

THE LONG-RUN RELATIONSHIP BETWEEN THE CONSTRUCTION SECTOR AND THE NATIONAL ECONOMY IN CAPE VERDE

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ABSTRACT: The relationship between a country's level of activity in the construction industry and its stage of economic development is a complex one. Several studies over the last forty years, based mainly on cross sectional data, found a positive association between national income and several measures of the construction industry activity. Early studies were concerned with the role of the construction sector, as part of physical capital, in the promotion of economic growth and development. A dominant paradigm that later emerged is the 'Bon curve' or the inverted U-shaped pattern of development. More recent research, based on longitudinal analysis, has also pointed to the non-linear relationship between the share of construction in GDP and the level of income per capita. Using time-series data drawn from the United Nations, this study applies an econometric methodology to assess the validity of the underlying propositions in a low-middle income economy-Cape Verde – over the long period of 38 years. The findings are in line with the assumptions that in the upward growth trend in developing countries, the pattern of the construction industry tends to follow that of the general economy.

KEYWORDS: 'Bon curve'; Cape Verde; Construction sector; Economic development

1. INTRODUCTION

The relationship between a country's stage of development and the level of activity in the construction sector is one, which has received great attention at the macroeconomic level for a number of years. For instance, (Strassman, 1970; Turin, 1973; World Bank, 1984; Wells, 1986) have attempted to model the relationship and found a positive correlation between several measures of construction output and the level of income per capita. These findings

have been the subject of much argument due to problems related with the reliability of data, limitations of the coverage and methods of analysis employed.

Existing paradigms on the structural change in the construction industry, as a national economy develops over time tend to be based on cross-sectional data across countries rather than longitudinal studies based on one country's time-series statistics. However, longitudinal studies pertaining to developing countries of Africa have been developed in

Lopes and Ruddock (1997) and Lopes et al. (2002). Bon (1990) also made use of a longitudinal analysis to present a development pattern for the industry, at a global scale, also based in the stage of economic development of a country's economy. Bon's 1990 study covers the period 1970-1985 and a vast number of countries from all the continents. The arguments were further developed in Bon (1992). An important aspect of the proposition was that, in the early stages of development, the share of construction increases but ultimately declines, in relative terms, in industrially advanced countries – and even at some stage, the decline is not only relative but also in absolute terms i.e. 'volume follows share'.

With the availability of long and reliable time-series data and the development of econometric methodology related to the study of economic relationships between variables a new set of studies has emerged. Some of these studies (Green, 1997; Lean, 2001; Tse and Ganesan, 1997; Yiu et al., 2004; Wong et al., 2008) have applied econometric analysis within the Granger's 1969 framework to test the causality link between construction output and GDP. For example, Yiu et al. (2004) found that, for Hong Kong, the real growth of the aggregate economy leads the real growth of the construction output and not vice versa, at least in the short term. On the other hand, Wong et al. (2008), using more recent data covering a longer period of Hong Kong's high-income status, concluded that the direction of the causality is from the construction sector, particularly the civil engineering subsector, to GDP. In the same line, Anaman and Osei-Amponsah (2007) analysed the relationship between the construction industry and the macroeconomy in Ghana, based on time series data from 1968 to 2004, and found that the construction industry leads the economic growth in Ghana. Khan (2008) studied data on the construction industry and other indicators of economic activity for the period 1950-2000, and also reported that the direction of causality is from construction

to GDP. Chen and Zhu (2008) analysed provincial data on housing investment in three main regions of China, and found that there was a bi-directional Granger causality between GDP and housing investment for the whole country, while the impact of housing investment on GDP behaved differently in the three regions.

Following previous works on the role of construction in economic development, this study applies an econometric methodology to assess the validity of existing paradigms in a developing country of Sub-Saharan Africa – Cape Verde – based on time series data for the period 1970-2008 drawn from the United Nations database. The structure of the paper is as follows: the next section introduces the conceptual framework of the study. Then data and the methodology are presented and discussed. The results of the study are elaborated and discussed in the fourth section. A concluding comment finalizes the analysis.

2. THE ROLE OF CONSTRUCTION IN ECONOMIC DEVELOPMENT

The construction industry has historically been linked with the process of industrialisation and urbanisation, particularly since the advent of the Industrial Revolution. Railways systems and canals played an important role in the connection of different regions of Europe, North America and in some parts of Latin America (Rostow, 1963). Transport infrastructures facilitated trade and co-operation between countries and also the diffusion of technical innovations from the most advanced to the less advanced areas of the globe. The construction industry played a key role in the reconstruction of the war-ravaged Europe. The heavy programme of construction improvement of housing and social infrastructure, beside its contribution to the national output, was also a reflex of a better re-distributive economic policy in Europe post World War II. The importance of the construction industry has also been recognized in the context of countries affected by

natural hazards (Ruddock et al., 2010; Amaratunga and Haigh, 2010). Besides its multiplier effect on other sectors of the economy, a well-devised reconstruction programme of building and community service infrastructure can contribute to sustainable development and protect the natural and built environments.

With regard to the relationship between construction and economic development, Turin (1973), using cross-country comparisons, found an association between construction investment and economic growth. That finding was consistent with the classical approach in growth theory in which physical capital formation is the main engine of economic growth and development. Turin's argument about the

pattern of the construction industry contrasts with the argument advanced by Bon (1992, 2000). In Bon's 1992 paper, the link between economic development and construction is discussed and Bon points out the problem with Turin's analysis, which is largely focused on developing countries. As the share of construction in total output first increases and then decreases with economic development, this is called the inverted U-shaped relationship, following Maddison, who, in his seminal study of economic development (Maddison, 1987), tracked several key advanced industrial countries (AICs). Bon's 1992 argument concerns the entire path from LDC (least developed countries) to NIC (newly industrialised countries) to AIC status (Figures 1 and 2).

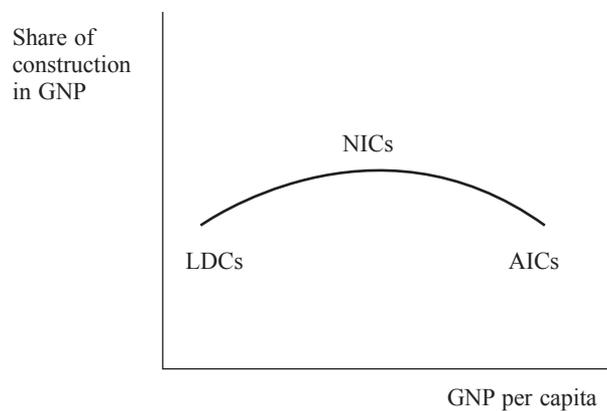


Figure 1. Share of construction in GNP versus GNP per capita (Bon, 1992)

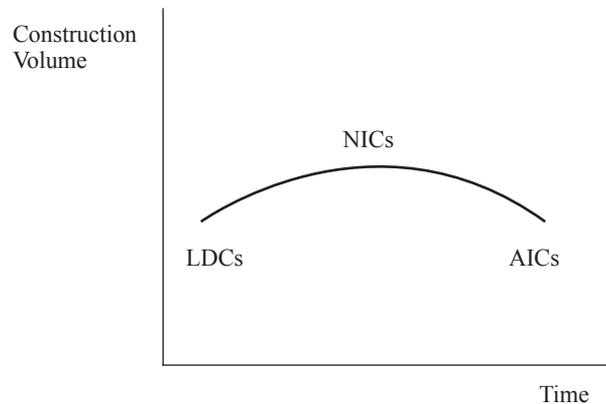


Figure 2. Construction volume over time (Bon, 1992)

In the aftermath of the 1979-1980 oil-shock and the international financial crisis that followed in 1981, most of Sub-Saharan African countries experienced until the late 1990s a decreasing growth in per capita national income, despite heavy investment in construction and other physical capital over the 1970-1980 period (Lopes, 1998). Following the *Structural Adjustment Programme for Africa* that started in the mid-1980s, World Bank (1994) took the view that, for the developing countries, the emphasis should be on the improvement of the quality of infrastructures rather than the quantity of infrastructures. Thus, it is reasonable to argue that this would be achieved through an adequate maintenance of existing infrastructure stocks and by prioritising investments that modernise production and enhance international competitiveness. Lopes (1998), discussed the role of construction in the economic development of countries in Sub-Saharan Africa. The development patterns of construction and related sectors were modelled based upon data from the period 1980-1993 and a sample of 15 countries comprising two different patterns of growth in that period. It was argued that construction and the national output grow at the same rate only in a declining economy, and that in a growing economy, the volume of construction, typically, would not grow faster than the rest of the economy.

3. DATA AND METHODOLOGY

The main statistical sources used in this analysis are the 2010 edition of the *Yearbook of National Account Statistics: Main Aggregates and Detailed Tables* from the United Nations (United Nations, 2010), and *World Development Report 2010* from the World Bank (World Bank, 2009a). The internet site of the UN statistical office presents data on gross domestic product (GDP) and its components both in the expenditure and production approaches. This publication presents various sets of economic

series detailing the evolution of GDP and its components in different statistical formats over the long period 1970-2008, at the world, world regions and country levels: at current prices in national currencies; constant 1990 prices in national currencies; current prices in US dollars; constant 1990 prices in US dollars. The indicators of economic activity analysed are: GDP and gross value added in construction (GVAC) both in constant 1990 prices in US dollars. Unfortunately, data on gross fixed capital formation in construction (GFCFC) are not provided in the UN publication. Thus, GVAC is used as a proxy for analysing the evolution pattern of construction investment in the Cape Verdean economy. As GVAC is roughly a half of GFCFC, it appears reasonable that GVAC can be used as a surrogate measure of construction investment. In order to place Cape Verde in the economic development arena, gross national income (GNI) per capita for the benchmark year 2008 has been chosen. This is provided by *The World Development Report 2010* (World Bank, 2009a). This publication presents the following definitions: the economies are divided according to 2008 GNI per capita. The groups are: low income countries (LICs), US\$ 975 or less; lower- middle- income (LMICs), US\$ 976-3,855; upper-middle-income (UMICs), US\$ 3,856 -11,905; and high income countries (HICs), US\$ 11,906 or more. According to the World Bank (2009a), Cape Verde had a GNI per capita of US\$ 3,130 in 2008 that classifies it as a lower- middle- income economy in the World Bank scale. However, social and human development indicators are also taken into account. As pointed out by Ruddock and Lopes (2006), there is no established convention for the designation of 'developed' and 'developing' countries in the United Nations system and as far as LDCs are concerned, as agreed by the United Nations Economic and Social Council, the General Assembly, on the recommendation of the Committee for Development Policy, decides on the countries included in the list

of the least developed countries (United Nations, 2004). Be that as it may, Cape Verde, in 2008, graduated from Least Developed Country (LDC) status on the United Nations scale to Middle Income Country (MIC).

In order to get a first glance at the relationship between construction output and the national economy, GVAC (as a measure of construction industry activity) and GDP are plotted over the long year period 1970-2008. However, to test whether construction flows stimulate aggregate output or the aggregate output leads construction flows, or there are feedback effects between the two macroeconomic indicators, the Granger causality test is used.

Granger (1969) implemented the causality test by testing the null hypothesis that $\alpha_{2i} = 0$ or $\beta_{2i} = 0$ in the following bi-variable (X and Y) regressions:

$$Y_t = \alpha_0 + \sum_{i=1}^n \alpha_{1i} Y_{t-i} + \sum_{i=1}^n \alpha_{2i} X_{t-i} + v_t \quad (1)$$

$$X_t = \beta_0 + \sum_{i=1}^n \beta_{1i} X_{t-i} + \sum_{i=1}^n \beta_{2i} Y_{t-i} + \mu_t \quad (2)$$

where: μ_t and v_t are uncorrelated and white noise residuals term series. Causality may be determined by testing the null hypothesis, $H_0 : \alpha_{21} = \alpha_{22} = \dots = \alpha_{2n} = 0$ and $H_0 : \beta_{21} = \beta_{22} = \dots = \beta_{2n} = 0$ against the alternative hypothesis that not all the coefficients α_{2i} and β_{2i} are equal to zero in equations (1) and (2), respectively. In this case, a number of lagged variables that range from one to six ($n = 1, 2, \dots, 6$) were studied.

In practice, if past values of the construction sector growth rate do contribute significantly to the explanation of GDP growth rate, then the construction sector is said to Granger-cause GDP. This means that the construction sector is Granger-causing GDP when past values of the construction sector have predictive power concerning the current value of GDP even if the past values of GDP are taken into

consideration. Conversely, if GDP is Granger-causing the construction sector, it would be expected that changes in GDP would take place before a change in the construction sector. It goes without saying that the term Granger-causality, as Wong et al. (2008) put it, is not a true causality concept but a statistical tool which in principle concerns only the predictability between time-series variables.

The implementation of the Granger causality test demands a previous empirical step. The presence of a trend in a time series could lead to false conclusions relating the relationship between two variables, that is, to a spurious relation (Granger and Newbold, 1974). The results could lead one to contend that there is a statistically significant relationship between the variables when, in fact, exists only a contemporaneous correlation between variables rather than a meaningful causal relation. For observing a real causal relation and to avoid the problem of spurious regression it is necessary to use stationary time series data. In practice, the unit root test is applied to test the stationarity of the series. The most commonly used unit root test is the Augmented Dickey-Fuller test (ADF) (Dickey and Fuller, 1979). To evaluate the stationarity of the two time series, the test is based on the following mathematical formulation:

$$\Delta Y_t = \alpha_0 + \alpha_1 T + \alpha_2 Y_{t-1} + \sum_{i=1}^n \gamma_i \Delta Y_{t-i} + \mu_t \quad (3)$$

where: $\Delta Y_t = Y_t - Y_{t-1}$, α_0 is a drift term and T is the time trend with the null hypothesis; $H_0 : \alpha_2 = 0$ and its alternative hypothesis $H_1 : \alpha_2 \neq 0$, n is the number of lags necessary to obtain white noise and μ_t is the error term.

Finally, the relationship between the construction sector and the national economy of Cape Verde is also examined by relating GDP with the gross valued added in construction as a share of GDP constructed from longitudinal yearly data series.

4. RESULTS AND DISCUSSIONS

Figure 3 depicts the evolution of GDP and construction output in Cape Verde over the past 38 years, both expressed in natural logarithms. The natural logarithm allows direct considera-

tion of the elasticity of the relevant variables. The first part of Figure 3 shows the variables in levels (LGDP and LGVAC) and the second part the variable's first differences (Δ LGDP and Δ LGVAC) that, in this context, can be analysed as the variables' growth rates.

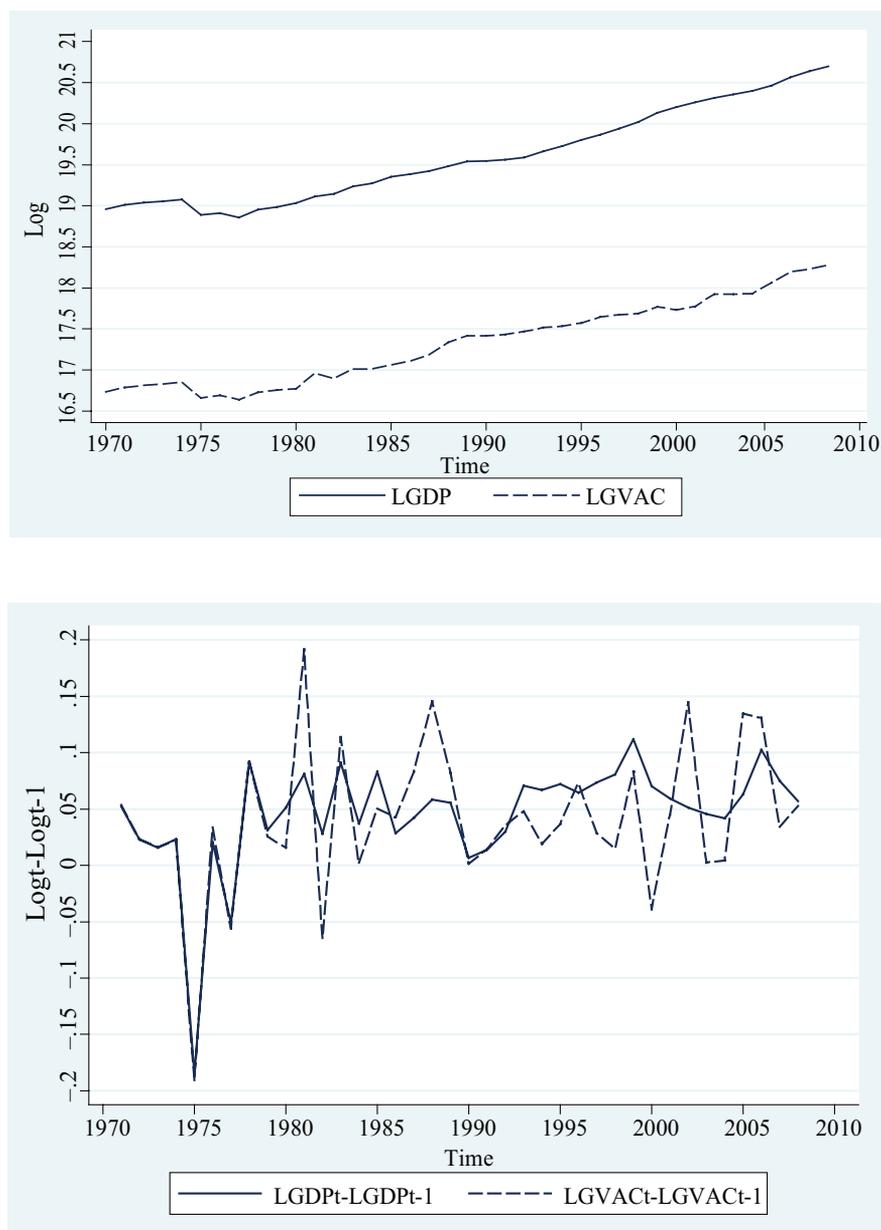


Figure 3. Evolution of GDP and construction flows in Cape Verde, over time, in levels and in first-differences

When observing the GDP and the Construction flows in levels it seems clear that a trend exists in both time series. It also appears that the evolution of the series is highly correlated. This can also be observed when analysing the summary statistics for both variables during the 1970-2008 period (Table 1). As the variables are measured in constant prices, the correlation matrix clearly demonstrates that the construction sector and GDP are strongly correlated in Cape Verde during the period 1970-2008.

Table 1. Summary statistics and correlation matrix

Summary statistics	LGDP	LGVAC
Number of observations	39	39
Mean	19,60	17,33
Median	19,54	17,42
Standard Deviation	0,57	0,50
Maximum	20,70	18,28
Minimum	18,86	16,64
Skewness	0,43	0,23
Kurtosis	1,89	1,82
Correlation matrix	LGDP	LGVAC
LGDP	1	0,9892
LGVAC	0,9892	1
	Δ LGDP	Δ LGVAC
Δ LGDP	1	0,7322
Δ LGVAC	0,7322	1

The same conclusion could not be withdrawn so easily when observing the evolution of the first differences of the variables. The growth rates of both variables (Δ LGDP and Δ LGVAC) are not so strongly correlated. Indeed, looking closely at Figures 4 and 5, it can be seen that three different patterns of growth can be disclosed.

The period 1970-1980 in which stagnation in GDP coincided with a stagnation in construction volume, i.e. the growth of GVAC was practically the same as that of GDP, both measured in US \$2000; the period from 1980

to early 1990s in which a high growth in GDP corresponded to an even higher growth in GVAC; and the period from early 1990s onwards in which the growth rate of GVAC has been decreasing whereas the relative growth of GDP was practically the same as that of the preceding period. The share of GVAC in GDP increased from about 10.8% in the period 1970-1980 to about 12% in early 1990s and from then on a trend of decline is clearly apparent until the first years of the last decade that was followed by stagnation at around 9% of GDP in the later years of the period.

The relatively high share of construction in GDP in Cape Verde compared with those of its counterparts in Sub-Saharan Africa as well as other countries in a similar stage of economic development can be explained by the territorial and economic structures of the country: half a million inhabitants and an area of approximately 4,000 km² scattered throughout 10 islands, one of them is uninhabited. Thus, the country faces the need of multiple physical infrastructures (particularly port and airport infrastructures) which could be less demanding in quantitative terms in a less scattered territory. Furthermore, Cape Verde is a service economy with construction, commerce, transport and communications, financial and public service sectors accounting for 80.6% of GDP in 2008 (African Development Bank/Organisation for Economic Cooperation and Development, 2010). Among the services, tourism is the leading sector. Construction which is closely linked with the latter was hardly hit in 2009 following the international financial crisis of 2008. Another aspect which is closely connected with the fate of the construction sector (particularly the housing sub-sector) is the remittances (9% of GDP in 2009) from the country's strong emigrant population, particularly that living in Portugal, France and USA. A significant part of the first generation of the *diaspora* has been investing part of their savings in housing in his/her home country to provide a kind of safety net after the end of his/her working age.

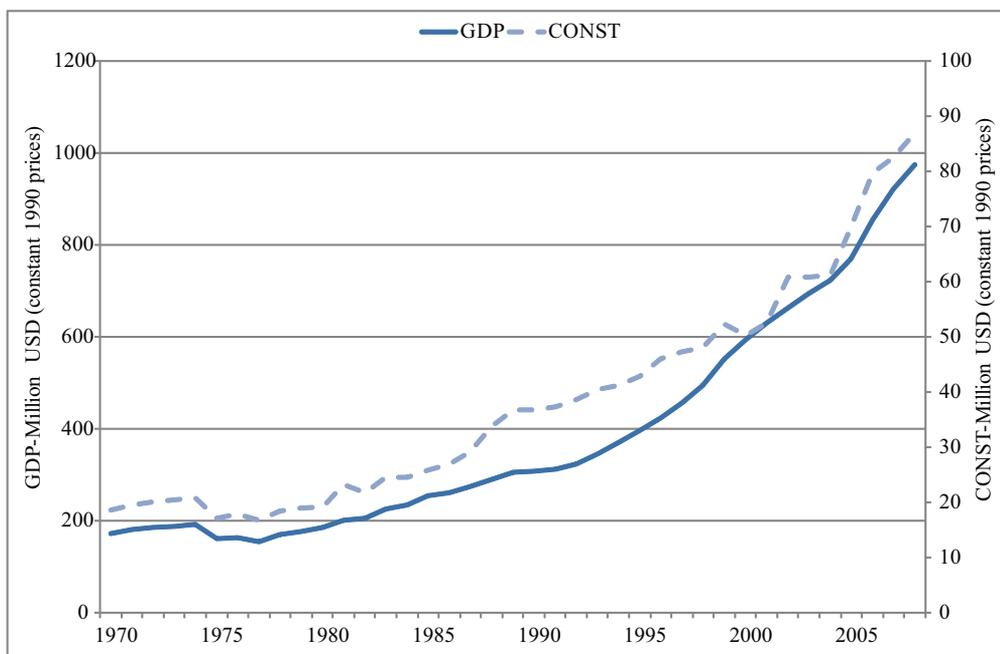


Figure 4. Evolution of GDP and construction valued added in Cape Verde (1970-2008)

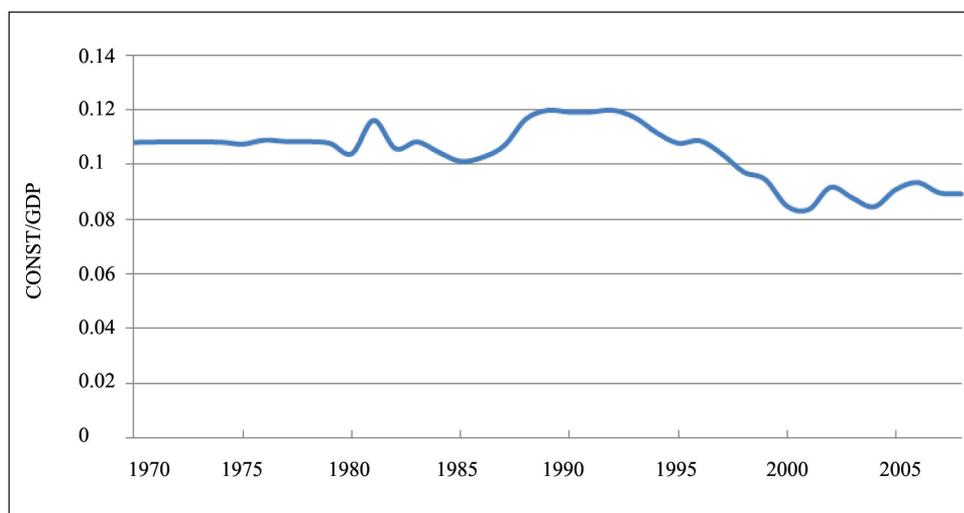


Figure 5. Share of construction valued added in GDP in Cape Verde (1970-2008)

Turning back to the causality link between the measures of construction output and those of the national aggregate, ADF tests were firstly applied to determine the integrated or-

der of the GVAC and GDP. The ADF tests the null hypothesis that the series is non-stationary (H_0 accepted). In this paper, the ADF test for each time series is applied – in levels

(without and with trend since Figure 3 points to the existence of a trend) and in first differences considering a lag order of 1, since annual data is used (also without and with trend).

Empirically, the following equations that allowed to compute the results presented in Table 2 were applied:

$$\Delta LGDP_t = \alpha_0 + \alpha_1 T + \alpha_2 LGDP_{t-1} + \sum_{i=1}^n \gamma_i \Delta LGDP_{t-i} + \mu_{1t} \tag{4}$$

$$\Delta LGVAC_t = \beta_0 + \beta_1 T + \beta_2 LGVAC_{t-1} + \sum_{i=1}^n \delta_i \Delta LGVAC_{t-i} + \mu_{2t} \tag{5}$$

Table 2. Augmented Dickey-Fuller (ADF) unit root tests

	Lags	ADF at level		ADF in first differences	
		No trend	Trend	No trend	Trend
LGDP	At 4-lag	1,467	-5.293*	-4.297*	-3.307***
LGVAC	At 5-lag	0,343	-3,191	-3.493**	-3.518***

Note: *, ** and *** denote the rejection of the unit root at 10%, 5% and 1% significance level, respectively

Interpolated Dickey-Fuller Critical Values	ADF at level		ADF in first differences	
	No trend	Trend	No trend	Trend
1%	-3,689	-4,297	-3,696	-4,306
5%	-2,975	-3,564	-2,978	-3,568
10%	-2,619	-3,218	-2,620	-3,221

Note that the null hypothesis is the presence of unit root. Thus, when the augmented Dickey-Fuller statistic lies inside the acceptance region at 1%, 5%, and 10% we cannot reject the presence of the unit root. In this case, the ADF test indicates that both series are not stationary in their level form (without trend) since the null hypothesis cannot be rejected at none of the critical values. In opposition, the ADF test indicates that both GDP

and Construction series are stationary in first differences (i.e., integrated of order 1 – I(1)), since the unit root test was rejected at least at the 1% critical value. This means that we can study the dynamic relationship between GDP and construction flows in Cape Verde using first differences data. Since we have the first differences of logarithm values, the first differences of the variables can be interpreted as the growth rates of the variables. Next we can study if exists a stable long run relationship between the growth rate of the construction sector ($\Delta LGVAC$) and the growth rate of the national economy ($\Delta LGDP$) since both variables are integrated of the same order I(1).

The results of causality relating the construction sector and GDP growth rates in Cape Verde are presented in Table 3. In this particular case, the Granger causality test, (1) and (2), can be expressed by the following regressions:

$$\Delta LGVAC_t = \alpha_0 + \sum_{i=1}^n \alpha_{1i} \Delta LGVAC_{t-i} + \sum_{i=1}^n \alpha_{2i} \Delta LGDP_{t-i} + v_t \tag{6}$$

$$\Delta LGDP_t = \beta_0 + \sum_{i=1}^n \beta_{1i} \Delta LGDP_{t-i} + \sum_{i=1}^n \beta_{2i} \Delta LGVAC_{t-i} + \mu_t \tag{7}$$

Table 3. Granger causality tests results

Null Hypothesis	Lags	F-Statistics	Prob > F
The GDP growth rate does not Granger cause the Construction Sector growth rate	1	0,46	0,5024
	2	0,82	0,4479
	4	0,74	0,5705
	6	2.14 *	0,0962
The Construction Sector growth rate does not Granger cause the GDP growth rate	1	1,29	0,2647
	2	0,15	0,8655
	4	0,28	0,8902
	6	1,00	0,4526

Note: * denote the rejection of the null hypothesis at 10% significance level

The Granger causality test shows that GDP growth leads the growth in the construction sector with a 6 years lag (for the lag 6 was possible to reject, at 10% significance level, the null hypothesis that the GDP growth does not Granger -cause the growth in the construction sector). However, the fact that the direction of causality from GDP to construction is not statistically rejected at 10% significance level means that there is, in the long-run, a weakly uni-directional relationship between the GDP growth rate and the construction sector growth rate in Cape Verde. On the other hand, the results do not show any effect of the construction growth on the GDP growth, at least in the short and medium-run.

The analysis depicted above also clearly demonstrates that the 'first half' of the Bon's inverted U-shaped curve holds for the evolution of the construction volume in Cape Verde. That is before countries reach the AIC status the volume of the construction output (in real terms) tends to increase with the increase in GDP per capita. Here, the methodology adopted in Ruddock and Lopes (2006) that comparing World Bank's grouping of countries according to their status of development with Bon's is followed, LICs and LMICs taken together represent the LDCs, UMICs represent NICs and HIC represent the AICs. Note that Bon's proposition that at some stage the decline of the construction industry activity switches from relative to absolute decline i.e. 'volume follows share' has been debated by some writers (Carassus, 2004; Ruddock and Lopes, 2006). The analysis also shows that the inverted U-shaped relationship does not totally hold for the share of construction in GDP, at least for the developing countries that are in the process of reaching the NIC status. It means that when countries reach a certain level of construction output (measured as a share of GVAC in GDP) and enter into a path of sustained economic growth and development, the growth of the construction industry tends to follow that of the general economy.

5. CONCLUSION

This paper has carried out an empirical investigation on the relationship between the construction output and the national economy in Cape Verde over a period of 38 years. Following previous works, this study has applied an econometric analysis within Granger's 1969 framework to test the causality link between construction output and GDP in that country. The results have shown that there is, in the long-run, a weakly uni-directional relationship between GDP and construction output in Cape Verde i.e. the growth of the construction sector is not greatly affected by the growth of the national economy even in the long-run. On the other hand, the results do not show any effect of the construction growth on the GDP growth, at least in the short and medium run. The results are in line with the assumption that the relationship between the growth of the construction sector and the growth of the national aggregate is not yet fully understood even with the use of advanced econometric methods. In the case of Cape Verde, the lack of disaggregate data on the different subsectors of the construction industry complicates the analysis. China, India and Brazil are countries to watch. They can provide the basic material required to build appropriate models of the role of construction in national progress (Ofori, 2007). The use of panel data that combines cross sectional analysis and longitudinal studies of countries that have passed through different stages of economic development seems to be a promising way to help to understand the role of the construction sector in the economic development of nations.

In terms of the relationship between the share of construction in GDP and a country's status of national income, the results from Cape Verde corroborate assumptions from previous works that posited that, in countries that have NIC status or are in a sustained process of reaching it, the evolution pattern of

the construction industry tends to follow that of the general economy. In the same line, go the findings of a recent report (World Bank, 2009b) that, with the present trend, there is no significant gap in construction investment (indeed physical infrastructure investment) in the middle-income countries of Africa for attaining the economic and social targets of the Millennium Development Goals.

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SANTRAUKA

ILGALAIKIAI RYŠIAI TARP STATYBOS SEKTORIAUS IR NACIONALINĖS EKONOMIKOS ŽALIAJAME KYŠULYJE

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Ryšys tarp šalies aktyvumo statybos pramonėje lygio ir jos ekonominės plėtros stadijos yra kompleksinis. Keliais per pastaruosius keturiasdešimt metų atliktais tyrimais, paremtais daugiausia tarpsektoriniais duomenimis, nustatyti teigiami ryšiai tarp nacionalinių pajamų ir kelių statybos pramonės aktyvumo priemonių. Ankstyvieji tyrimai buvo susiję su statybos sektoriaus, kaip fizinio kapitalo dalies, vaidmeniu skatinant ekonominį augimą ir plėtrą. Vėlesnis pavyzdys yra „Bon kreivė“ arba apverstos U raidės formos plėtros modelis. Naujausi tyrimai, paremti longitudine analize, taip pat buvo orientuoti į nelineinius ryšius tarp statybos dalies BVP ir pajamų, tenkančių vienam gyventojui, lygio. Naudojantis Jungtinių Tautų duomenimis, šiame tyrime taikoma ekonometrinė metodika, kuria siekiama įvertinti pagrindinius projektus mažas ir vidutines pajamas gaunančioje valstybėje – Žaliajame Kyšulyje – per 38 metų laikotarpį. Išvados atitinka prielaidas, kad besivystančių šalių augimo tendencija, statybos pramonės modelis yra linę sekti bendros ekonomikos tendencija.