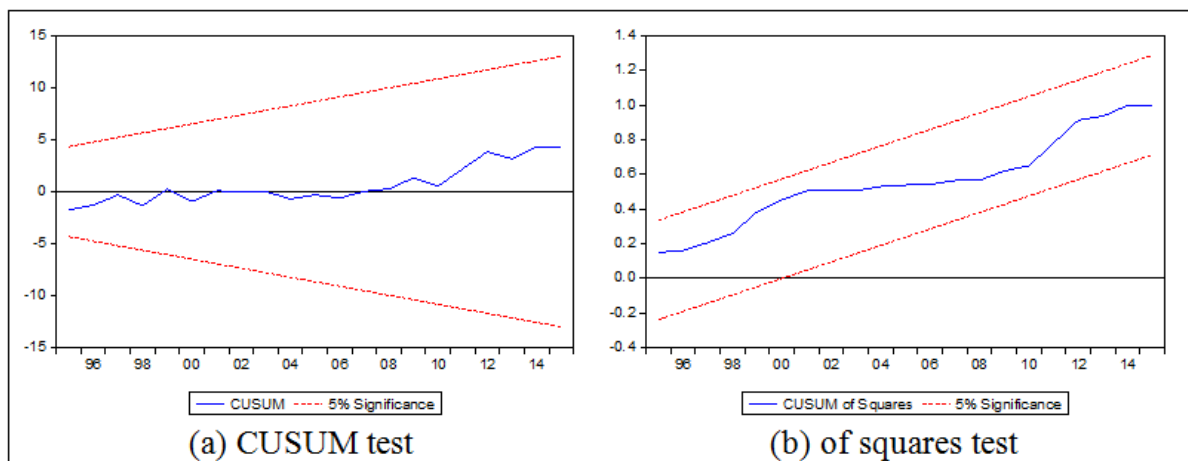

Fig-2: Stability test

CONCLUSION

The central objective of this research is to examine the effect of the contribution of road infrastructure on economic growth through econometric analysis using annual data in the Benin Republic over the period 1985 to 2015. Results of the model are quite satisfactory and signs of the coefficients are positive for both long and short run. It is found that road infrastructure expenditure is a source of long-term economic growth in the country. In the short term, road infrastructure expenditure has a positive impact on economic growth but non-significant. Private investment and labor productivity are sources of long-term economic growth. However, these expenditures are in no way sufficient for economic growth; then they should be improved.

As road capital is an asset that is depreciating, the government in accelerating growth must regularly maintain and renew road infrastructure in order to let the public investment to play the role that is devoted to it in the economy.

Based on the findings, the extension of production capacity and the introduction of regulatory measures should be made by the government to create an enable environment for private investment. The study proposed the model that can be useful to the General Directorate of Public Works in effectively monitoring the level of road infrastructure expenditure in terms of growth and poverty reduction objectives. Leaving the General Directorate of Public Works to continue the necessary research in order to make this pre-established model a political budgetary tool.

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