Abstract

This paper discusses the development of a model of interdependence between investment in construction and gross domestic product (GDP) per capita, based on a long-term trend, for the developing countries of sub-Saharan Africa. The study follows research undertaken by previous writers, who have investigated the relationship between investment in construction and economic development and found a positive correlation between the share of construction in GDP and the level of national income.

A hypothesis tested in the research is: There is a minimum level of investment in construction in developing countries (measured in terms of construction value added (CVA) as a percentage of GDP) in order to achieve sustainable growth in the economy. The study is based on data on 15 countries for a twenty-two year period and the sample is split into two groups; one in which GDP per capita is rising and the other in which GDP per capita is falling. This research puts forward evidence that there is a critical level of CVA/GDP (at 4 – 5%) below which a relative decrease in construction volume corresponds directly to a decreasing growth in GDP per capita. The converse does not appear to be true. Some implications for public policy for the concerned countries are discussed.

Keywords: Investment in construction, economic growth, sub-Saharan Africa.

INTRODUCTION

The role of construction in economic development has been addressed by various writers and international bodies, many of whom have focused in developing countries [Turin (1973), World Bank (1984), Wells (1987), Ofori (1990)]. Turin and Wells, using cross-country comparisons, both found an association between construction investment and economic growth. That finding was consistent with the classical approach in growth theory in which capital formation is the main engine of economic growth and development. In the aftermath of the 1980 oil-shock and the international financial crisis that followed in 1981, most of sub-Saharan African countries have been experiencing a long-term decreasing growth in per capita national income.
Another approach to the theory of growth [Romer (1990), Barro, (1991)] has been emerging. Following this endogenous growth theory, endogenous policy changes (such as macroeconomic stability, investment in human capital, capacity building) play an increasing role in the development process. De Long and Summers (1991), using data from the United Nation Comparison Project drawn from 61 countries representing all stages of economic development, found that machinery and equipment investment have a strong association with economic growth. Further, they put forward evidence that investment in structures is only weakly associated with growth. The World Bank and its affiliates in the *Structural Adjustment Programme* for Africa, seem to follow the view that investment should accompany economic growth. This study argues that the relationship between the share of construction in GDP and GDP per capita seems to be consistent only with a downturn economy.

The paper presents a part of the findings of a research project concerned with the role of construction in economic development in sub-Saharan Africa. Data on construction and economically related sectors spanning twenty years are used to model the development pattern of the construction industry in these countries. Statistical sources used in the analysis are drawn from World Bank and United Nations publications. Additionally, field study data, including secondary data, from Angola and Mozambique are used in detail to complement data provide by international sources.

In this study, data on construction and economic related sectors are taken from 15 countries in sub-Saharan Africa which represent the most recent development pattern of this regional group. Indeed, when viewed on a world-wide scale, all this sub-region (excluding Gabon, Mauritius, Seychelles and South Africa) falls, according to recent statistics (World Bank, 1998), in the two lowest stages of the World Bank’s ranking of economic development – low income economies and low-middle income economies.

Another particular feature that characterises the countries which have been referred to, is the multi-varied growth pattern that occurred in the period of reference (1970 – most recent estimates) used for this analysis. This comprises:

1. Countries that experienced an increasing growth along the entire reference period.
2. Countries in which an increasing growth in the period 1970-1980, was followed by a decreasing growth after 1980.
3. Countries that experienced a decreasing growth through the entire period of reference.
4. The case of Mozambique which presented a markedly three period pattern of growth: a sustained economic growth between 1975 and 1980, a dramatic decreasing growth in 1980-1986 and an increasing growth from 1986 up to most recent estimates.

The sample used in this analysis comprises the following countries: Angola, Botswana, Malawi, Mozambique, Mauritius, Namibia, Swaziland, Tanzania, Zambia and Zimbabwe (Southern African Development Community- SADC), Kenya from Eastern Africa, and four Western African countries- Cape Verde Islands, The Gambia, Ghana and Nigeria.

**MEASURES USED IN THE STUDY**

The central hypothesis of this study, can be stated as follows:

*There is a minimum required level of investment in construction in developing countries (measured in terms of construction value added (CVA) as a percentage of GDP) in order to achieve, in the long-term, sustainable growth in the economy.*

To put it differently, there is a critical band (the share of CVA in GDP in the 4 – 5 % band) below which a relative decrease in construction volume corresponds directly to a decreasing growth in GDP per capita. The converse is not true. That is, above that band, a sustained or increasing growth in GDP per capita may not correspond to a relative increase in construction volume. It is worth noting that reference here is to a long-term trend rather than annual fluctuations that characterise the short-term pattern of the construction industry.
Two important points concerning the main indicators of economic activity used in this model need to be explained:

1. Two reasons are worthy of being mentioned concerning the choice, in this analysis, of construction value added (CVA) as the main indicator of the construction industry activity rather than gross fixed capital formation in construction (GFCFC) or gross construction output (GCO): i) the production approach (value added components) has generally been utilised by international bodies as a more reliable way to compound a country’s national aggregate; ii) as far as this sample of countries are concerned (and for the period of reference analysed), data on construction value added are more consistent than data on the other indicators of the construction industry, let alone data on construction employment.

2. The other main indicator of economic activity used in this model is GDP per capita. It introduces the variable population into the aggregate domestic product of a nation. In this sense, it appears to be a better indicator of a country’s welfare than GDP. Gross national product (GNP) per capita could, also, be used in this correlational model. Nevertheless, data on GDP are more consistent than data on GNP for the majority of countries. It is important to note that the latter can be easily constructed for a country with a reasonably reliable set of statistics on external transactions. Furthermore, as Bon (1992) put it, construction goods, strictly speaking, are not tradable outside a country’s boundary, thus the results do not vary significantly whichever of the two indicators (GDP per capita or GNP per capita) is chosen.

Regarding the aforementioned critical band (CVA/GDP), a consideration of the economic history [see Kusnets (1968), Reynolds (1985)] of today’s advanced industrial countries and some middle income economies looking back as far as 1750, has referred to the average of 20% as the share of capital formation in a country’s domestic expenditure, obviously with temporal and cross-sectional variations. More recently (from World War II), when international bodies, particularly the United Nations, started publishing data on the construction sector, there has been a remarkable uniformity across countries on the value of 50% as the average contribution of capital formation in construction to a country’s domestic investment. As construction value added is roughly a half of the former, it appears that a value around 5% for the contribution of CVA to the national aggregate, as a starting point for a good performance, is reasonably constructed. Data on construction value added presented in this study tends to corroborate this assumption.

**Statistical sources and data collection**

The main statistical sources used in this analysis are the three volumes of the *Yearbook of National Account Statistics* from the United Nations (1985, 1988 and 1995 editions) and *African Development Indicators* (World Bank, 1992, 1995 and 1997 editions). Additional data were collected from the following sources: SADC Annual Report (1992-1993 & 1993-1994) and National Report (various years) from Angola and Mozambique. Regarding the data provided by the UN publications, it was followed the methodology used in similar works (see e.g. Bon, 1990). Whenever exists divergence in these sets of data in the years they overlap, the data that were chosen were those from the most recent edition.

Data used in this analysis comprise two sets of economic series: the period 1970-1980 and 1980- most recent estimates. It is worth noting that data for the period 1970-1980 are not, consistently, available for 6 countries of the sample. Furthermore, viewed in terms of constant prices, the base years used for the two periods are not the same in the majority of those countries. As data for the period 1970-1980 have not been generally revised, they are not strictly comparable with those from the period 1980-most recent estimates. For this reason, the model used in this study is based on data from the latter period. The underlying analysis for the period 1970-1980, which is characterised by two oil shocks and the ensuing adjustment process that faced the world economy, can be found in the work by Lopes (1997).
**Testing the hypothesis**

In order to statistically test the hypothesis, two separate groups were established:

*Group 1* - corresponding to the group of countries in which GDP per capita increased in the period 1980-most recent estimates (Botswana, Cape Verde Islands, The Gambia, Kenya, Mauritius and Swaziland).

*Group 2* - corresponding to the group of countries in which GDP per capita experienced a decreasing growth in the same period (Angola, Ghana, Malawi, Mozambique, Namibia, Nigeria, Tanzania, Zambia and Zimbabwe).

Figs. 1– 4 present CVA as a share of GDP and GDP per capita (US dollars in 1987 constant prices) for the groups of countries and illustrate the divergence in the measures for the two groups.

![Graph showing Indices of Gross Domestic Product per capita: Group 1 (mean)](image)
Fig. 2: Construction Value Added as a Share of GDP: Group 1 (mean)

Fig. 3: Indices of Gross Domestic Product per capita: Group 2 (mean)
THE MODEL

The model is tested using a statistical test for the equality of two correlations.

Let $i=1,2$ corresponding to the two groups whose correlations are being compared in this study. Sample correlations $R_{ij}$ were observed based on $n_{ij}$ observations for $i=1,2$ and $j=1,\ldots,n_i$.

$n_1$ is 6 and $n_2$ is 9, so $R_{11},\ldots,R_{16}$ and $R_{21},\ldots,R_{29}$ can be observed, and $n_{ij}$ is typically about 13 (i.e. time series for the period 1980-1992).

For each sample correlation, it is necessary to evaluate

$$W_{ij} = \frac{1}{2} \ln \left( \frac{1 + R_{ij}}{1 - R_{ij}} \right)$$

and let $W_i = \frac{1}{n_i} \sum_{j=1}^{n_i} W_{ij}$ be the averages of the $W_{ij}$ in the 2 groups.

Also let us define

$$\nu = \frac{1}{n_1^2} \sum_{i=1}^{n_1} \frac{1}{n_1} + \frac{1}{n_2^2} \sum_{i=1}^{n_2} \frac{1}{n_2}$$
Then a $100\alpha\%$ test of the null hypothesis $H_o: \rho_1 = \rho_2$ against the alternative hypothesis $H_i: \rho_1 < \rho_2$ is obtained by comparing the test statistic

$$Z = \frac{(W_1 - W_2)}{\sqrt{v}}$$

with the lower $N(0, 1)$ critical value $-z_{\alpha}$, e.g. for a 5% test $z_{0.05} = 1.645$

**Proof**

According to Hogg & Tanis (1988), it is possible to obtain an approximate test of size $\alpha$ by using the fact that

$$W_{ij} = \frac{1}{2} \ln \frac{1 + R_{ij}}{1 - R_{ij}} \sim N \left( \frac{1}{2} \ln \frac{1 + \rho_i}{1 - \rho_i}, \frac{1}{n_{ij} - 3} \right)$$

that is $W_{ij}$ is asymptotically normal distributed with

$$\text{mean} \quad \frac{1}{2} \times \ln \left( \frac{1 + \rho_i}{1 - \rho_i} \right); \quad \text{and variance} \quad \frac{1}{n_{ij} - 3}$$

Assuming the $W_{ij}$ are independent, it follows that

$$W_i = \frac{1}{2} \ln \frac{1 + \rho_i}{1 - \rho_i}, \quad \sum_{i=1}^{n_i} \frac{1}{n_{ij} - 3}$$

for $i = 1, 2$ hence

$$W_1 - W_2 \sim N \left[ \frac{1}{2} \ln \frac{(1 + \rho_1)(1 - \rho_2)}{(1 + \rho_2)(1 - \rho_1)}, \frac{1}{n_1} \sum_{i=1}^{n_1} \frac{1}{n_{ij} - 3} + \frac{1}{n_2} \sum_{i=1}^{n_2} \frac{1}{n_{2j} - 3} \right]$$

so, under $H_o: \rho_1 = \rho_2$

$$Z = \frac{W_1 - W_2}{\sqrt{v}}, \quad \text{where}$$

$$v = \frac{1}{n_1} \sum_{i=1}^{n_1} \frac{1}{n_{ij} - 3} + \frac{1}{n_2} \sum_{i=1}^{n_2} \frac{1}{n_{2j} - 3}, \quad \text{as required}$$
ANALYSIS OF RESULTS

In this analysis, the hypothesis \( H_0: \rho_1 = \rho_2 \) is tested against the alternative hypothesis \( H_1: \rho_1 < \rho_2 \) at an \( \alpha = 0.05 \) significance level. The groups corresponding to these correlation coefficients (group 1 and group 2) were earlier defined.

The variables used in this model are \( 87lcva \) (the share of construction in GDP at 1987 constant prices) and \( 87GDPpc \) (gross domestic product per capita measured at US dollars, in 1987 constant prices).

The sample correlations \( R_{1j} \) and \( R_{2j} \) are based on \( n_{1j} \) and \( n_{2j} \) observations (time series data in the period 1980-1992) for group 1 and group 2 respectively. As has been referred to \( n_1 = 6 \) and \( n_2 = 9 \); \( n_{1j} \) and \( n_{2j} \) are typically 13.

Thus, for Group 1

\[
W_{1j} = \frac{1}{2} \ln \frac{1 + R_{1j}}{1 - R_{1j}}; \quad W_1 = \frac{1}{n_1} \sum_{j=1}^{n_1} W_{1j}
\]

\( R_{1j} \) : Correlation between \( 87lcva \) and \( 87GDPpc \) for Group 1, for \( j=1....6 \) hence

- Botswana; \( R_{11} = -0.211 \)
- Cape Verde Islands \( R_{12} = -0.170 \)
- Gambia, The \( R_{13} = 0.111 \)
- Kenya \( R_{14} = -0.560 \)
- Mauritius \( R_{15} = 0.436 \)
- Swaziland \( R_{16} = -0.417 \)

\( W_1 = -0.14807 \)

For Group 2

\[
W_{2j} = \frac{1}{2} \ln \frac{1 + R_{2j}}{1 - R_{2j}}; \quad W_2 = \frac{1}{n_2} \sum_{j=1}^{n_2} W_{2j}
\]

\( R_{2j} \) : Correlation between \( 87lcva \) and \( 87GDPpc \) in Group 2, for \( j=1........9 \)
For $j=1...9$ hence

- Angola: $R_{21} = 0.668$
- Ghana: $R_{22} = 0.764$
- Malawi: $R_{23} = 0.628$
- Mozambique: $R_{24} = -0.355$
- Namibia: $R_{25} = 0.778$
- Nigeria: $R_{26} = 0.648$
- Tanzania: $R_{27} = 0.647$
- Zambia: $R_{28} = 0.734$
- Zimbabwe: $R_{29} = 0.584$

Under $H_0$: $\rho_1 = \rho_2$; the null hypothesis

$$Z = \frac{W_1 - W_2}{\sqrt{v}} \sim N(0,1),$$

and at an $\alpha = 0.05$ significance level

$$Z = \frac{-0.14807 - 0.73052}{0.167635} = -5.241 < -1.645$$

Therefore the null hypothesis $H_0$ is rejected in favour of the alternative hypothesis $H_1$.

The results of the above statistical test show that the pattern of the construction industry in the two groups presents distinct developments during the period 1980-most recent estimates. These development patterns are better understood looking at the illustrations presented in Figs. 1 to 4, which show the evolution of GDP per capita and CVA as a share of GDP in Group 1 and Group 2 during this period. Figs. 1 and 2 indicate that in the countries in which gross domestic product per capita ($\text{GDPpc}$) increased in the period 1980-most recent estimates (Group 1), the share of CVA in GDP ($\text{CVA/GDP}$) remained, for the group average, practically constant during the same period. The construction volume increased, in general, absolutely but not relatively.

The other side of the picture (Figs. 3 and 4) shows that for the group of countries in which gross domestic product per capita experienced a decreasing growth in the period 1980-most recent estimates (Group 2), the share of CVA in GDP decreased as well during the same period. The construction volume decreased relatively, not only absolutely. The exception in this group is Mozambique which showed an absolute increase in construction volume from 1987 onwards but not an increase in the share of construction value added in gross domestic product, a pattern similar to that of Group 1 during the period of analysis.

**RECOMMENDATIONS**

The role of construction in economic development is an important factor facing the construction research community, government and international development agencies. In terms of macroeconomic interdependence, investment in construction, as a major component of a nation’s physical capital, is an
important tool in the management of the group of interrelated processes of economic growth (Kuznets, 1968). It follows that the construction sector pursues the economic lead of the manufacturing industry, its main partner in economic growth and development (Bon, 1992). The process of industrialisation will consequently shape the general pattern of construction activity. Growth theories have evolved from a traditional approach in which a sustained increase in a country’s physical capital is the main engine of economic growth, to one where endogenous policy changes (such as macroeconomic stabilisation and investment in human capital) play an increasing role (World Bank, 1991). Following this second line of reasoning, a sound macroeconomic management (for example, tight fiscal and monetary policy and a competitive exchange rate) is a pre-requisite for the success of any industrial or investment strategy in developing countries.

The recommendations that follow are consistent with the implications for public policy derived from the results of the study. These are:

1. The development pattern of the construction industry in sub-Saharan Africa, in the near future, should follow rather than lead economic growth.
2. Related to the above, it is the need to investigate the role of construction in a process of economic decline, and the measures on the demand-side and supply-side of the construction industry that will help to reverse the path of economic decline in sub-Saharan Africa.

CONCLUSIONS

The picture that emerges from the analysis presented above shows that the direct relationship between the share of construction in gross output and economic growth is consistent only with a downturn economy. This suggests that since the countries reverse the path of economic stagnation or decline, the construction output will grow faster than the gross domestic product in the first stages of their recovery. Thus, it is reasonable to assume that when a certain level is achieved (say a share of CVA in GDP of around 4 to 5%, depending upon the year taken as the base) and countries enter into a period of sustained economic growth and development, the construction output tends to grow, in general, at the same rate as the GDP.

Although the data used in this analysis are, to our knowledge, the best available in terms of coverage and uniformity, the sample of this study must be broadened and the period of reference should go back as far as possible. Descriptive and predictive studies, at the country or regional level, are also needed to further develop, and test the applicability of, the model presented in this study.

The construction sector plays an important role in the development strategy of any country that goes beyond its share in national output. Many writers have referred to its effect on employment creation, others to its multiplier effects in the national economy. Another relevant feature should be added: it is the great flexibility of construction activity in adjusting to different framework conditions that makes this particular sector of the economy a major contributor to the process of economic growth and development.

REFERENCES

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