

# Impact of Construction Industry on Economic Growth in Africa: Granger Causality and GMM Estimation of Dynamic Panel Models

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**Abstract:** This paper assesses the impact of the construction industry on economic growth of 36 African economies. A Granger causality analysis is performed and both static and dynamic panel data models are estimated under the Generalized Method of Moments (GMM). Empirical findings reveal that there is a causal relationship between the value added of the construction industry and Gross Domestic Product per capita in the studied economies. Finally, estimates of both static and dynamic panel data models suggest that the construction industry is positively related to economic growth.

**Keywords:** Economic growth, construction industry, Granger's causality, panel data models, Africa.

**JEL Classification:** O10, O55, N67.

## 1. INTRODUCTION

The impact of the construction sector on economic growth in both developed and developing countries has long been a topic of great concern to many empirical researchers. We may mention, for instance: Moavenzadeh (1978), Ofori (1988), Slaughter (1998), Gann and Salter (2000), Kartam and Kartam (2001), Ball (2002), Miller (2002), Cooke and Leydesdorff (2006), Ding (2008), Ugwu and Haupt (2007), Wigren and Wilhelmsson (2007), Asomanin-Anaman and Osei-Amponsah (2007), Sev (2009), Ortiz et al. (2009), Lopes et al. (2010), Raftery et al. (2010), Caneghem et al. (2010), Giang and Pheng (2011), Ozkan et al. (2012), Torner (2013), Donaldson and Hornbeck (2016), Hong et al. (2017), and Xue and Zhang (2018), among others. Most of these authors examine empirically the effects of the building industry on growth, employment, environment, and development. It is worth noticing that many of them find that the construction industry has a positive relationship with economic growth. Moreover, some of them find causality between the construction industry and economic growth, but there is no consensus on the direction of the causality.

It is relevant to point out that Onat et al. (2020) highlight, using the SCOPUS database, that approximately 60% of the investigation on the construction industry between 2009 and 2020 focus on China. In this regard, we mention, for instance: Wang et al. (2020) that analyze the driving effects of growth drivers in the construction industry in China; Du et al. (2019) that investigate the decoupling relationship between economic growth and carbon emissions from the construction industry of China's 30 provinces, and Xu et al. (2020) that use an extended Cobb-Douglas production func-

tion to test the relationship between engineering standards and the economic growth in construction industry.

In the globalization process of the last decades, not only local companies and public sector have participated in the construction sector, but also foreign investment. Less developed countries, such as Namibia and Rwanda, have serious limitations in their construction sector for a rapid socio-economic transformation. Thus, less developed countries must mobilize capital from industrialized countries to bridge their savings-investment gap devoted to the construction. Another relevant issue that has been widely examined consists of assessing the capacity of the construction sector in developing countries to meet the demand, and determining the different resources needed for the development of a lagging industry in some African economies (Moavenzadeh, 1978).

This research examines the interrelationship between the construction industry and economic growth of 36 economies belonging to the African continent during the period 2003-2011. This is the longest period with complete data that produces a balanced panel data. For this purpose, a Granger's causality analysis is carried out and static and dynamic panel data models are estimated with information from the World Bank. We look for empirical evidence about the links between the construction industry and economic growth based on panel data models. This research also establishes recommendations that will allow the construction industry enhancing economic growth.

Regarding the current state of the subject, this investigation is distinguished in the following: 1) it is only concentrated in African countries as Angola, Burundi, Benin, Burkina Faso, Botswana, Cote d'Ivoire, Democratic Republic of Congo, Republic of Congo, Cape Verde, Algeria, Arab Republic of Egypt, Ethiopia, Gabon, Ghana, Guinea, Gambia, Kenya, Lesotho, Morocco, Mali, Mauritania, Mauritius, Malawi,

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Namibia, Rwanda, Sudan, Senegal, Sierra Leone, Seychelles, Togo, Tunisia, Tanzania, Uganda, South Africa, Zambia and Zimbabwe; 2) it has a greater availability of data with respect to the past; 3) it carries out a Granger's causality analysis; 4) it estimates static and dynamic panel data models; 5) it uses a larger number of units (countries), variables and periods; and 5) it solves the common problems of multicollinearity and autocorrelation.

The rest of the paper is organized as follows: section 2 deals with a short review of the literature on the subject in question; section 3 presents the statistical description of the relevant variables; section 4 states the theoretical foundation of the analysis of data panel; section 5 shows and discusses the obtained empirical results from Granger's causality and presents the estimation of several panel data models; finally, section 5 presents the conclusions and provides a set of policy recommendations derived from this research.

## 2. A SHORT REVIEW OF THE RESEARCH ON CONSTRUCTION AND GROWTH

The assessment of the effect of construction industry on economic activity has been analyzed in several investigations: Syed-Zakaria and Amtered-El-Abidi (2020), Asomanin-Anaman and Osei-Amponsah (2007), Wigren and Wilhelmsson (2007), Ali-Khan et al. (2014), Song and Geenhuizen (2014), Ahmadi and Shahandashti (2017), Olanrewaju et al. (2018), Achten et al. (2018), Lopes et al. (2010), and many others. In particular, Syed-Zakaria and Amtered-El-Abidi (2020) highlight that the Malaysian government has been encouraging Industrialized Building System (IBS) adoption as a modern method of construction to improve the precision of material and workmanship in order to increase economic growth. However, the migration of foreign labor to Malaysia from its neighboring countries that offer comparatively lower labor income has affected IBS adoption in construction projects. Alternatively, Wigren and Wilhelmsson (2007) examine the statistical relationship between the construction sector and the GDP. These authors also study the displacement effect within the construction industry in Europe, and they find that there is no displacement effect within the construction industry; on the contrary, they suggest that investments in infrastructure have a complementary effect due to an increase in the construction of residential and other type of buildings. Moreover, these authors carry out a Granger's causality tests and find that investment in public infrastructure cause GDP in the short term, and that residential construction cause economic growth in the long term. Thus, public infrastructure policies have an effect on economic growth in the short term, but only a weak effect in the long term.

On the other hand, Asomanin-Anaman and Osei-Amponsah (2007) study the construction industry as a mean to accelerate economic growth and employment in Ghana. The authors examine causality links between the construction industry and economic growth in the period 1986-2004. These authors investigate whether the construction industry can be used to boost economic growth. They find that the construction industry impacts positively growth of GDP, and that the construction industry has to be considered driver of economic activity in Ghana. Additionally, Lopes et al. (2010) study

the long-term interdependent relationship between investment in construction and GDP per capita in developing countries of sub-Saharan Africa. Their study is based on 15 countries in sub-Saharan Africa for 22 years. Their research presents evidence that there is a critical level of construction participation as a percentage of the GDP between 4% and 5%, below which a relative decrease in the volume of construction directly corresponds to a decrease in the GDP per capita.

Moreover, Giang and Pheng (2011) examine the role of the construction industry in economic development over four decades. Their results indicate that the construction industry and economic growth have a significant relationship in developing countries, pointing out that further expansion of the construction industry beyond the capacity of adaptation of the economy will only waste national resources; little is known about the ability of other sectors of the economy to adapt to the construction sector. This knowledge gap requires further study to formulate a more effective long-term strategy for the development of the construction industry. Ozkan (2012) studied the relationship between economic growth of the construction industry in Turkey by using the Engle-Granger cointegration tests, error correction models, and Granger causality to determine the links between these variables. They find that investments in infrastructure and residential construction have a direct relationship with the GDP and have causal effects. They also emphasize that long-term infrastructure investments are not affected by short-term economic crises and that public investments in developing countries exert long-term effects on GDP.

Ali-Khan et al. (2014) study the role of the construction sector in the economic growth of Malaysia, in the period 1991-2010, by using time series analysis and find that the construction sector has played a relevant role in boosting economic activity. These authors also find that the construction sector has contributed to the generation of income, capital formation, job creation, growth of the Gross Domestic Product (GDP) and the socioeconomic development of Malaysia. These authors also emphasize that the government should guide public policies focused on the construction sector that allows Malaysia to jump to be a developed country. More recently, Ahmadi and Shahandashti (2017) examine in an empirical work the temporary relationship between the construction industry and economic growth in the United States of America, and determine the impact of investment in construction at each State in the USA. They estimate Granger's causality and find that the added value of the construction causes real state GDP in 18 States and in the District of Columbia. These authors obtain empirical results pointing out that the real GDP causes added value of construction in 10 States and the District of Columbia. In 8 States the added value of the construction causes the real GDP in a lagged way. Their results show that the effect of construction industry on economic growth differs for the states of the USA. Furthermore, they emphasize that the added value of construction causes the real GDP in the States with the highest proportion of construction in real GDP. Their research contributes to the knowledge of the relationships between investment in construction and economic growth in the states of the United States and also globally. In summary, there is no consensus about the impact of the construction industry

on economic growth. While most studies indicate that investment in the construction industry contributes to increasing economic growth, there are some other authors pointing out that the construction industry has negative effects on economic growth,

Likewise, Ofori (1988) studies the role of the construction industry in economic growth in Singapore in the period 1960-1986. This author also examines the public sector investment in the construction industry and how it influences the economy to improve the industry. He also studies Singapore's recent progress from a developing country to one of recent industrialization in less than one generation and the performance of the construction industry in the process of economic development. Moreover, Raftery et al. (1998) study the recent developments in the construction sector in the Asian region, which shows three trends: 1) greater participation of the private sector in infrastructure projects, 2) greater vertical integration in the construction project packaging, and 3) greater foreign participation in the national construction. These authors suggest that these trends have helped to show the financial and technical superiority of the construction sector of developed countries in contrast with those of developing countries. In the short term there is a concern that imported construction services may grow at the expense of the lag in the sector in developing countries. However, in the long term the gap can be filled through technology transfer. The construction industry of developing countries has to take technological, financial and management leaps to compete in a global, open and more competitive environment.

### 3. DATA AND DESCRIPTIVE STATISTICS

The data used in this research is obtained from the World Bank<sup>1</sup>. The GDP per capita and the added value of the construction industry were obtained from the statistics provided by the World Bank. The Gross Domestic Product per capita is measured in USD and the added value of the construction industry in USD is measured through prices. All the variables correspond to the period 2003-2011. The reason for choosing this period is that it produces a balanced panel data given the constraint of data availability<sup>2</sup>. That is, the period was restricted to the availability of data and to the generation of a balanced panel. Under this constraint, the panel includes 36 African economies: Angola, Burundi, Benin, Burkina Faso, Botswana, Cote d'Ivoire, Democratic Republic of Congo, Republic of Congo, Cape Verde, Algeria, Arab Republic of Egypt, Ethiopia, Gabon, Ghana, Guinea, Gambia, Kenya, Lesotho, Morocco, Mali, Mauritania, Mauritius, Malawi, Namibia, Rwanda, Sudan, Senegal, Sierra Leone, Seychelles, Togo, Tunisia, Tanzania, Uganda, South Africa, Zambia and Zimbabwe.

Table 1 shows the dynamics of the construction industry and the GDP in the African countries under study. As it can be seen, the added value of the construction industry grew on

average at an annual rate of 17.07% in the period 2003-2011, while the GDP grew at an annual average rate of 13.78% in the same period for all the economies object of this study. It is important to point out that the boom of both the construction industry and economic growth has been remarkable in the African continent in the period 2004-2011.

**Table 1. Evolution of the construction industry and GDP.**

	2004	2005	2006	2007	2008	2009	2010	2011
Average growth rate of the construction industry	17.81	16.79	17.28	26.82	19.99	9.09	12.61	16.18
Average GDP growth rate	19.18	15.19	15.03	16.89	14.98	0.52	16.72	12.81

Source: Own elaboration with data from the World Bank.

Table 2 shows the variables that will be used in this research, as well as their averages, standard deviations, and maximum and minimum levels. For the sample of the 36 economies of Africa, the average GDP per capita is 4811.74 USD, the standard deviation is 4921.48 USD, the minimum GDP per capita is 558.70 USD and it corresponds to the Democratic Republic of the Congo, the highest GDP per capita is 22,556.58 USD and corresponds to the Seychelles. The aggregate value of the average construction industry of the sample is 1.43E+09 USD, with a standard deviation of 2.79E+09 USD, and a minimum of 2.57E+07 USD, which corresponds to Burundi and a maximum of 1.86 E+10 USD corresponding to Algeria.

**Table 2. Descriptive Statistics.**

Variables	Name	Average	S. Dev.	Min.	Max.
Gross Domestic Product <i>per capita</i>	gdpper	4811.74	4921.48	558.70	22556.58
Value added of construction industry	cva	1.43E+09	2.79E+09	2.57E+07	1.86E+10

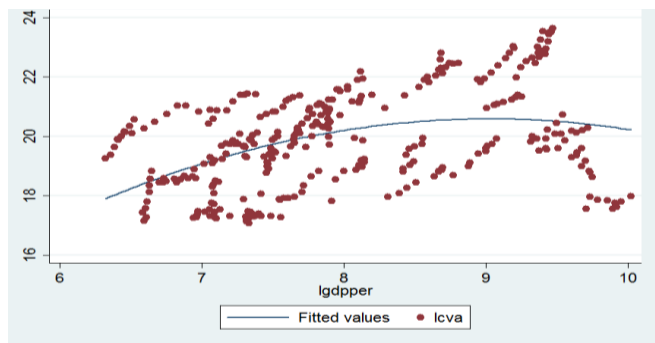
Source: Own elaboration with data from the World Bank.

Most of the studies on the construction industry and economic growth nexus predict that there is a positive relationship between them. Below, in Fig. (1), are the results from a graphical analysis that relates the dependent variable GDP per capita with the added value of the construction industry for the economies under study. This chart presents the dynamics between the logarithm of the added value of the construction industry and the logarithm of the GDP per capita for all the economies, it is observed a positive relationship between the logarithms of these variables.

<sup>1</sup> World Development Indicators 2018.

<sup>2</sup> We have the same number of observations for all the variables for all countries.

**Fig. (1).** Relationship between construction industry and GDP per capita



Source: Own elaboration with data from the World Bank.

Fig. (1) shows the trend that the increase in the added value of the construction industry tends to cause an increase in the GDP per capita, and vice versa. In short, the graph supports the idea that the expansion of the construction industry is positively associated with economic growth.

#### 4. PANEL DATA ANALYSIS

The use of panel data is increasingly common for applied research. The panel data is a sample of the characteristics that the units (countries) have as time passes, that is, panel data an arrangement of time series with cross-section. The general model that is intended to be estimated is the following:

$$y_{it} = \alpha y_{it-1} + \beta X_{it} + u_{it} \quad (1)$$

where  $y_{it}$  is the dependent variable that changes depending on  $i$  (the number of countries) and  $t$  (the number of years),  $y_{it-1}$  is the lagged dependent variable,  $X_{it}$  they are exogenous variables and  $u_{it}$  is a random disturbance. The Ordinary Least Squares (OLS) estimates will be biased. To avoid this, alternative models are proposed to the grouped regression using fixed effects models (FE) and random effects model (RE), which will be discussed later. The use of panel data presents several advantages because it examines a greater number of observations with more and better information, admits a greater number of variables, reduces multicollinearity between data of the explanatory variables, and provides greater efficiency in the estimation. Another advantage in our proposal is that more data is available and each country (observation unit) can be tracked. It also solves the problem of some omitted variables, since variables that do not change in time can be eliminated by differences.

Panel data also has limitations since the data is more complex, heterogeneity and individualities are not taken into account. Moreover, the errors could be correlated with the observations and this may lead to inconsistent ordinary least squares estimators. The fixed effects model considers a small number of assumptions. In this case, the model to be estimated is:

$$y_{it} = \alpha y_{it-1} + \beta X_{it} + \varepsilon_{it} \quad (2)$$

where

$$\varepsilon_{it} = v_i + u_{it} \quad (3)$$

In this case, the error term  $\varepsilon_{it}$  it can be broken down into two parts, a fixed part, constant for each country,  $v_i$  and second part,  $u_{it}$  that is random and that meets the OLS requirements, which is equivalent to making a general regression and giving each individual a different point of origin (ordinate). The random effects model (RE) has the same specification as the fixed effects model with the exception that the terms  $v_i$ , instead of having a fixed value for each country and being constant over time it is a random variable with a mean value  $E[v_i]$  and a variance  $\text{Var}[v_i] \neq 0$ . In this way, the specification of the model is

$$y_{it} = \alpha y_{it-1} + \beta X_{it} + v_i + u_{it} \quad (4)$$

where now the part  $v_i$  is random. The RE model is more efficient<sup>3</sup> but less consistent than the FE model. For the dynamic panel data estimation, the Generalized Method of Moments (GMM) will be used; see, for example, Arellano and Bond (1991). The GMM estimator extended in differences developed by Arellano and Bover (1995) is based on regressions in differences to control the unobservable effects. Subsequently, these authors use previous observations of the explanatory variables and lags of the dependent variables as instruments.

The GMM in differences (or difference GMM) has limitations or disadvantages as shown by Blundell and Bond (1998), particularly when the explanatory variables are persistent over time. The lagged levels of these variables are weak instruments for the difference equations. On the other hand, this approach biases the parameters if the lagged variable (in this case the instrument) is very close to being persistent. In order to avoid this problems, these authors propose the introduction of new moments on the correlation of the lagged variable and the error term. For this, the condition of covariance between the lagged dependent variable and the difference of the errors is added, as well as the change in the lagged dependent variable, and the error level must be zero. The system GMM estimator uses a set of equations in differences that are instrumented with the lags of the equations in levels. This estimator also relates a set of equations in instrumentalized levels with the lags of the equations in differences.

In the system GMM estimator, sufficient orthogonality conditions are imposed to ensure consistent estimators of the parameters even with endogeneity problems and with not observed individual-country effects. This approach will be used to estimate the parameters and was developed by Arellano and Bover (1995) and, subsequently, several improvements were made by Blundell and Bond (1998). The estimator thus obtained has advantages over other estimators such as EF and others, since it does not bias the parameters in

<sup>3</sup> The variance of the estimate is smaller, that is, it is more efficient.

small samples or in the presence of endogeneity. The optimal GMM estimator has the following form:

$$\hat{\theta}_{GMM} = \begin{pmatrix} \hat{\alpha}_{GMM} \\ \hat{\beta}_{GMM} \end{pmatrix} = \left[ \begin{pmatrix} y_{-1}^* \\ x^* \end{pmatrix}' z^* V_N^{-1} z^{*'} \begin{pmatrix} y_{-1}^* \\ x^* \end{pmatrix} \right]^{-1} \left[ \begin{pmatrix} y_{-1}^* \\ x^* \end{pmatrix}' z^* V_N^{-1} z^{*'} y^* \right] \quad (5)$$

The above equation is a system that consists of a regression that contains joint information in levels and in differences in terms conditions of moments.<sup>4</sup>

## 5. ANALYSIS OF EMPIRICAL RESULTS

In what follows, a Granger causality analysis is performed and both static and dynamic panel data models are estimated under the GMM.

### 5.1 Granger Test

Granger's causality analysis<sup>5</sup> is useful to detect the correlation between the current values of one variable with the lagged values of another variable. Thus, this is a test that consists of measuring the level of causal relationship between two or more variables in the above sense. The test consists in establishing the null hypothesis that there is no causality between two variables. The rejection criterion is based on detecting the statistical value of F, and its level of probability.<sup>6</sup> The causality tests for the variables of this study are presented in Table 3 where the results of the estimates of the Granger causality test between the logarithm of GDP per capita and the logarithm of the added value of the construction industry of the 36 economies studied are presented. The estimations indicate that, in general, there exists causality in both directions for an important number of lags between the logarithm of the GDP per capita and the logarithm of the aggregate value of the construction industry from 2003 to 2011. The GDP per capita causes added value of the industry of construction in the lags 1, 2, 8 and 9. While the added value of the construction industry causes the GDO per capita in the lags 2, 3, 4, 5, 6, 7, 8, and 9.

In summary, Granger's analysis of causality reveals that there is a unidirectional causality from the added value of the construction industry toward the GDP per capita in 5 lags, a single unidirectional causality lag from the GDP per capita toward added value of the construction industry, and a bidirectional causality of three lags. Granger's causality analysis shows that the added value of the construction industry causes stronger the GDP per capita in the studied economies of the African continent.

### 5.2. Models of Panel Data

The purpose of this section is to examine the impact of the construction industry on the GDP growth for the set of 36 African economies. The variables are expressed in levels and in logarithms. Specifically,  $\lgdppr$  is the logarithm of the

GDP per capita, and  $\lgva$  is the logarithm of the added value of the construction industry in USD. The period 2003-2011 allows us to have 36 groups and 9 years. With the use of the Stata package, a balanced panel is estimated. The main results are expressed in the following tables. Table 4 shows the results of four panel data estimates. The first column indicates that the dependent variable is the logarithm of the real GDP per capita. The explanatory variable is the logarithm of the added value of the construction industry and the constant. The coefficient of determination is estimated for the models and the Hausman and Lagrange Multiplier tests are carried out.

The second column of table 4 shows the estimate by OLS indicating a positive and significant coefficient of the logarithm of the value added of the construction, it also indicates a significant constant. It is worth noticing that the coefficient of determination  $R^2$  is 0.5919. The third column presents the results of the cross-sectional estimation in which an adequate positive and significant sign is observed in the logarithm of the added value of the construction, and the coefficient of determination  $R^2$  is 0.5919. The fourth column shows the estimation by RE indicating that coefficients are positive and significant for both the logarithm of the value added of the construction and for the constant. In this case, the coefficient of determination  $R^2$  is 0.5919. The last column shows the results of the estimation by FE, which indicates adequate, positive and significant signs for the logarithm of foreign investment and the constant. The coefficient of determination is  $R^2 = 0.5919$ . Subsequently, the Lagrange Multiplier test is presented<sup>7</sup> providing a  $\text{prob} > \chi^2 = 0.0000$ , which indicates that the estimate by RE is preferable to the estimate by OLS. Subsequently the Hausman test is presented<sup>8</sup> with  $\text{prob} > \chi^2 = 0.6599$  indicating that the estimate by RE is preferable to the estimate by FE. In order to mitigate the usual autocorrelation problems, dynamic panel data models are estimated, and the main results are shown in table 5.

Table 5 presents the results of the dynamic panel data estimates. The first column indicates the dependent variable, the independent variables, the constant, the first-order serial autocorrelation tests, the difference-in-Sargan test, the number of countries, and the number of observations. The second column of the previous table shows the results of the estimation by GMM in differences in one stage, the coefficients of the lagged GDP per capita and the added value of construction and the constant presenting appropriate and significant signs. The Sargan test does not reject the null hypothesis of over-identification, therefore the general validity of the instruments and the specification of the model are admitted. The third column shows the results of the GMM estimate in two-stage differences. In this case, both the coefficient of the GDP per capita lagged, the coefficient of the foreign investment, and the constant have adequate and significant signs. The autocorrelation test is not rejected (first-order serial au-

<sup>4</sup> For a more detailed analysis of the methodology see, for instance, Aali-Bujari *et al.* (2017)

<sup>5</sup> For a more detailed analysis see Granger (1969).

<sup>6</sup> In this regard, it is recommended to review Gujarati and Porter (2009), Wooldridge (2011) and Greene (2012).

<sup>7</sup> If the test is not rejected, there are no differences between OLS and RE, and it is preferable to use the OLS method.

<sup>8</sup> The null test hypothesis of Hausman is that the estimators of RE and FE do not differ substantially, if the null hypothesis is rejected, as in this case, FE is convenient.

tocorrelation), the autocorrelation of second-order is rejected. According to the Sargan test, the specification of the model is not admitted. The fourth column presents the estimates by one-stage GMM system. The coefficient of the lagged GDP is positive and significant. However, the coefficient of the construction value added is positive, but not significant. On the other hand, the tests show that first order serial autocorrelation exists and second order autocorrelation is rejected. The Sargan test does not reject the correct use of instruments. The fifth column presents the estimates by GMM system in two stages, the coefficient of the lagged GDP is positive and significant; however, the coefficient of the added value of construction has a positive and significant sign. Moreover, the tests show that first-order serial autocorrelation exists, but rejects second-order autocorrelation. The Sargan test does not reject the hypothesis and admits the

correct specification of the model. The estimations indicate that the model that best fits is that from the GMM system in two stages, which points that GDP per capita is related in a positive manner to lagged Gross Domestic Product (lplib.L1), which is also positively related to the added value of the construction industry. The model estimated in system GMM in two stages indicates that a 1% increase in the added value of the construction industry will have an impact of 0.009375% on the GDP per capita in the examined 36 economies in the African continent in the period 2003-2011. The estimation of the GMM system in two stages is preferable and the most adequate with respect to the rest of the estimated models and, therefore, this is the model to choose to explain the impact of the added value of the construction industry on growth economic. Therefore, the construction industry has a positive relationship with economic growth.

**Table 3. Causality in the Sense of Granger between Construction and GDP.**

Pairwise Tests								
					1 Lag	2 Lags		
Null Hypothesis:					Obs.	F-Statistic	Prob.	Prob
lcva does not Granger Cause lplibper					288	7.62844	0.0061	0.2748
lplibper does not Granger Cause lcva						0.92849	0.3361	0.1188
3 Lags	4 Lags	5 Lags	6 Lags	7 Lags	8 Lags	9 Lags	10 Lags	
Prob.	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.	Prob.	
0.2398	0.2390	0.5050	0.4386	0.5891	0.3036	0.3036	0.0000	
0.0180	0.0162	0.0010	0.0082	0.0058	0.2141	0.2141	0.0000	

Source: Own elaboration with data from World Bank. lplibper denotes the log of GDP per capita, and lcva denotes the log of added value of construction.

**Table 4. Static Panel Data (Estimates).**

The dependent variable is lgdpper	O.L.S.	B.E.	R.E.	F.E.
lcva	0.183175 (0.00000)	0.2327867 (0.026)	0.183175 (0.00000)	0.1827746 (0.00000)
Constant	4.369321 (0.00000)	3.383661 (0.098)	4.369321 (0.00000)	4.377276 (0.00000)
R <sup>2</sup>	0.5919	0.5919	0.5919	0.5919
ML BP				Prob>Chi2=0.0000
Hausman				Prob>Chi2=0.6599
Number of countries	36	36	36	36
Number of observations	324	324	324	324

Source: Own elaboration with data from World Bank. S. E. in parentheses.

**Table 5. Estimates of dynamic panel data with GMM.**

Dependent Variable: Lgdpper	GMM Difference (One Step)	GMM Difference (Two Step)	GMM System (One Step)	GMM System (Two Step)
LgdpperL1	0.6183081 (0.000)	0.6151549 (0.000)	1.006868 (0.000)	0.979803 (0.000)

Lcva	0.0758155 (0.000)	0.0753197 (0.000)	0.0032512 (0.253)	0.009375 (0.001)
Constant	1.567279 (0.000)	1.579533 (0.000)		
AR (1)		Prob>Z=0.0401	Prob>Z=0.000	Prob>Z=0.015
AR (2)		Prob>Z=0.7489	Prob>Z=0.291	Prob>Z=0.095
Sargan Test	Prob>Chi2=0.000	Prob>Chi2=0.2392	Prob>Chi2=0.000	Prob>Chi2=0.000
Number of countries	36	36	36	36
Number of observations	252	252	288	288

Source: Own elaboration with data from World Bank, Stata 11. S.E. in parentheses.

## 6. CONCLUSIONS

The empirical evidence presented in this investigation has shown that the construction industry is relevant and it has important effects on economic growth in Africa. A greater effort to boost the construction industry will contribute to the promotion of the economic activity in the 36 studied African economies. This research showed, firstly, by reviewing the literature and later through a graphic analysis that the increase in the value added of the construction industry has a positive relationship with the growth of the GDP. Subsequently, Granger's analysis of causality reveals that there is a causal relationship between the value added of the construction industry and GDP per capita in the analyzed economies.

On the other hand, the panel data estimates showed the positive impact of the value added of the construction on the GDP per capita and, therefore, on the economic growth. The empirical evidence presented here supports the hypothesis of this work: there is a positive impact of the increase in the added value of construction in economic growth in the countries that were the object of this study in 2003-2011. Derived from the present investigation, economic policy decision makers are recommended to find the appropriate instruments and incentives that promote a greater added value of the construction industry to boost economic growth, as well as contribute to the economic development.

A pulsating construction sector in developing countries in Africa is needed to mobilize human and local material resources in the expansion and maintenance of buildings, housing and infrastructure. An effervescent construction sector is an important driver to increase local employment and to speed up economic growth and, therefore, to augment well-being in Africa. Most of the African countries have intended to use the agricultural sector as the medium for achieving economic growth in order for becoming middle income countries; amazingly, it seems that the construction industry has been left out as a driver of economic activity in undeveloped economies. According to the present research, African countries instead should focus in the promotion of the construction sector. Special attention should be paid to the construction industry as one of the main drivers of economic growth in Africa due to the strong relationship with economic growth.

## CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

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