Routledge
Taylor & Francis Group

Construction Management and Economics

ISSN: 0144-6193 (Print) 1466-433X (Online) Journal homepage: https://www.tandfonline.com/loi/rcme20

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To cite this article: Kwabena Asomanin Anaman & Charity Osei-Amponsah (2007) Analysis of the causality links between the growth of the construction industry and the growth of the macro-economy in Ghana, Construction Management and Economics, 25:9, 951-961, DOI: 10.1080/01446190701411208

To link to this article: https://doi.org/10.1080/01446190701411208

Construction Management and Economics (September 2007) **25**, 951–961

Analysis of the causality links between the growth of the construction industry and the growth of the macro-economy in Ghana

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Received 7 August 2006; accepted 19 April 2007

A vibrant construction industry in a developing country, that mobilizes human and local material resources in the development and maintenance of buildings, housing and physical infrastructure, is an important means to promote increased local employment and accelerate economic growth. Ghana, a country of about 22 million people, currently has one of the fastest growing economies in West Africa. The Government of Ghana (GOG) has recently set a target of annual economic growth rate of 8% and above, up from annual growth rates of 5–6% in the past five years (2001–05). It intends to use the agricultural sector as the major vehicle for achieving such high growth rates in order for the country to reach the status of a middle income country by 2015. Surprisingly, the construction industry was left out from the list of major growth drivers of the economy. We contend that with the construction industry currently making up the third largest sector of the economy, special attention should be given to this industry as one of the main drivers of economic growth in Ghana. Therefore we conducted a study to analyse the causality links between the growth in the construction industry and the growth in the macro-economy of Ghana, measured by the gross domestic product (GDP), to ascertain whether the construction industry can be used to lead the entire economy on a growth path. The analysis was based on a simple Granger causality test using time series data from 1968 to 2004. We showed that growth in the construction industry Granger-caused growth in GDP, with a three-year lag. The construction industry needs to be considered as one of the major drivers of economic growth in Ghana.

Keywords: Construction industry, gross domestic product, economic growth, Ghana, Granger causality test, West Africa.

Introduction

The construction industry plays an important role in the economy, and the activities of the industry are also vital to the achievement of national socio-economic development goals of providing shelter, infrastructure and employment. A report by the United Nations Industrial Development Organization (UNIDO) in 1993 suggested that inadequate attention is given by policy makers and economic planners to the construction industry in developing countries. Ghana, a fast-growing developing country situated in the West African region, is dependent on international funding and technical assistance as it restructures its economy to a more broad-based and sustainable one. Multi-party democratic government over the past 14 years (since 1993), coupled with political stability and peace in Ghana over the past 23 years (since 1984), has contributed to the achievement of average annual growth rates of at least 4% in a part of the world characterized by intermittent civil conflicts. From 1966 to 1983, the country experienced five successful military coups and several unsuccessful armed rebellions and unrest, albeit no civil war.

Gold, timber and cocoa production are major sources of foreign exchange. The domestic economy continues to revolve around semi-subsistence and smallholder agriculture, which accounts for about 40% of gross domestic product (GDP) and employs 60% of the workforce (Government of Ghana, 2006a). The agriculture sector which the country depends so much on is largely rain-fed. This implies that if the

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Construction Management and Economics
ISSN 0144-6193 print/ISSN 1466-433X online
http://www.tandf.co.uk/journals
DOI: 10.1080/01446190701411208

country experiences serious drought, as happened in 1977 and 1983, it is likely that the economy will run into a recession. The economy has shown a highly unstable pattern of cyclical fluctuation, driven by the marked instability of prices for the country's three primary export products, cocoa, gold and timber, in international markets (Government of Ghana, 2005). There is therefore a clear need to look at the non-agricultural industries that can help to accelerate economic growth.

The construction industry is often seen as a driver of economic growth especially in developing countries. The industry can mobilize and effectively utilize local human and material resources in the development and maintenance of housing and infrastructure to promote local employment and improve economic efficiency. The industry is currently the third largest economic sector in Ghana based on value added to GDP, outstripping the manufacturing industry since 2004. The construction industry contributed 8.8% to GDP in 2003 and 2004, ranking third behind agriculture and government services in terms of economic importance (Government of Ghana, 2005; see Table 1).

Surprisingly, policy makers have not promoted this industry as a driver of economic growth. This is reflected in the lack of attention given to the construction industry in recent government policy and strategy documents (see for example, the scant attention given to the construction industry in the government's medium-term strategy document called *Growth and Poverty Reduction Strategy* (Government of Ghana, 2005) published in November 2005 and officially launched in May 2006). This low level of attention to the construction industry can be compared to the considerable attention given by the government to the agriculture, tourism and information and technology communication sectors and even the sports industry as the main drivers of economic growth to allow the country to reach middle-income country status by 2015. Indeed, in the recently released industrial census report (June 2006), commissioned by the Ghana Statistical Service, there were no data on the construction industry while comprehensive data were provided for thousands of firms in the utilities, manufacturing and mining industries.

An argument put forward by some analysts for using the construction industry as a driver of economic growth is the need to diversify the economy. Given the persistent fluctuations in terms of trade of agricultural export commodities and the heavy reliance on the largely rain-fed agricultural sector as the main driver of economic growth, the objective of the government for the country to reach middle-income status in less than nine years may be compromised owing to the high exposure of the economy to risks. We believe that the importance of the construction industry as a major growth pillar in Ghana needs to be continuously publicized to policy makers, economic planners and the general public in order to accelerate sustainable economic growth. As part of our advocacy drive to convince policy makers on the importance of the construction industry in Ghana, the Institute of Economic Affairs has undertaken several publicity drives through the mass media in 2006. In addition, we have also undertaken the current study to analyse the causality links between the construction industry and the larger macro-economy to demonstrate the importance of using the construction industry as one of the drivers of economic growth in Ghana.

To the best of our knowledge a study of this nature has not been done in Ghana. Most studies that we have reviewed about Ghana's construction industry are basically centred on technical issues such as the feasibility of using certain building materials for housing projects, roofing techniques and the use of cheap but durable materials for affordable housing projects. We also believe that this study will serve as a useful template from which other researchers can design a methodology for similar studies in other sectors of the economy.

The current study is also of importance to the larger international audience in construction management and economics, particularly for those in developing countries. First, given the relative political stability of

Table 1 The contribution to GDP of various economic sectors in Ghana including the construction industry (in percentages)

Sector/Year	2000	2001	2002	2003	2004	Average
Agriculture	35.27	35.24	35.15	36.38	37.94	35.99
Government services	10.06	10.17	10.08	9.92	9.69	9.98
Construction	8.71	8.79	8.83	8.79	8.80	8.78
Manufacturing	9.02	9.00	9.03	8.94	8.75	8.95
Mining and quarrying	4.98	4.72	4.72	4.68	4.59	4.74
Transport, storage and communication	4.29	4.36	4.41	4.41	4.44	4.38
Electricity and water	2.69	2.70	2.69	2.66	2.59	2.66

Ghana over the past two decades, the country has become a beacon of peace and stability in the West African region and throughout Africa, as exhibited by the numerous invitations to, and participation by the country's representatives in, intra-African peace negotiations and development discourse. The political stability has also resulted in sustained moderate economic growth since 1984 and led to increased foreign direct investment especially in the areas of construction and mining. For example, major international hotel chains such as Hilton, Holiday Inn and Intercontinental are currently constructing hotels in Ghana which are due to be completed before the country hosts the African Nations Soccer Cup festival in January 2008. Other major hotels are also undergoing extensive renovation such as the Ambassador Hotel in Accra (built in 1957, the year Ghana gained independence) and the City Hotel in Kumasi. The rapid increase in hotel construction is linked to the accelerated growth of the tourism industry, regarded as a major industry in the country.

Second, the country, especially in the last few years, is witnessing the rapid growth of construction of international-type shopping malls. Woolworth Supermarket Chain, has opened several shopping malls around the country. The biggest shopping mall in Ghana, the Accra Mall was completed in May 2007 during the year that the country celebrates its 50th independence anniversary with the larger international community. Expansion of the construction of shopping malls leads to the increase in the output of the retailing sector and greater integration with the economies of neighbouring countries through the influx of many cross-border tourists visiting Ghana for shopping.

Third, the role of the construction industry in Ghana and other developing countries can be appreciated better if the industry's linkage to the agriculture sector and rural development is stressed. The construction industry is responsible for the development of rural roads and bridges crucial for access to rural areas and the marketing of agricultural produce. An additional major impact that the construction industry can introduce to rural areas is the construction, maintenance and renovation of farmers' markets and village market centres. Village and town market centres, with self-financing modern facilities such as water closet modern toilet facilities, electricity supply, cold stores, children's playgrounds and community meeting places, offer an environment that acts as an incentive to increase rural incomes and youth employment. The provision of market infrastructure reduces urban migration by providing rural producers of food and other agricultural produce access to better functioning markets. The construction industry through the provision of modern market facilities encourages sustainable growth in the rural areas which contain the largest numbers of people living in developing countries such as Ghana.

Through the linkage of the construction industry to tourism, the retailing sector, agriculture and rural development, the industry can be a major growth driver to achieve sustainable growth. The construction industry is also pivotal in the construction, renovation and repair of rural homes and dwellings to improve the standards of living of rural dwellers. In Ghana, many rural houses are dilapidated and are in need of repair. The industry can play a role in the renovation of rural homes. Renovation of rural homes will involve the construction industry's active linkage and association with rural banks. This situation is applicable to many developing countries.

This present study does not seek to investigate the interrelationships between the construction industry and the other major parts of the economy in Ghana. Such a study will be considered in the near future with the completion of a general equilibrium model of Ghana by the Institute of Economic Affairs, Accra, Ghana. The proposed general equilibrium model has the construction industry as one of the economic sectors. In the light of the preceding discussion, the main objective of this study is to evaluate the causal links between the growth of the construction industry and the growth of the macro-economy of Ghana. A secondary objective is to analyse the performance of the construction industry in terms of its contribution to the national GDP.

The rest of this paper is organized as follows: the next section provides a summary of the literature reviewed. This is followed by a discussion of the methodology used for the study. The subsequent section discusses the results of the study. The conclusion and policy recommendations follow after this section. The list of references and an appendix are reported at the end of the paper.

Literature review

Overview of the construction industry in Ghana

The construction industry is defined as a group of firms with closely related activities involved in the construction of real estate, buildings, private and public infrastructure (Lange and Mills, 1979). It also deals with all economic activities directed to the creation, renovation, repair or extension of fixed assets in the form of buildings, land improvements of an engineering nature and other such engineering constructions such as roads, bridges and dams. This means that construction firms are those involved with the direct

construction of buildings and infrastructure and those supplying materials for construction-related activities. The industry is important in Ghana because infrastructure facilities required for improved living conditions are relatively undersupplied (Eyiah, 2004). The industry accounts for a significant share of GDP and is currently the third largest economic sector after agriculture and government services. The industry has a big potential to help accelerate economic growth in Ghana.

Construction firms in Ghana are classified as small or large based on their levels of output which are in turn largely dependent on their financial capabilities. Eyiah and Cook (2003) establish that the large firms consist of mainly foreign firms while the small firms are mostly local Ghanaian businesses. The construction industry in Ghana is one of the most highly regulated industries. Contractors find themselves interfacing with national, regional and district bureaucracies at all levels of a project: to obtain building permits, to have work inspected and to have the completed project certified 'good for possession' so that they can be paid by the relevant authorities.

Summary of empirical studies in estimating causality links among industries

Substantial links between the construction industry and the wider economy have been theoretically and empirically established by several studies see for example, Bon *et al.* (1999). Ofori (1988) considered the role of the construction industry in Singapore's economy from 1960 to 1986. The study concluded that the construction industry played a significant role in the development process of Singapore. Tse and Ganesan (1997), in their study found that growth in the economy as measured by the GDP translates to an increase in activity of the construction sector of Hong Kong from 1985 to 1995. Ruddock and Lopes (2006) used the 'Bon Curve' to analyse the effect of construction activity as an agent in the promotion of economic growth in economies at different stages of development. They found that the construction sector played a major role in economic development. Kirmani (1988) describes the construction industry as a powerful engine for economic growth. Generally, demand for construction activities tends to be highest at the early stages of economic development and level off after a high level of economic development has been attained (Wells, 1986). Barot (2002) used the Granger causality tests to carry out analysis on nine sub-sectors of the Swedish private sector. He combined the growth rates of value added, hours worked and estimated labour productivity for the period 1960–99. The causality test indicated that growth rates in investment Granger-caused growth rates in total factor productivity for agriculture and financial institutions, real estate and other business, while total factor growth rates in mining and quarrying and manufacturing Granger-caused growth rates in investment.

Green (1997) analysed the impact of residential versus non-residential construction investment on GDP throughout the business cycle, using the Granger causality test. His findings showed that residential construction investment Granger-caused GDP, while non-residential construction investment did not Granger-cause GDP. Burke (2002) investigated the relationship that existed between the stock market and business cycles. He first researched the history of the two major stock market crashes and their effects on the macro-economy. He then theoretically established the process through which the stock market affects business cycles and vice versa using a vector auto-regression model. The study used the Granger causality test to examine whether a causal relationship existed between the stock market and the business cycles.

In a study to investigate the causal relationship between export growth and economic growth in Ghana, Sakyi-Bekoe (1989) use four causality models (Granger, Sims, Modified Sims and Hsiao). He found out that at 5% level of significance, the Granger, Sims and Modified Sims tests failed to detect any causal relationship between exports and economic growth. However, at 10% level, the Granger test showed a unidirectional causality from economic growth to export, the Sims test indicated a causal flow from exports to economic growth while the Modified Sims test showed a weak bi-directional causality between exports and economic growth. The introduction of a third variable (investment) in the Granger test reduced the influence of economic growth and showed that no causality existed between exports and economic growth. On the other hand, the Hsiao test implied a strong support for unidirectional causality from economic growth to exports. The inconsistent results of the Granger, Sims, Modified Sims and the Hsiao tests appeared to reflect the arbitrary manner in which the lag lengths were determined for these tests.

Anaman (2003) studied the relationship between the construction industry and the macro-economy in Brunei based on a simple Granger causality test. The study used time series data on real GDP and the GDP share contributed by the construction industry. He concluded that the macro-economy, as measured by GDP, Granger-caused the real value of the construction industry in a positive relationship. An increase in real GDP in the previous year would lead to an increase in the value of the construction industry in the current

year. A feedback mechanism from the construction industry to the macro-economy was estimated. Higher levels of construction industry activities in the previous year were followed by a decline in real GDP.

Ching *et al.* (2005) empirically examined the relationship between residential real estate price and national output in Hong Kong. They focused their testing methodology on the Granger causality test and employed time series data on residential real estate price and national output GDP from 1978 to 2004 for their analysis. They concluded that real GDP Granger-caused residential real estate price, but residential real estate price did not Granger-cause real GDP.

Methodology

Theoretical and analytical framework

It has been shown that during periods of accelerated economic growth, construction output grows at a faster rate than the economy as a whole (Wells, 1986). Currently in Ghana, as indicated in the government budget statement dated 16 November 2006, the construction industry is considered the fastest growing economic sector with a provisional growth rate for 2006 of 8.2% compared to the average of 6.2% for the whole economy (Government of Ghana, 2006b).

A question that frequently arises in time series analysis is whether or not one economic variable can help forecast another economic variable. One way to address this question was proposed by Granger (1969). It is a simple test which looks at the causality links between one variable and the other. For the Granger causality test, two autoregressive (AR) models are estimated as shown below:

$$X_t = A_o + \sum_{m=1}^{r1} B_m(1-L)Y_{t-m} + \sum_{n=1}^{r2} C_n(1-L)X_{t-n} + U_{1t} \quad (1)$$

$$Y_t = A_o + \sum_{m=1}^{r1} D_m(1-L)Y_{t-m} + \sum_{n=1}^{r2} E_n(1-L)X_{t-n} + U_{2t} \quad (2)$$

where r1 and r2 are the orders of the AR models, L is the lag operator and U1t and U2t are the random error terms (assumed to be uncorrelated). If the set En is statistically significantly different from zero while Bm is not, then there is unidirectional causality from Xt to Yt. However, if both sets Bm and Cn in Equation 1, and Dm and En in Equation 2 are found to be jointly statistically significant using the F-test, then there occurs feedback or bilateral causality exists which means that both variables 'Granger-cause' each other simultaneously.

Estimation of the model

The model estimated in this study involved two equations. These two equations are specified as follows:

$$\begin{aligned} LRGDPt &= C0 + C00\ STABLEP + \\ &C1\ LRGDPt-1 + C2\ LRGDPt-2 + \ldots + Cp \\ &LRGDPt-p + D1\ LRCONGDPt-1 + \\ &D2\ LRCONGDPt-2 + \ldots + \\ &Dp\ LRCONGDPt-p + Ut \end{aligned} \quad (3)$$

$$\begin{aligned} LRCONGDPt &= C0 + C00\ STABLEP + \\ &C1\ LRGDPt-1 + C2\ LRGDPt-2 + \ldots + Cp \\ &LRGDPt-p + D1\ LRCONGDPt-1 + \\ &D2\ LRCONGDPt-2 + \ldots + \\ &Dp\ LRCONGDPt-p + Vt \end{aligned} \quad (4)$$

where $LRGDP_t$ is the natural logarithm of the real gross domestic product of Ghana for year t, deflated based on the GDP deflator using 2000 as the base year; $LRCONGDP_t$ is the natural logarithm of the real output of the construction industry in year t based on the value added to RGDP by the construction industry also deflated based on the GDP deflator using 2000 as the base year; STABLEP is an exogenous dummy variable denoting political stability. The variable, STABLEP carries a value of 1 for years where there was no military coup or abortive coups or military insurrection and zero for years of political instability marked by military coups or attempted armed insurrection. It was postulated that growth of both GDP and the value of the construction industry flourished with political stability. C_i and D_i are the constant terms; and U_t and V_t are the random error terms assumed to be uncorrelated. The data are listed in the Appendix.

The study uses annual data rather than monthly data because monthly data for the construction industry are currently not available in Ghana. It would have been more appropriate to have split the construction industry into residential and non-residential parts to be able to have a deeper insight into what happens in each part. Unfortunately, lack of data did not permit this type of analysis.

The ordinary least squares estimation method is employed in this study. The optimal number of lags, i, is determined by the estimated equation with the least value of Schwarz Bayesian information criterion. The lag number of 3 was chosen based on this criterion. The correct use of the Granger causality test requires that regressions be based on stationary variables. The test of stationarity was therefore conducted for both LRGDP and LRCONGDP. As reported later in this paper, we

found that the first differences of both LRGDP and LRCONGDP were stationary. These first differences were therefore used for the Granger causality analysis. Given the fact that the first differences of LRGDP and LRCONGDP were used, this implied that the two variables measured the annual growth of RGDP and the annual growth of RCONGDP respectively.

Data and data sources

Nominal time series data on value added to GDP by the construction industry (NCONGDP) were obtained from various annual issues of national accounts published by the United Nations Office of National Accounts for Ghana. The nominal GDP of Ghana and GDP deflator figures were obtained from the International Financial Statistics of the International Monetary Fund (IMF) and Ghana Statistical Service. Data used for analysis were from 1968 to 2004. The data for 2005 were considered provisional and were therefore not used for the analysis. The GDP deflator is used here as a proxy for construction output price index due to lack of data on output price index of the construction industry in Ghana. The usage of the GDP deflator may lead to a potential bias in the RCONGDP series and this is a limitation of the study.

Results

The Granger causality test requires the use of stationary time series data (Granger and Newbold, 1974; Ong, 1994). This implies that the data should be tested for unit roots. The study used two well-known unit root tests known as augmented Dickey–Fuller (ADF) test (Dickey and Fuller, 1979, 1981) and the Phillips–Perron (PP) test (Phillips and Perron, 1988). The null hypothesis for both tests was that there was a unit root in the time series. The optimal number of lagged first differences in the ADF test was chosen automatically by the Time Series Processor (TSP) software (Hall and Cummins, 2001). The PP test of stationarity is generally preferred to the ADF test. This is due to the low capability of the ADF test to discriminate efficiently between non-stationary and stationary time series with high degree of autocorrelation. The ADF test is also sensitive to time series with structural breaks (West, 1988; Culvell and Papell, 1997). On the other hand, the PP test is capable of discriminating clearly between non-stationary and stationary time series with autocorrelation and is not sensitive to structural breaks in the time series data.

Figure 1 shows the movement of LRGDP and LRCONGDP over the period of study from 1968 to 2004. The results from the preferred PP test showed that LRGDP and LRCONGDP were not stationary at the levels (Table 2). The two variables were stationary however, when the time series data were first-differenced and the unit roots tests re-ran. The Granger causality test was therefore based on stationary variables, DLRGDP and DLRCONGDP. The lag length used for the Granger causality test was chosen at 3 based on the minimization of the Schwarz Bayesian information criterion (SBIC) score and the proper

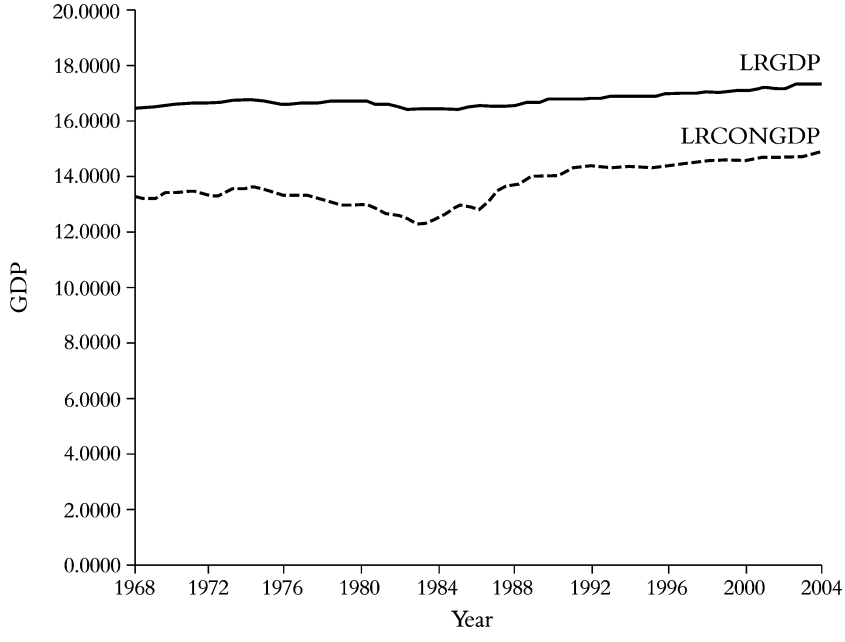

Figure 1 Movement of the series, LRGDP and LRCONGDP, for Ghana from 1968 to 2004

Table 2 Unit root tests of variables at the levels and first differences*

Variable	ADF statistic	P-value	PP statistic	P-value
LRGDP	−2.504	0.326	−1.592	0.979
LRCONGDP	−2.939	0.150	−4.711	0.842
DLRGDP	−1.559	0.808	−22.054	0.047**
DLRCONGDP	−2.303	0.432	−34.126	0.004**

Notes: LRGDP and LRCONGDP denote variables at the levels.
DLRGDP and DLRCONGDP denote variables differenced once.
* The optimal number of lag length was 10, 7, 10 and 2 for LRGDP, LRCONGDP, DLRGDP and DLRCONGDP respectively for both the ADF and PP tests of stationarity.
** denotes that the parameter is significantly different from zero at the 10% confidence level. The 10% confidence level is used throughout the study.

specification of the model as related to the relative absence of econometric problems. A simple cointegration analysis developed by Engle and Granger (1987) used for this study revealed that the variables LRGDP and LRCONGDP did not have a valid cointegration relationship between them. This result supported the use of the first differences of the two variables for the Granger causality test.

The results of the Granger causality analysis are presented in Tables 3 and 4. In Table 3, the dependent variable is specified as DLRGDP, which measures the annual growth rate of RGDP. There was absence of significant heteroskedasticity as measured by the LM test. Based on the Durbin–Watson d-value, significant autocorrelation did not exist in the model reported in Table 3. The model could be regarded as modestly strong based on the relatively high R^2 and adjusted R^2. As expected, the political stability variable, STABLEP, significantly influenced the annual growth of RGDP. With the value of 0.085 as the parameter estimate for STABLEP, this implied that years of political stability resulted in 8.87% ($e^{0.085}-1$) more annual growth of RGDP than years of political instability. The statistically significant negative parameter estimate for $DLRGDP_{t-3}$ suggested that there was a three-year cycle of growth in Ghana with a recession occurring every three years. Of the relationship between the growth of RGDP and the growth of the construction industry (RCONGDP), the null hypothesis of no significant relationship was rejected. This rejection was due to the statistically significant parameter estimate for $DLRCONGDP_{t-3}$. This significant positive estimate indicated that DLRCONGDP Granger-caused DLRGDP. Thus the growth of the construction industry preceded growth in the whole economy with a three-year lag.

In Table 4, the dependent variable is specified as DLRCONGDP, which measures the annual growth rate of RCONGDP. For the model in Table 4, there was no significant heteroskedasticity as measured by the LM test. Further there was no significant autocorrelation as measured by the Durbin–Watson d-value. With a R^2 of about 59%, the model could be regarded as relatively strong. Based on the F-test reported in Table 4, the block

Table 3 Results of Granger causality test between DLRGDP and DLRCONGDP in Ghana

Explanatory variable	Parameter estimate	T-statistic	P-value
INTERCEPT	−0.040	−1.991	0.058**
$STABLEP_t$	0.085	3.413	0.002**
$DLRGDP_{t-1}$	0.207	1.184	0.248
$DLRGDP_{t-2}$	−0.196	−1.052	0.303
$DLRGDP_{t-3}$	−0.345	−1.991	0.058**
$DLRCONGDP_{t-1}$	−0.067	−1.383	0.179
$DLRCONGDP_{t-2}$	0.030	0.660	0.516
$DLRCONGDP_{t-3}$	0.095	2.033	0.053**

Notes: Dependent variable is $DLRGDP_t$.
R^2=0.455**.
Adjusted R^2=303**.
F-value of the impact of the block of DLRCONGDP variables=1.965.
Corresponding p-value of the F-test of the DLRCONGDP variables=0.145.
Durbin–Watson d-value=1.762.
Probability value of rejecting the null hypothesis of no significant heteroskedasticity based on Langrange multiplier heteroskedasticity test=0.315.
** denotes that the parameter is significantly different from zero at the 10% confidence level. The 10% confidence level is used throughout the study.

Table 4 Results of Granger causality test between DLRGDP and DLRCONGDP in Ghana

Explanatory variable	Parameter estimate	T-statistic	P-value
INTERCEPT	−0.265	−4.050	0.000**
$STABLEP_t$	0.427	5.200	0.000**
$DLRGDP_{t-1}$	0.780	0.575	0.187
$DLRGDP_{t-2}$	−1.467	−2.400	0.024**
$DLRGDP_{t-3}$	−0.736	−1.280	0.212
$DLRCONGDP_{t-1}$	−0.332	−2.072	0.049**
$DLRCONGDP_{t-2}$	0.176	1.165	0.255
$DLRCONGDP_{t-3}$	0.218	1.417	0.169

Notes:
Dependent variable is $DLRCONGDP_t$.
R^2=0.586**.
Adjusted R^2=0.471**.
F value of the impact of the block of DLRGDP variables=3.047**.
Corresponding p value of the F-test of the DLRGDP variables=0.047**.
Durbin–Watson d-value=1.969.
Probability value of rejecting the null hypothesis of no significant heteroskedasticity based on Langrange multiplier heteroskedasticity test=0.202.
** denotes that the parameter is significantly different from zero at the 10% confidence level. The 10% confidence level is used throughout the study.

of DLRGDP variables together exerted a significant impact on DLRCONGDP. This implied that the growth of RGDP had significant effect on the growth of RCONGDP. Specifically, the significant variable was $DLRGP_{t-2}$ which indicated that DLRGDP Granger-caused DLRCONGDP with a two-year lag. The growth of the macro-economy as measured by RGDP preceded the decline in the output of the construction industry with a two-year lag. The higher level of RGDP that was followed two years later by a decline in the real value of the output of the construction industry could be linked to the completion of major investment projects such as roads and infrastructure that would drive the growth of RGDP in a particular year. However it took some time for the restart of new government construction projects due to negotiations for funding and execution of projects.

The highly significant parameter estimate for STABLEP implied that the politically stable atmosphere of recent years had led to sustained increase in the value of output of the construction industry. The value of 0.427 suggested an increase of about 53% annual growth of the construction industry in years of political stability compared to periods of political instability marked by coups and armed rebellion. This clearly indicated that the resurgence of the construction industry in the past two decades could be partly traced to the political stability achieved in the country since 1984.

Conclusions and policy recommendations

The construction industry is currently the third largest economic sector in Ghana and the fastest growing sector. We analysed whether the industry can be a major driver of economic growth in Ghana. This analysis was based on evaluating the causality links between the construction industry and the macro-economy, measured by GDP, to ascertain whether the construction industry can be used to lead the entire economy on a growth path. The analysis was based on a simple Granger causality test using time series data from 1968 to 2004 and based on stationary variables. The results showed that growth in the construction industry Granger-caused growth in RGDP with growth in RGDP preceded by growth in the construction industry with a three-year lag. In addition, a higher level of RGDP was followed two years later by a decline in the real value of the output of the construction industry linked possibly to the completion of major investment projects such as roads and infrastructure that would drive the growth of RGDP in a particular year. Years of political stability led to increased levels of output of both the construction industry and macro-economy as compared to years of instability marked by coups and armed rebellion.

Despite the data limitations, this study provides some useful policy implications. Given the results obtained from this study, it is recommended that since growth in construction industry precedes growth in the larger macro-economy, the government should provide a conducive environment for construction firms to enhance their performance. Construction firms need the support of interested donor agencies in areas such as staff development and training. Construction firms should also be helped to access loans from banks. The Ghana Statistical Service and the Building and Road Research Institute must be equipped to undertake

periodic surveys of construction firms and information on labour issues, output, problems and government policies collected. This will help researchers conduct analysis of the construction industry easily and effectively. A unit within the association could be responsible for disseminating the results of such research in the most appropriate manner to the firms. The Ministry of Roads and Transport and their agencies, the Ghana Highway Authority, the Architectural Engineering and Service Company, the Department of Feeder Roads and the Public Works Department should assist construction firms on technical issues to ensure efficiency so as to increase productivity.

Economic growth is one of the most effective ways of reducing poverty in Ghana, and infrastructure delivery has been identified as one of the key drivers of economic growth. The government should develop plans to intensify its involvement through increasing its investment in the construction industry. An increase in government spending on the construction industry will improve the quality of Ghana's infrastructure and pave the way for the efficient delivery of other sectors such as manufacturing and retailing, water and electricity, tourism, agriculture and communication thus serving as a catalyst for higher economic growth and employment creation.

Investment spending by government on the construction industry such as roads, water and electricity supply needs to be coordinated with productive sectors of the economy for a bigger impact on economic growth. For example, with agriculture the backbone of the economy of Ghana and with rural areas accounting for over half of the country's GDP, the development of rural roads, electricity and water supply should be linked with the development of modern multi-purpose farmers' and village market centres with modern amenities such as pipe-borne water, water-closet toilets, electricity and cold stores that will act as real incentives to accelerate the production of rural goods and services and create increased employment of rural youth. An important area of public policy related to both rural development and the construction industry is the need to renovate the dilapidated extended family houses scattered throughout Ghana. Many of these houses were built in the cocoa boom years of the 1950s and early 1960s when the government, through its roof loan housing scheme, gave small loans to rural dwellers to roof their houses with iron sheets. Many rural houses were built with mud by migrant construction workers from neighbouring countries of Benin and Togo. This loan scheme which has been abandoned can be revived with the government giving small loans to rural dwellers in the context of the current government micro-credit programme.

This study looks at the construction industry as a whole and does not differentiate between residential and non-residential construction, owing to lack of appropriate data in Ghana. It is suggested that the residential and non-residential sectors of the construction industry in Ghana should be analysed in future studies. We also hope to undertake further studies relating to the microeconomic analysis of the construction industry in the future.

It will be interesting to know the linkages between the construction sector and other sectors of the economy. We recommend that future studies should look at the contribution of the construction industry to other sectors of the country such as agriculture, tourism, rural development and services.

Finally, a contribution of this paper is an apparent solution to the persistent puzzle in the economic growth and economic development literature on Africa as to why for most economic growth studies on African countries there is no established statistically significant link between total investment expenditures and economic growth. A recent study published by the Institute of Economic Affairs, Accra, Ghana (Anaman, 2006) on the determinants of economic growth in Ghana provides further evidence to support the studies summarized by Rogers (2003) that for African countries there appears to be no statistically significant link between total investments and economic growth.

This is how our paper published in this journal resolves this apparent paradox. Construction activities generally account for about 50% of total investment expenditures of the total economy. As we have shown, for example, in Ghana, construction activities affect growth of GDP based on a three-year forward lag. So investment expenditures, of which a large proportion is construction output, apparently affects economic growth measured as the growth of GDP in a forward lag form. In other words, the full-blown effect of total investment expenditures, especially construction activities, may take three years before it is fully captured in economic growth. The direct effect in the current year may be too small to be captured in an econometric analysis using aggregate data. Thus the effect may not be picked up easily based on the link between current investment expenditures and current economic growth. This suggests that in future economic growth studies on African countries, it may be useful to use lagged investment expenditures as one of the independent variables rather than current investment expenditures. We suggest an optimal lag length of two or three years based on this study (see Table 4).

References

Anaman, K.A. (2003) Can the construction industry pull the rest of the economy out of a recession? Evaluation of the causality links between the construction industry and the macro-economy in Brunei Darussalam, in Anaman, K.A. and Duraman, I. (eds) *Applied Economic Analysis in Brunei Darussalam: Evaluation of Economic Growth and Trade, Microeconomic Efficiency and Analysis of Socio-economic Problems*, Universiti Brunei Darussalam, Bandar Seri Begawan, pp. 16–23.

Anaman, K.A. (2006) *Determinants of Economic Growth in Ghana*, Monograph Number 14, Institute of Economic Affairs, Accra, Ghana.

Barot, B. (2002) Growth and business cycles for the Swedish economy 1963–1999. *Journal of Construction*, **3**(2), 217–53.

Bon, R., Birgonul, T. and Ozdogan, I. (1999) An input–output analysis of the Turkish construction sector, 1973–1990: a note. *Construction Management and Economics*, **17**(5), 543–51.

Burke, K. (2002) Investigating the relationship between the stock market and business cycles, available at www.allegheny/edu/academics/econ/catalogue.php (accessed 6 July 2006).

Ching, A., Shao, B., Yu, N. and Liu, S. (2005) Residential real estate price and real GDP: Granger causality test. Hong Kong University of Science and Technology (unpublished).

Culvell, E.S. and Papell, H.D. (1997) Is there a unit root in the inflation rate? Evidence from sequential break and panel data models. *Journal of Applied Econometrics*, **12**, 435–44.

Dickey, D. and Fuller, W.A. (1979) Distribution of the estimates for autoregressive time series with a unit root. *Journal of the American Statistical Association*, **74**, 427–31.

Dickey, D. and Fuller, W.A. (1981) Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica*, **49**, 1057–72.

Engle, R.F. and Granger, C.W.J. (1987) Co-integration and error correction representation, estimation and testing. *Econometrica*, **55**(2), 251–76.

Eyiah, A. (2004) Regulation and small contractor development: a case of Ghana. Working Paper, Centre on Regulation and Competition, University of Manchester.

Eyiah, A. and Cook, P. (2003) Financing small and medium scaled contractors in developing countries: a Ghana case study. *Construction Management and Economics*, **21**(4), 357–67.

Government of Ghana (GOG) (2005) *Growth and Poverty Reduction Strategy (GPRS11)*, Final Draft Report, National Development Planning Commission, Government of Ghana.

Government of Ghana (GOG) (2006a) *Ghana at a Glance: 2005–2006*, Country Report: Ghana, available at www.ghana.gov.gh (accessed 4 June 2006).

Government of Ghana (GOG) (2006b) Government budget presented to Parliament, 16 November 2006 by the Minister of Finance and Economic Planning, Honourable Kwadwo Baah-Wiredu.

Granger, C.W.J. (1969) Investigating causal relations by econometric models and cross-spectral methods. *Econometrica*, **34**, 541–51.

Granger, C.W.J. and Newbold, P. (1974) Spurious regressions in econometrics. *Journal of Econometrics*, **2**, 111–20.

Green, R.K. (1997) Follow the leader: how changes in residential and non-residential investment predict changes in GDP. *Real Estate Economics*, **25**(2), 253–70.

Hall, B.H. and Cummins, C. (2001) *Time Series Processor Version 4.5 Reference Manual*, TSP International, Palo Alto, CA.

Kirmani, S. (1988) The construction industry in development: issues and options., Discussion Paper, Infrastructure and Urban Development Department, World Bank, Washington, DC.

Lange, J.E. and Mills, D.Q. (1979) An introduction to the construction sector of the economy, in Lange, J.E. and Mills, D.Q. (eds) *The Construction Industry: Balance Wheel of the Economy*, Lexington Books, Lexington, MA, pp. 1–10.

Ofori, G. (1988) Construction industry and economic growth in Singapore. *Construction Management and Economics*, **6**, 57–70.

Ong, S.E. (1994) Structural and vector autoregressive approaches to modeling real estate and property stock prices in Singapore. *Journal of Property Finance*, **5**(4), 4–18.

Phillips, P. and Perron, P. (1988) Testing for a unit root in time series regression. *Biometrica*, **75**, 335–46.

Rogers, M. (2003) A survey of economic growth. *Economic Record*, **79**(244), 112–35.

Ruddock, L. and Lopes, J. (2006) The construction sector and economic development: the 'Bon Curve'. *Construction Management and Economics*, **24**(7), 717–23.

Sakyi-Bekoe, K. (1989) Investigating the causal relationship between export growth and economic growth in Ghana, Master of Development Economics thesis, University of Dalhousie.

Tse, C.Y.R. and Ganesan, S. (1997) Causal relationship between construction flows and GDP: evidence from Hong Kong. *Construction Management and Economics*, **15**, 371–6.

United Nations Industrial Development Organisation (UNIDO) (1993) *Prospects for the Development of the Construction Industry in Developing Countries*, Report No. ID/WG. 528/5, Vienna.

Wells, J. (1986) *The Construction Industry in Developing Countries: Alternate Strategies for Development*, Croom Helm Ltd, London.

West, K.D. (1988) On the interpretation of near random walk behaviour in GNP. *American Economic Review*, **78**, 202–9.

Appendix

Data on GDP deflator (GDPDEFL), nominal GDP (NGDP), nominal output of construction industry in millions of Cedis (NCONGDP) and political stability dummy variable (STABLEP) from 1968 to 2004

Year	GDPDEFL	NGDP	NCONGDP	STABLEP
1968	0.0128	1700	73.0	1
1969	0.0143	1999	82.0	1
1970	0.0151	2259	93.8	1
1971	0.0158	2501	117.9	1
1972	0.0183	2815	104.0	0
1973	0.0198	3502	130.9	1
1974	0.0254	4660	213.2	1
1975	0.0331	5283	235.6	1
1976	0.0422	6526	261.8	1
1977	0.0706	11163	422.3	0
1978	0.1225	20986	517.0	0
1979	0.1709	28222	659.0	0
1980	0.2469	42853	1055	1
1981	0.4738	72526	1491	0
1982	0.5950	86451	1486	0
1983	1.4121	184038	2796	0
1984	2.0122	270561	5945	1
1985	2.4358	343048	9780	1
1986	3.4595	511000	12962	1
1987	4.8010	746000	37143	1
1988	6.4249	1051000	52854	1
1989	8.2252	1417000	96046	1
1990	11.4024	2032000	135194	1
1991	12.9556	2427500	200858	1
1992	14.4030	2802900	244287	1
1993	18.9569	3872500	286600	1
1994	24.6404	5205200	390000	1
1995	35.3014	7752600	582200	1
1996	49.3514	11339200	856500	1
1997	58.9887	14113400	1083946	1
1998	69.0029	17295710	1332230	1
1999	78.6251	20579790	1601400	1
2000	100.0000	27152700	2140781	1
2001	134.5801	38070740	3019012	1
2002	165.2154	48862410	3892013	1
2003	212.5405	66157700	5312289	1
2004	242.8785	79803690	7029900	1

Source: United Nations National Accounts Office, New York, United States, the International Monetary Fund International Financial Statistics and the Ghana Statistical Service, Accra, Ghana.