# Road Infrastructural Investments and Economic Growth in Cameroon

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**Abstract**

*The main objective of this study is to examine the effects of road infrastructural investments on economic growth in Cameroonian fact, the theoretical and empirical literature highlights an ambivalent relationship between government expenditure and economic growth without focusing on transport infrastructure. This study lays a particular emphasis on transport infrastructures. At the level of the methodology, an autoregressive distributed lag model is applied to variables integrated of order 0 and 1. After preliminary tests aimed at avoiding spurious regression, we estimate the parameters of the model usingOLS. We find a negative and significant effect of road infrastructural investments on economic growth. This is explained by the degraded state roads which negatively affect economic growth. However, in the long run, the road infrastructures have a positive and significant effect on economic growth.*

## *Introduction*

Investment in transport infrastructures is a recurrent political intention during periods of low growth. Two main effects are generally expected from these investments. In the short run, government expenditure in the construction sector is expected to have a multiplier effect on aggregate demand. The popular risks involved are those of inflation and of the crowding-out of private sector investment by the induced increase in interest rates. We do not explicitly consider these short run effects which are not specific to government expenditure on transport infrastructures. In the long run, decision makers believe that investments in transport infrastructures improve the structure of the economy. This belief is based on the idea that fast, sure and inexpensive transport is one of the foundations of prosperous regions. Conversely, the absence of this form of investment is an obstacle to economic growth and labour productivity. The reduction of transport costs, reduction in time and accessibility acts in many sectors. Government spending on infrastructures thus increase the profitability of the companies. These profits then stimulate private sector investment. If these effects exist, they will be reflected in the income of households, employment, the productivity of companies, and private sector investment which are also indicators of economic growth.

The assertions in the above paragraph consider that the transport infrastructures play an important role in economic growth and ignore the fact that for this to happen, many other conditions are necessary: an environment favourable to the development of the private sector, a stable legal framework, a fair competition between economic agents, an effective and efficient public administration, etc. These conditions cannot replace an active government spending policy which they specifically seek to strengthen and render more effective.

However, the debate on the role of infrastructure in growth is important for economic policy and economic development. For a developing country, the putting in place of quality infrastructures within a short period of time to support growth is a major challenge. The report of the World Bank holds that the lack of infrastructures in poor countries delays their economic takeoff. It also specifies that "infrastructures are important for economic growth, the fight against poverty, and the preservation of the environment but this only happens when the services they provide are in line with effective demand" (World Bank, 1994, p.3). One of the problems facing developing countries is that of infrastructures. In Africa, the development of the infrastructures is done at a slow pace relative to other regions of the world and this can slow down economic growth and increase the level of poverty. Cameroon being a developing country also faces these same difficulties. In fact, the problems faced by the road network of the country include: insufficient signalling and tracing, cracks, potholes, bad drainage, absence of pavements and cycling tracks, and parking disorder. Many factors that explain the bad condition of roads in Cameroon[1]are constraints that limit the economic growth and development of Cameroon.

[1]The absence of an institutional framework, overloading, corruption, an irrational and poor management of the road network, inappropriate maintenance, and the presence of obstacles and broken down vehicles on roads.

Despite an increase in road financing by the Cameroonian government, the resources allocated to road infrastructures remain insufficient to eliminate the important lag in the maintenance and construction of roads. According to Wagenvoort and al., (2010), no country has a rapid and sustained development without an increase in investment in the financing of the government infrastructures.

However, with the putting in place of the Growth and Employment Strategy paper (GESP) for the 2010-2020 period, the Cameroonian government after issuing bonds worth CFAF 200 billion engaged itself in a many key projects aimed at increasing government production expenditure in view of inciting private sector investments and economic growth.

The main question we seek to address in this study is: What is the effect of road infrastructural investments on economic growth? This study thus has as objective: to determine using an empirical approach, the effects of road infrastructural investments on the economic growth in Cameroon for the 1985 to 2015 period.

The rest of this study is organized as follows: A first section presents the review of the literature on the relationship between road infrastructural investments and economic growth.The second section presents the methodology while the third section presents the empirical results and their interpretation.

## 1- Review of literature on the relationship between road infrastructural investments and economic growth

In the long run, government expenditure as a whole does not have any effect other than on the short-run economic situation (Artus and Kaabi, 1993).Some authors find that the effect of current expenditure and "future expenditure" (infrastructure, education and research), with the latter having a favourable effect in the medium term (Mills and Quinet, 1992).In fact, the correlation between investment and growth is very clear for investments in equipment (De Long and Summers, 1991).In this section, we focus on the effects of public investments in infrastructures. After recalling certain theoretical arguments, we comment on the main attempts to empirically verify them.

From the theoretical point of view, the first class of models shows that investing has endogenous positive effects on growth. For example, Romer (1986) uses a model where positive technological externalities are the result of the accumulation of capital. These externalities are based on two mechanisms: *learning by doing* and the complementarily of activities. A classical example of the latter point is that of the steel and railways. These two industries depend on each other. The hypothesis of intersectoral externalities is empirically validated by some authors (Caballero and Lyons, 1989), but it is possible that the phenomenon observed is due to Keynesian mechanisms than technological reasons. Whatever the case, it is not a question of effects that are specific to infrastructural investments.

Endogenous growth theory has led to the development of a certain number of models relating government expenditure to the long run growth rate of (Barro, 1990 and 1991).Government expenditure can affect economic growth through two main channels. Through the first channel, they increase the stock of capital of the economy through government spending on economic and social infrastructures or through the investment of state enterprises. Through the second channel, government spending indirectly affects economic growth by increasing the marginal productivity of the factors of production offered by the private sector through education and health expenditures as well as expenditure on other services which contribute to the accumulation of human capital (Tanzi and Zee, 1997).According to Dévarajan et al., (1996), Ventelou (2002) does a deeper analysis of the government spending-economic growth couple using the concepts of productive and unproductive spending. This distinction makes the author's analysis different from former studies. The author finds that the size of the government is an important index of government spending and growth but the question of the optimal combination of government spending remains unanswered. He concludes that the final decision depends on the contribution of the components of spending in the economic growth process. Government spending positively affects growth through spill-over effects on the rest of the economy (Nelson, 1994).

Empirically, Aschauer (1989) greatly influenced political decision makers (Munnell, 1992) by showing that the decline of American productivity in 70s was mainly related to the dropin the rate of investment in public capital. This result is obtained with a Cobb-Douglas type production function whose factors are private capital, non-military public CapitaLand employment, to which he adds a trend and the rate of utilisation of production capacities in order to take into account variations in economic activity. The data used is on the United States from 1949 to 1985.Aschauer obtains an elasticity of production in terms of the stock of capital that enables himto conclude that a 1%increase in the stock of capital leads to a 0,39% increase in production.

Many authors also use aggregate time series data and a Cobb-Douglas production function to adequately estimate the stock of infrastructures. This is the case of Destefanis and Sena (2005) who show that in Italian regions, the elasticity of the global productivity of the factor "economic infrastructures" was highest over the 1970-1998 period, particularly in the least developed regions. However, Bajo-Rubio and Diaz-Roldan (2005) arrive at the opposite conclusion in Spanish regions.

They find that labour productivity is more elastic relative to public capital in the regions where it was already highest than in regions where it was it less, and inelastic relative to infrastructures in the intermediary regions. Michaels (2008) uses an approach similar to that of Fernald (1999) to study the activities which use in an intensive manner, the waste services in rural American counties crossed by the inter-federal highways, i.e. the road transport of the goods and retail business. The author finds that the productivity of the counties in these sectors which were lucky to be connected to the network is from 7 to 10% higher than that of other counties that don't benefit from a highway. Using the instrumental variables technique, Duranton and Turner (2009) estimate the effect of an increase in the road network on productivity in some American cities over the 1980-2000 period. They find that a 1% increase in the road network causes a growth of the population and usage of the American metropolitan surfaces by approximately 0,2%, that is to say 10 times less than in studies on the productivity undertaken in the 90s, and are accompanied by a considerable increase in the number of wealthy town dwellers who have more cars than modest households.

In addition, other authors carry out studies using an approach in terms of performance index (Conrad and Seizt, 1992;Shah, 1992;Lynde and Richmond, 1992 and 1993; and Morrisson and Schwartz, 1996).These studies are based on manufacturing industries. The results converge towards the same conclusion according to which investments in infrastructure contribute to reduce production costs in the private sector. In the same manner, Nadiri and Mamuneas (1996, 1998)use American data to carry out their analysis on the different sectors of production, thus enabling them to it easily isolate the effects on the productivity generated by public infrastructures. The global elasticities of production costs obtained are -0,044 for the study of 1996 and 0,080 for that of 1998. For the majority of sectors of production, the results are in conformity with expectations. In fact, for the 21 processing industries, a 1% increase in government spending on road infrastructures leads to a reduction of operating costs of about 0,14% to 0,22%.Nadiri and Mamuneas (1998) are of the opinion that the road network is not beneficial for industries other than transformation ones. According to them, the supply of a road network is greater than demand for industries other than processing industries. In fact, these companies will witness a rise in production cost if they were to use the road network.

In a study based on causality tests with annual data from 1970 to 2005, Chimobi (2009) shows that there does not exist a long run relationship between government expenditure on health, education and the national income in Nigeria. However, the author stresses that government expenditure plays an important role in economic growth.

However, the literature does not always consider government spending as an engine of economic growth. Its efficiency is called into question through the theory of political markets. Authors like James Buchanan and Gordon Tullock (1961) contest the idea according to which the State is the representative of general interest. They show that public authorities are economic agents who seek to maximize their satisfaction through an election or a re-election and that public decisions are the result of the aggregation of private decisions such as electoral promises. They thus seek to honour electoral promises rather than being concerned about the efficiency or productivity of public expenditure. The theory of bureaucracy stipulates that agents or bureaucrats seek to maximize their incomes or power. This leads to an unjustified increase in government spending.

Just as Ojo and Oshikoya (1995), Ojo and Shibata (2001) show that an increase in government spending significantly reduces the growth of GDP per capita in an economy with only two sectors. Chandra (2004) does not find any significant effect of the share of government consumption spending in the GDP on economic growth in India. Ténou (1999) finds the same results. By considering the ratio of the budget deficit rather than that of government consumption spending, Ghura and Hadjimichael (1996) find a negative and significant relationship with theGDP per capita growth rate in a sample of sub-Sahara African countries. Using data on OECD countries, the results obtained by Dar and Amirkhalkhali (2002) do not show that government spending positively affects economic growth since the coefficients are not statistically significant.

In developing countries and Africa, studies on the effects of road infrastructures on economic performance are limited. However**,** Sahnand Younger (2002) using a microeconomic approach show a positive effect of government spending on the evolution of GDP per capita using data on economic agents who have characteristics specific to African countries. In West Africa, empirical studies on the government spending-growth couple are very few. Dumont and Mesplé-Somps (2000) analyze the effects of public infrastructures on the competitiveness and growth of the Senegalese economy within the framework of a computable general equilibrium model. They find that an increase in government infrastructural spending leads to a better commercial performance and economic growth. Concerning the contribution of government spending to economic growth in Cameroon, we can cite the study by Kuitcha (2005) who shows that physical and social infrastructures have a positive effect on economic growth in Cameroon; Ongono (2006) who determines the optimal size of the Cameroonian State, value beyond which any spending will have a negative effect. Mfoulou (2007) undertakes his study in the CEMAC zone and arrives at the conclusion according to which public capital largely contribute to the growth of the productivity of private factors in the CEMAC countries. Kamgnia et al. (2002) highlight the existence of a significantly negative relationship between government spending and economic growth in Cameroon.

To justify the increase in government spending in Cameroon, Tamba (2005) advances the argument of the official support for the strategies of the foundations of development in CEMAC countries. He appreciates this support in two ways: through the share of government spending in the GDP according to the Wagner scale and by the ratio of internal credit.

Although certain studies focus on the effects of government investment spending on growth and others on the crowding out effect of government investments on private sector investments, very few analyse the effects of government infrastructural spending on the level of economic growth using time series data. The majority of studies undertaken have used panel data. This study uses time series analysis and comes to supplement the approach of Kuitcha (2005) who neglects the determinants of growth like the level of inflation and government aid to development in his analysis.

### *2 - Methodology*

In this section, we do not only specify the model used for the analysis and present the variables used, but we also present the data used in our estimations.

### 2.1- Specification of the econometric model

The positive effect of government spending on growth is widely agreed in the literature. The formulation of the theoretical model of the analysis of the effects of government infrastructural spending on growth in Cameroon uses a Cobb-Douglas type production function having as variables physical capital (K), human capital (H), labour (W) and technical knowledge or technical progress. More formally, we obtain:

$Y = A\, K^{a}H^{b}W^{1-a-b}$ (1)

By linearising equation (1), we obtain:

Log (Y) = LogA + aLogK +bLogH + (1-a-b)LogW(2)

The physical capital per head ($PIB$r) is considered to depend on the private investment rate (IPRI), labour depends on government spending on road infrastructures (INTR) and Official development aid (APD), the foreign national debt (DETEX), inflation (INFL) and tradeopenness (OUV) are related to human capital. This enables us to rewrite equation (2) as follows:

$$Log(PIBr_t) = \beta_0 + \beta_1 Log(IPRI_t) + \beta_2 Log(OUV_t) + \beta_3 Log(DETEX_t) + \beta_4 Log(APD_t) + \beta_5 Log(INF_t) + \beta_6 Log(INTR_t) + \varepsilon_t \quad (3)$$

In this expression, the coefficients$\beta_1$ to $\beta_6$represent the elasticities of the coefficients and $\varepsilon_t$ the error term.

Taking into account the order of stationnarity of our variables (I (1) and I (0)), we use an ARDL[2] model in our analysis. Its advantage is that it takes into account the short run dynamics and the long run equilibrium. We thus retain the following specification in our estimation:

$$\Delta \text{Log}(PIBr_t) = \beta_0 + \beta_1 \text{Log}(IPRI_{t-1}) + \beta_2 Log(OUV_{t-1}) + \beta_3 Log(DETEX_{t-1}) + \beta_4 \text{Log}(APD_{t-1}) + \beta_5 \text{Log}(INF_{t-1}) + \beta_6 \text{Log}(INTR_{t-1}) + \delta ECT(-1$$
$$\sum_{i=0}^{a} \beta_{7i} \Delta\text{Log}(IPRI_{t-i}) + \sum_{i=0}^{b} \beta_{8i} \Delta\text{Log}(OUV_{t-i}) + \sum_{i=0}^{b} \beta_{9i} \Delta\text{Log}(DETEX_{t-i}) + \sum_{i=0}^{c} \beta_{10i} \Delta\text{Log}(APD_{t-i}) + \sum_{i=0}^{d} \beta_{11i} \Delta\text{Log}(INFL_{t-i}) + \sum_{i=0}^{b} \beta_{12i} \Delta Log(INTR_{t-i}) + \varepsilon_t \quad (4)$$

In this specification, the long run elasticitiesare represented by the coefficients$\beta_1$to $\beta_6$and the short run coefficients by $\beta_7$to $\beta_{12}$.The error term is represented by $\varepsilon_t$.

### 2.2- Data sources

The data used in this study are from secondary sources. They come mainly from the database World Development Indicators - 2016 of the World Bank. All the data cover the period going from 1985 to 2015.

For practical reasons, our empirical analysis required for its implementation, the use of the Eviews 9 software.

### 2.3- Presentation of the variables and estimation procedure

#### 2.3.1- Presentation of the variables

The model specified above includes two types of variables: the dependent variable and independent variables.

#### 2.3.1.1- The dependent variable

In the specification, it is given by the real GDP growth rate (PIBr).In fact, it is the variable on which other variables (independent variables) are likely to affect.

#### 2.3.1.2- Independent variables

[2]AutoRegressive Distributed Lag

We retain six variables. These include:

- ✓ Private sector investment (IPRI): Theoretically, private sector investment has a positive and significant effect on growth relative to public investment. Moreover, empirical studies undertaken in both developed and developing countries lead to convergent results. In fact, an increase in private sector investments results in the creation of companies and the reduction of unemployment which has a spill over effect on economic growth.
- ✓ Trade openness (OUV): This is given by the ratio of the GDP divided by the sum of imports and exports.For a sufficiently productive economy, openness has a positive effect on growth but for an unproductive one, one obtains a contrary sign. The expected sign of this variable is thus unspecified.
- ✓ Government spending on road infrastructures (INTR): Government investment expenditure can lead to a reduction of private sector investment, particularly when they are financed by the emission of government bonds on the financial market. This operation can result in a temporary reduction of liquidity, thus causing an increase in interest rates and a fall in private sector investments (crowding out effect). Nevertheless, government investment spending, especially in infrastructures (especially road) has a positive effect on economic growth since they create positive externalities in favour of private agents (spill over effects).
- ✓ The foreign national debt (DETEX): In fact, its increase reduces economic growth since it requires a mobilization of the government income for the refunding of the debt or servicing. However, when it is well managed, the foreign debt can be an advantage to the economy concerned. Therefore, its sign is unspecified.
- ✓ The consumer price index (IPC):a strong progression of the general level of the prices can lead the central bank to increase its directing rates thus involving an increase in the cost of the loans and a fall of the private sector investment. The awaited sign is consequently negative.
- ✓ Official development aid (APD): If it is not supplied with conditions, then, it has a positive effect on growth. But in the opposite case, its impact is negative. Its effect on growth is thus unspecified.

Table 1: variables used and their expected signs

| Types | Variables | Abbreviations | |
|---|---|---|---|
| Endogenous | PIBR | Real economicgrowth | SignsWaited |
| Exogenic | IPRI | Real privatesectorinvestment | + |
| | IPC | Consumer price index | + |
| | OUV | Ratio to the GDP of the sum of the imports and exports | + |
| | INTR | Ratioto the GDP of government spending on infrastructure | + |
| | DETEX | Foreign national debt | - |
| | APD | Official development aid | + |

*Source:* authors going from a review of the literature.

### 2.3.2- Estimation procedure

The approach usually used in the analysis of government infrastructural spending and growth is that based on panel data or cross sectional data. However, besides these traditional methods, others have developed based on time series applying stationnarity tests which we use. We then present the method of Bound test which enables us to check the existence of a long run relationship or short run relationship between investment in road infrastructures and economic growth. The majority of studies on the effect of government spending on economic growth privilege the VAR method. However, VAR models make the assumption that the series are stationary. Generally, macroeconomic and financial series are non-stationary. Differencing them allows us to render them stationnary. This operation however has limits, particularly if the variables have one or more stable long run relationships. Moreover, former studies mainly concern short run relationships.

Given this limitation, we use the ARDL approach developed by Pesaran, Shin and Smith (2001) because it has several advantages. It is adapted to test the existence of long run and short run relationships in samples of small size and unlike the approach of Johansen and Juselius (1990), it makes it possible to test these relationships between variables with different orders of integration (Acikgoz and Merter, 2010).

## *3-Econometric Analysis and interpretation of results*

This analysis includes the results of the stationarity tests and the estimates of the econometric model presented above.

### 3.1-Tests of stationnarity and cointegration

### 3.1.1 - Results of the stationnarity test

As underlined by Granger and Newbold (1974), if in an econometric model non-stationary series are used, the results of the statistical tests are biased. We obtain what is commonly referred to as a spurious regression. Thus, the Augmented Dicker-Fuller (ADF) and Philips-Perrontests were administered to each variable initially at levels, then in first difference.

Once the test is performed, we compare the various values of the t-statistic of the Dicker-Fuller and Philips-Perrontests at the various levels of significance to 1%,5%, and 10%.According to Table 2 below, the results of the two stationary tests converge for the various variables. The results obtained are presented as follows:

Table 2:ADF and PP unit root tests

| Variables | at levels | | Decision I (0) | In first difference | | Decision I (1) |
|---|---|---|---|---|---|---|
| | Probability | | | Probability | | |
| | ADF | PP | | ADF | PP | |
| L (APD) | 0.0237 | 0.0249 | YES ** | 0.0000 | 0.0000 | YES *** |
| L (DETEX) | 0.7713 | 0.7961 | NO | 0.0135 | 0.0131 | YES ** |
| L (INTR) | 0.2247 | 0.2258 | NO | 0.0000 | 0.0000 | YES *** |
| L (IPRI) | 0.2640 | 0.2520 | NO | 0.0003 | 0.0002 | YES *** |
| L (OUV) | 0.0019 | 0.0019 | YES *** | 0.0007 | 0.0000 | YES *** |
| L (PIBr) | 0.9298 | 0.9007 | NO | 0.0274 | 0.0280 | YES *** |
| INFL | 0.0003 | 0.0003 | YES *** | 0.0000 | 0.0001 | YES *** |

Note: ADF: Augmented Dickey-Fuller; PP: Philips-Perron.*;**;*** Respectively represent significanceat the 10%,5% and 1% levels respectively.
Source: Calculations of the authors.

In fact, three variables are stationary at levels or I(0). These are official development assistance (APD), trade openness (OUV) and inflation (INFL).However, at first difference, all the variables are stationary. This enables us to suspect the existence of a possible Co-integration relationship between them.

### 3.1.2- Result of the test of cointegration of Pesaranetal. (1999)

Also referred to as the ``*Bounds Cointegration test*", this test enables us to establish if there exists a long run relationship between the variables of the model. The objective of this test consists in comparing the computed *Fisher F value* with the critical intervals of Pesaran and Shin (1999) at the 1%,5% and 10% significance levels. Table 3 below has convergent results. In this table, we see that the table value of Fisher is higher than the critical values at the 5% level. This shows the existence of a long run relationship between the growth rate and the explanatory variables road infrastructures (INTR), trade openness (OUV), inflation (INFL), the foreign debt (DETEX), private sector investment (IPRI) and official development aid (APD).

Table 3: Bounds cointegrationtest

| | Model | | | | | |
|---|---|---|---|---|---|---|
| Calculated Fisher | | | 8,6481 | | | |
| Level of significance | 10% | | 5% | | 1% | |
| | I (0) | I (1) | I (0) | I (1) | I (0) | I (1) |
| Bounds critical value | 2,12 | 3,23 | 2,45 | 3,61 | 3,15 | 4,43 |

Source:Calculations of the authors.

We thus have reasonable evidence to reject the null hypothesis of absence of cointegration. We can thus conclude on the existence of a long run relationship between the variables in the model. Moreover, after having carried out a regression of the model by Ordinary Least Squares, we captured the residuals of each regression. The results of the stationnarity tests on the residuals show that they are all stationary at levels or I (0).

### 3.2- Presentation of the estimation results and economic policy recommendations

Here, we analyze the results of our estimates and of make economic policy recommendations.

### 3.2.1- Results of the estimates

We successively present the results on the descriptive analysis of the variables, the analysis of the correlation between the variables, the estimation of the ARDL model, and the causal relationship between government spending in road infrastructures and growth.

#### 3.2.1.1- Descriptive analysis of variables

The descriptive statistics of the variables are presented in table 4 below. In this table, we find the median, minimum and maximum values, the variance and standard deviation, and the asymmetry and kurtosis values of the variables.

Table 4: Summary of the descriptive analysis of the variables

| | Ln (PIBR) | Ln (OUV) | Ln (IPRI) | Ln (INTR) | Ln (DETEX) | Ln (APD) | INFL |
|---|---|---|---|---|---|---|---|
| Mean | 14.207 | 3.731 | 2.609 | 6.778 | 3.787 | 8.721 | 4.025 |
| Median | 14.432 | 3.705 | 2.632 | 6.885 | 3.894 | 8.732 | 2.685 |
| Maximum | 16.160 | 4.174 | 2.902 | 7.065 | 4.897 | 9.284 | 35.094 |
| Minimum | 12.314 | 3.457 | 2.179 | 6.383 | 2.465 | 8.183 | -3.206 |
| Std.Dev. | 1.578 | 0.146 | 0.199 | 0.223 | 0.847 | 0.225 | 6.628 |
| Skewness | 0.0020 | 0.748 | -0.223 | -0.530 | -0.262 | 0.083 | 3.500 |
| Kurtosis | 1.234 | 4.338 | 2.119 | 1.803 | 1.575 | 4.267 | 16.863 |
| Jarque-Bera | 4.026 | 5.207 | 1.259 | 3.303 | 2.974 | 2.111 | 311.57 |
| Probability | 0.1335 | 0.0739 | 0.5328 | 0.1917 | 0.2259 | 0.3478 | 0.0000 |
| Sum | 440.427 | 115.67 | 80.902 | 210.137 | 117.427 | 270.37 | 124.79 |
| Sum Sq. Dev. | 74.729 | 0.6465 | 1.1901 | 1.5046 | 21.526 | 1.5195 | 1317.9 |
| Observations | 31 | 31 | 31 | 31 | 31 | 31 | 31 |

Source: Calculations of the authors.

Table 4 shows that the median value of the road infrastructures is higher than that of economic openness, private sector investments, the foreign debt and inflation. Also, after the growth rate whose value is higher than those of all the other variables, comes official development aid. We observe a certain similarity between the various means and medians, showing that the distribution could be normal. Moreover, the statistics of Jarque-Béra have probabilities all higher than the threshold of 5%showing that the distributions follow a normal distribution.

### 3.2.1.2- Analysis of the correlation between the variables

In order to understand the correlation between the variables of the model, an analysis of correlation is carried out to calculate the coefficient of correlation. The results of the matrix of correlation are presented in the table below.

Table 5: Matrix of correlation between the variables

| | Ln (PIBR) | Ln (OUV) | Ln (IPRI) | Ln (INTR) | Ln (DETEX) | Ln (APD) | INFL |
|---|---|---|---|---|---|---|---|
| Ln (PIBR) | 1 | | | | | | |
| Ln (OUV) | 0.402 | 1 | | | | | |
| Ln (IPRI) | 0.828 | 0.0583 | 1 | | | | |
| Ln (INTR) | 0.777 | 0.6114 | 0.5709 | 1 | | | |
| Ln (DETEX) | -0.641 | -0.372 | -0.525 | -0.395 | 1 | | |
| Ln (APD) | 0.5538 | -0.025 | 0.5251 | 0.3709 | -0.2633 | 1 | |
| INFL | -0.238 | 0.0810 | -0.266 | -0.067 | 0.164 | -0.127 | 1 |

Source: Calculations of the authors.

Table 5 shows the existence of a positive correlation between government infrastructural spending (INTR), commercial openness (OUV), private sector investments (IPRI), official development assistance (APD) and economic growth (PIBr).In addition, there exists a negative correlation between the foreign debt, inflation and real GDP.

### 3.2.1.3- Estimation results of the ARDL model

The results of the estimates of the model are presented in table 6 below.

Table 6: Results of the effects of government spending on road infrastructures on the economic growth

| Dependent variable:D (PIBr) | |
|---|---|
| short run dynamics | |
| Independent variables | |
| ΔL(OUV) | 0.1640<br>(0.4310) |
| ΔL(IPRI) | -0.2929<br>(- 0.8668) |
| ΔL(INTR) | -0.9069 **<br>(- 2.8262) |
| ΔL(DETEX) | 0.0786<br>(0.5085) |
| ΔL(APD) | 0.2843<br>(1.3601) |
| Δ(INFL) | 0.0085<br>(1.6685) |
| ECT (- 1) | -0.2361 ***<br>(- 3.0260) |
| long run Equilibrium | |
| L(OUV) | -0.6948<br>(- 0.4177) |
| L(IPRI) | 1.2409<br>(1.0169) |
| L(INTR) _ | 3.8413 ***<br>(3.5093) |
| L(DETEX) | -1.1966 ***<br>(- 4.0600) |
| L(APD) | 0.0128<br>(0.0153) |
| INFL | -0.0359<br>(- 1.5874) |
| C | -8.4313<br>(- 1.0274) |
| $R^2$ | 0.9927 |
| $\bar{R}^2$ | 0.9895 |
| F-statistic | 306.0685 |
| Prob (F-statistic) | 0.0000 |
| Durbin-Watson | 1,6897 |
| Diagnosis of the model | |
| Test of Autocorrelation of Breusch-Godfrey ($\chi 2$) | 2.4508<br>(p-value:0.2936) |
| ARCH ($\chi 2$)heteroskedasticity test | 0.1025<br>(p-vakue:0.7594) |
| Test of Normality of Jarque-Bera | 3,3373<br>(p-value:0,1885) |
| Test of stability of Ramsey | 5.2734<br>(p-value:0.1012) |

Note:*;**;*** represent significance at the 10%,5% and 1% levels respectively. The values in brackets represent the t-statistics associated to the coefficients.
Source: Calculations of the authors.

As we mentioned previously, we apply the test of Breusch-Godfrey to our model. The results of this test are presented in table 6. These results confirm the absence of autocorrelation of the residual given that the F-statistic have a probability (0.2936) higher than the level of significance of 5%.Also, the hypothesis of heteroscedasticityis rejected because the probability attached to the Fisher statistic (0.7594) is higher than 5%.The errors are thus homoscedastic.

Globally, table 6 above shows that our model is well specified. This is justified by the fact that the $R^2$ or coefficient of determination and adjusted $R^2$ are very high (0,9927 and 0,9895).Thus the linear adjustment is of good quality;In

addition, the model is globally significant because the probability of the Fischer statistic is lower than 5%. This shows that the model is good for forecasts. Furthermore, the coefficient of the adjustment variable *ECT (- 1)* is negative and significant at the 5% level showing that the model is good. The value of the statistics of Durbin-Watson is equal to 1.69 showing the absence of autocorrelation since it is inside the conventional interval (0 and 4) of absence of autocorrelation. Because of the limits of the Durbin-Watson statistics, the test of autocorrelation of Breusch-Godfrey is carried out and confirms the absence of autocorrelation.

The probability of the statistics of Jarque-Bera (0.1885) is higher than the 5% level, showing that the residuals are standard. In the same manner, the probability of the statistics of Ramsey (0.1012) is also higher than the 5% level. This enables us to affirm that the model as a whole is stable over all the study period.

**3.2.1.3- Interpretation of the results of the short and long run dynamics**

In the short run, government spending on road infrastructures have a negative and significant effect on growth.This result has many explanations. In fact, insufficient and obsolete infrastructures reducegrowth while the effect of an improvement in the level of infrastructures on the growth of the real GDP per capita is estimated at 4,5 points (World Bank, 2011).Thus, the positive effect of infrastructures (roads, railways,…) realised during the period of the oil crises was only in the short run because most of them were not renewed in the long run. Still during these years, the governmentput in placeseveral factories[3].

The government also invested in infrastructures: the number of kilometres of tarred roads thus went from forty six thousand kilometres in 1970 to sixty two thousand kilometres in 1980 (World Bank, 1994). These roads worsened with time because of the lack of maintenance. However, the investments carried out in industries favoured growth much more in the short than in the long run because their effects on the economy were not truly felt. This is why these industries were qualified as "White elephants".

Furthermore, Cameroon still suffers from the problem of remoteness of rural areas. Government spending on infrastructures in these areas are not high. However, the development of infrastructures such as the roads and access to market are of a major importance in these zones (Kamajou, 1984).The growth of the investments is estimated at 5.8 percent in 2007. This growth is more important in public investment thanks to the 90 billion francs CFA drawn from the cancellation of the foreign debt. These resources were devoted to many large government projects: construction of roads, schools, rehabilitation of medical infrastructures, development of the electrical and water network, modernisation of communication systems, rehabilitation of ports and airport sites. The increase in public investment was even more considerable in 2008 within increase of 26.8 percent still gained through financings from debt cancellation.

- Also, government spending in Cameroon is characterized by the low level of capital expenditure which although increasing, accounts for only 3% of the GDP on average between 2002 and 2009 and less than a quarter of total expenditure. The main problem stems primarily from their low level of execution. This level reached approximately 50% on average between 2008 and 2010 (IMF, 2011b).Difficulties at the level of the bodies in charge of the engagement of expenditure and management of the liquidity of the State, as well as a limited capacity of absorption of the Cameroonian economy are two possible explanations of this low execution.

- Trade openness (OUV) has a non-significant positive effect on economic growth. In fact, Cameroon because of the commercial relations it maintains with other countries makes the general level of prices to be subject to the influence of the prices of imported goods. The direction in which the prices are directed is not known in advance. When it results in inflation, we talk of imported inflation.

Cameroon does not have a good production capacity and this affects the degree of substitutability between foreign and domestic products. The difference between effective and potential output is traditionally presented as a main source of inflation in Cameroon. This is also the case for the foreign debt, official development aid, and inflation.
In fact, inflation affects long run economic activity favourably. A 1% increase in the price index leads to an 8.72% increase in the private investment rate. This can be explained by the fact that:

- A rise in consumer prices encourages private agents to increase their investments with the increased prospects for profit.
- A shock on demand leads to an increase in the consumer price index, pushing private investors to increase investments.
- We can also say that the increase in consumer prices affects economic activity negatively but authors like Bikai and Kamgnia (2011), Mantsie (2003) show that there exist thresholds below which inflation cannot be bad for economic activity.

[3]We can for example cite the creation of SODECOTON (in 1974), HEVECAM (in 1975), CAMSUCO (in 1975), SONARA (in 1975), many other companies

In the long run,

- Investments in road infrastructures have a positive and significant effect on growth at the 5% level. A unit increase in government investment in road infrastructures leads to an increase of 3,84 units in the rate of economic growth.
- The foreign debt (DETEX)has a negative and significant effect on the economic growth of Cameroon. In fact, a unit increase in the volume of the foreign debt leads to a reduction of 1,19 units in the real growth rate.

### 3.2.1.3- Granger causality test results

The granger causality test result enables us to conclude on a direct relationship between two or more several variables. In our case, this test makes it possible to establish the relationship between investments in road infrastructures and growth.

**Table 7:**Result of the Granger causality test

Pairwise Granger Causality Tests
Sample:1985 2015
Lags:2

| No Hypothesis: | Obs | F-Statistic | Prob. |
|---|---|---|---|
| LN_INTR_ does not Granger Cause LN_PIBR_ | 29 | 1.18870 | 0.3219 |
| LN_PIBR_ does not Granger Causes LN_INTR_ | | 11.2749 | 0.0004 |

According to table 7, wesee that investments in road infrastructures do not granger cause growth, even at the 10% level;on the other hand, the economic growth Granger causes investments in road infrastructures at the 1% level. We find that the increase in the growth rate contributes significantly at the 1% level to increase investments in road infrastructures.

### 3.2.2- Economic policy recommendations

Given the results of our tests and estimates, two main recommendations are made in order to make road infrastructures a catalyst of growth:

- a rehabilitation of transport infrastructures in bad condition. However, the costs of this work must be estimated judiciously, especially since according to the United Nations Economic commission for Africa (2005), in the years 1990, the resources allocated to infrastructures in African countries were subjected to severe budgetary cuts. This, combined with the harmful effects of corruption considerably affects growth prospects due to the geographical location of Cameroon which normally serves the land-locked countries, particularly Chad and the Central African Republic.
- Invest in the development of a network of road infrastructures that can be self-financed. In fact, road infrastructures are limited by the financial resources of the State. The solution is thus the putting in place of a digital toll gates likely to generate financial resources that can be mobilised not only for maintenance but also for the extension of the existing road infrastructures. As the popular saying goes, "where the road passes, development follows?"

### *Conclusion*

The main objective of this study is to empirically analyse the effects of investments in road infrastructures on economic growth in Cameroon. To achieve this goal, the nature of the relationship between government spending and economic growth in Cameroon is analysed going from a Cobb-Douglas type production function with physical capital, human capital, labour and technical knowledge or technical progress as inputs. The tests of Dickey-Fuller and Philips-Perronenable to us to establish the orders of stationarity of our variables. Certain variables were integrated of order 0 (at levels) and others atfirst difference. With this in mind, we use an autoregressive distributed lag (ARDL) model because it does not take into account the order of integration of the different variables, which they are integrated of order 0 or at first difference. After this, we perform the Breusch-Godfrey and ARCH tests to check for autocorrelation and heteroscedasticity of the errors respectively. The main results of this analysis show that the government investment on road infrastructures positively and significantly affect long run economic growth; the foreign debt has a negative and significant effect on long run economic growth; private sector investment and the general level of the prices have a positive but insignificant effect on the long run rate of economic growth. Also, there exists a one-way causality which goes from the economic growth towards investments in road infrastructures.

Taking into account these results, we recommend that road infrastructures should at the centre of the development policies of the Cameroonian government. In fact, to improve the competitiveness of the Cameroonian economy and achieve emergence by 2035, the road infrastructures which is a factor of economic and social development impossible to circumvent should be available in quantity, quality and at an optimal cost.

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