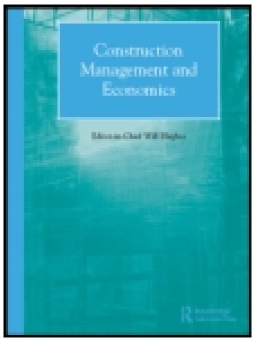

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Construction and economic development: the case of Hong Kong

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Construction and economic development: the case of Hong Kong

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The role of construction in economic development is an important issue facing the construction research community, government and international development agencies. Based on empirical analyses, the complexities of the relationship between construction activity and stage of economic development in Hong Kong were examined. With time series data, Granger causality test results show that the construction output particularly the infrastructure sector drives the economic growth of Hong Kong, and not vice versa. Findings further indicate that the role of the local construction industry changes as the economy matures from newly industrializing country (NIC) to advanced industrialized country (AIC) status, as revealed by the diminishing rate of capacity addition by construction as well as the growing maintenance and repair sector. This complies with Bon's inverted U-shaped relationship between construction activity and gross domestic product (GDP). However, the proposition of 'volume follows share' is not supported since the indigenous construction investments still sustain for the service-oriented economy which inevitably needs commercial development and logistics infrastructure to provide the services. The results may be significant for policy makers in NICs, in the long run, to formulate corporate and industrial policies to chart out a viable and sustainable course to revive the vigour of the industry.

Keywords: Bon curve, construction industry, investments, economic development, Hong Kong.

Introduction

The construction sector has been recognized as a key engine for economic growth. Its role in national economy can be viewed in the context of the role that physical investment plays in economic development. There are three functions of capital investment namely: accumulation, efficient allocation and rapid technological catch-up (World Bank, 1993). The industry's contribution indeed varies during the development process of an economy transforming from a rural agricultural economy into an urban industrial economy, and consequently into an urban service economy (Pietroforte and Gregori, 2006). The complexities of the relationship between an economy's level of construction activity and the stages of economic development are considerable. Hence, this relationship has been assessed by various scholars and international bodies since the 1970s (e.g. Turin, 1973; Drewer, 1980; Wells, 1985).

However, existing paradigms on 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 a country's time series statistics. Many studies focused on the simple relationship between the gross value/value added of construction output and GDP/GDP per capita. Crosthwaite (2000) utilized cross-sectional analysis and verified the inverted U-shaped relationship between construction spending share in GDP and GDP per capita as advocated by Bon (1992). Jin *et al.* (2003) also found a non-linear relationship between the share of construction output in GDP with the GDP per capita across 34 countries and regions. Mostly the phenomenon was explained by reference to the change of growth rate in construction output at different stages of economic development.

Cross-sectional analysis has its limitations due to the heterogeneity of the built environment in different

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countries. Beside the stages of economic development, many factors such as geographical size, topology of land and even culture vary enormously between countries (Yiu *et al.*, 2004). Without controlling these differences, any conjecture as to the relationship between construction growth and economic growth becomes implausible. A more direct approach is to make use of longitudinal (or time series) analysis, which studies data series of a single country or city along a certain period of time. It controls the characteristics of the built environment as constant, unless there is structural change in the industry. A number of scholars (e.g. Crosthwaite, 2000; Yiu *et al.*, 2004) also called for longitudinal analysis to explore this longitudinal relationship between the growth rates of construction output and the economy.

There have been, over the past three decades, only a few studies which are based on macroeconomic time series analysis. Those studies have attempted to model the relationship between the construction and economic development but have usually been hampered by problems of data quality and availability. Lopes and Ruddock (1997) and Lopes *et al.* (2002), for instance, carried out the analysis but pertaining to developing countries of Africa. Tse and Ganesan (1997) and Yiu *et al.* (2004) assessed the relationship between construction flow and GDP in Hong Kong. As they explored causality only, the role of construction in the process of economic growth in terms of share and volume was not examined.

With the availability of longer time series of data across structural changes in the development of the Hong Kong economy in general and her construction industry in particular, an examination of the validity of Bon's proposition is, therefore, conducted and the role of the construction sector critically examined in this paper. Specifically, the following key research questions are investigated to explore the relationship between the complexities of the construction activity and the stage of economic development using the Hong Kong data:

(1) Is there a significant change in the mix of construction demand as Hong Kong develops?
(2) Does construction cause economic growth or vice versa?
(3) Does the construction industry of Hong Kong follow an inverted U-shaped relationship between construction spending share in GDP and GDP? Does volume follow share?
(4) What are the implications for existing knowledge and areas of further research?

The case of Hong Kong is interesting and suitable because her transition from an emerging economy to a developed one suggests that the role of construction over the entire economic development process can be empirically evaluated. In addition, previous examinations of the role of the construction sector are limited to the national level. Investigations have seldom been made at the regional or metropolitan levels. The findings of this study are imperative for policy makers and contribute knowledge to the understanding of the construction process and economic growth. The study could also shed light on the benefits of physical investment on the national economy, especially in industrialized countries. Hence, the construction development model identified in this study will be particularly valuable to maturing cities like Shanghai, Guangzhou and Macau in Mainland China, emerging metropolises in the Middle East including Dubai, Bahrain and Doha as well as other capitals worldwide.

The structure of the paper is as follows: the theoretical background regarding the relationship between the construction sector and economic development is introduced in the next section. The hypothesis is also set out. The data and research method are then discussed. The results of the empirical analyses are subsequently presented and discussed prior to concluding remarks.

Construction and economic development

The role which construction activity plays in the social and economic development of nations has been studied for several decades, the studies having been given impetus by realization of the linkages between construction activity and the rest of the economy (Hillebrandt, 2000). Turin (1969, 1973) initially showed positive and significant log-log linear correlations between GDP and various building parameters (e.g. construction value-added as a percentage of GDP; gross output of construction as a percentage of GDP) on the basis of cross-section data for 87 low and middle-income countries for the period of 1955–65. Similar relationships were exposed by Strassmann (1970) although the findings were derived from a relatively smaller sample of countries. They argued that as the construction industry provides the necessary infrastructure and productive facilities, it must grow faster than the economy as a whole. In addition, Anaman and Osei-Amponsah (2007) analysed the causality links between the growth in the construction industry and the growth in the macro-economy of Ghana, measured by the GDP based on a simple Granger causality test using time series data from 1968 to 2004. The study contended that the construction industry is a major driver of the economic growth in Ghana.

Bon (1992), however, points out the problem with Turin's and Strassmann's analyses, which were largely focused on developing countries. Drewer (1980) and Ofori and Han (2003) also criticized the Turin–Strassmann hypotheses and models for: (1) poor data quality; (2) absence of corrections for output quality, prices and factor substitutions; and (3) assumption of a 'natural' development path, i.e. construction must constitute particular proportions of GDP for economic growth. Drewer used data from countries included in the UN Economic Commission for Europe region and concluded that more construction does not necessarily mean a higher level of economic development.

Examining the changing role of the construction sector at various stages of economic development in developed countries including the USA, UK, Japan, Italy, Finland and Ireland, Bon (1992, 2000) concluded that construction activity follows an inverted U-shape relationship, not only in terms of the construction share in total GNP[1] but also in terms of total construction volume, as an economic system develops from less developed country (LDC) to newly industrializing country (NIC) and to advanced industrialized country (AIC) eventually with time, as graphically shown in Figures 1 and 2.

This notion is well explained by Tan (2002, p. 593): 'In low income countries, construction output is low. As industrialization proceeds, factories, offices, infrastructure and houses are required, and construction as a percentage of GDP reaches a peak in middle-income countries'. Wells (1986) suggested that as a nation's GDP increases, construction constitutes an increasing proportion of GDP, and this rate of increase is the fastest when the country passes through the middle-income range. As the economy matures, the growth then tapers off as the infrastructure becomes more developed and housing shortages are less severe or eliminated.

Bon (2001) argued that the provision of new capacity is replaced by more efficient deployment of existing capacity. In other words, a mature construction sector tends to add new capacity at a lower rate than during the early stages of economic development (Pietroforte and Gregori, 2006). These modest returns are expected in highly industrialized countries with a well-developed transportation infrastructure. An important aspect of the proposition is that, in the early stages of development, the share of construction increases but ultimately declines, in relative terms, in industrially advanced countries. Even at some stages, the decline is not only relative but also in absolute terms, i.e. 'volume follows share' in the long run (Bon, 1992; Tan, 2002). This theory about construction's share in economic development runs counter to the argument first advanced by Turin (1973).

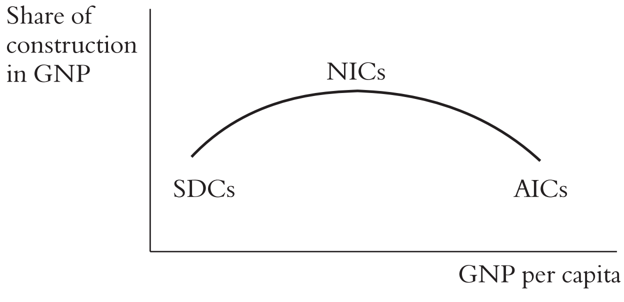


Figure 1 Share of construction in GNP versus GNP per capita (Bon, 1992)

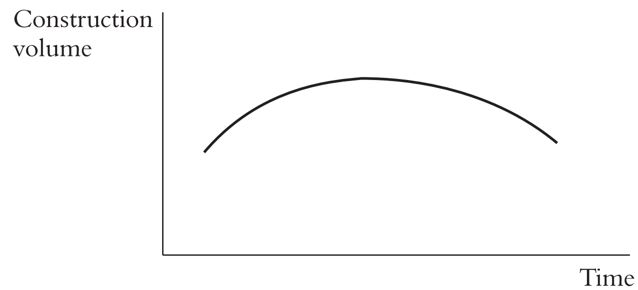


Figure 2 Construction volume over time (Bon, 1992)

As also described by Maddison (1987), in the last century, economic development has been characterized by 'the bell shaped pattern of relative industrialization and de-industrialization'. The contribution to GNP by both the construction and manufacturing sectors starts to decline as an economy matures, while the services industry becomes the new engine of the AICs' economy. At the same time, the capital stock that was generally built in the early stages of economic growth tends to age over time. Crosthwaite (2000) also confirmed the non-linear (inverted U-shaped) relationship between construction spending as a share of GDP and GDP per capita, using cross-sectional data of 150 countries.

On the other hand, Turin's studies pointed out that the proportion of civil engineering works in the total construction output of developing countries is higher than that in their industrialized counterparts. The mix of construction demand and output changes as an economy develops. This derives directly from the importance of capital formation in setting the basis for economic development. Consequently, the share of maintenance and repair work has upsurged to approximately 50% of the total construction volume in highly developed countries (Pietroforte and Gregori, 2003). Productivity in construction at this stage will be stagnant, if not declining. One primary reason is indeed the increasing share of maintenance and repair work in total construction, which is more labour intensive than new construction.

Hong Kong is classified as an advanced industrialized city (World Bank, 2006), and it is reasonable to speculate that her construction industry would follow the inverted U-shaped relationship between construction spending share in GDP and GDP along with the diminishing construction volume as suggested by Bon (1992). The transformation of the construction demand as the economy develops is also evaluated. Whether the construction sector and the aggregate economy are segmented or interdependent is also explored here through an examination of the specific lead-lag causal relationships between construction flow and GDP.

Data and research method

The indicator of construction industry used for this study is the gross value of construction works (GVCW). Data of GVCW in real terms are available from the *Report of Quarterly Survey of Construction Output* published by the Census and Statistics Department (various years) of The Government of Hong Kong SAR. The reports provide data of quarterly real expenditure-based gross domestic product (GDP). All time series data used in this study are in real terms to discount price inflation. The data period ranges from the first quarter of 1983 to the fourth quarter of 2006, giving in total 96 quarterly points within a span of 24 years (Figure 3).

As stipulated by the International Monetary Fund and the World Bank, income as reflected by the GDP per capita can be used for classifying economies. Advanced industrialized countries (AICs) are categorized as high-income economies with per capita GDP of US$11 116 or more. Newly industrializing countries (NICs) are categorized as middle-income economies with per capita GDP of between US$906 and US$11 115. Less developed countries (LDCs) are categorized as low-income economies with per capita GDP of US$905 or less (World Bank, 2006). Using this categorization, Hong Kong may be classified as a developing country from 1974 to 1988 when GDP per capita increased from US$1000 in 1974 to US$10 599 in 1988; and classified as a developed country since 1989 when GDP per capita started to increase from US$12 091 to US$29 851 in 2007. In addition, according to the World Bank figures, Hong Kong has the characteristics of a developed economy, for example, Hong Kong ranked sixth in terms of GDP per capita in purchase power parity, the highest in Asia; the share of maintenance and repair works increased from 21% in 1998 to 54% in 2006; there is an ageing population as occurring in other advanced economies such as Japan, etc. These factors show that the coverage of the data used in the study should be sufficient to justify the assertion of Hong Kong's transition from an industrialized economy to an advanced industrialized economy and to show the role of construction in economic development.

In this study, the historical trend of the Hong Kong construction volume is first plotted to scrutinize the relationship between construction spending and GDP as well as the change in mix of construction demand

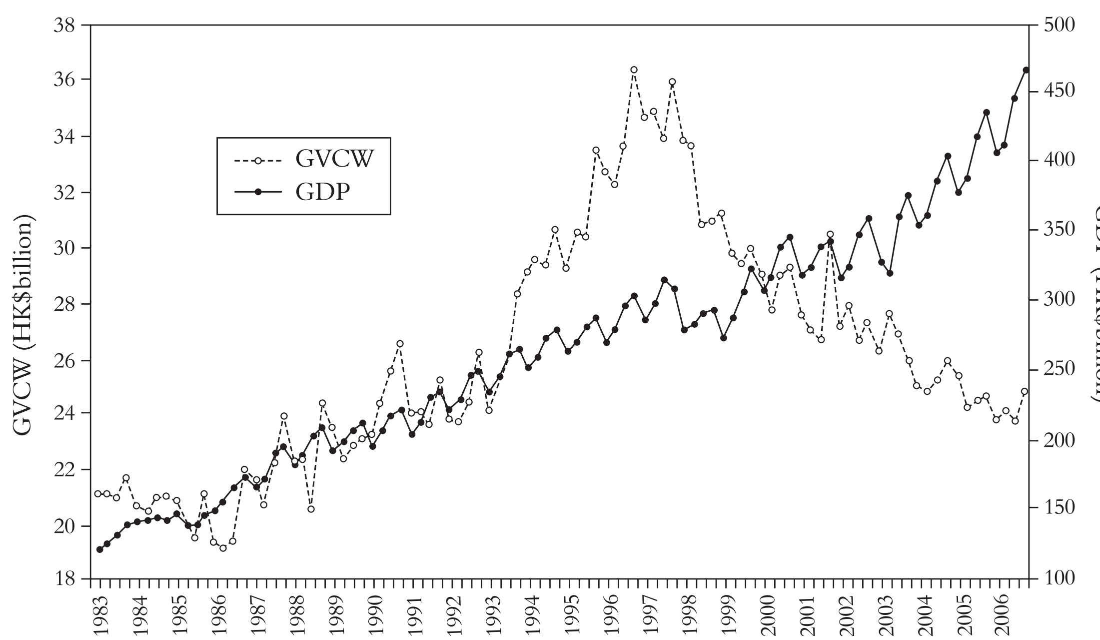


Figure 3 GVCW and GDP time series in Hong Kong

over time. To test whether construction flow stimulates the aggregate economy or the aggregate economy leads construction activity, or if feedback effects between the two macroeconomic indicators exist, the Granger causality test is applied. Augmented Dickey–Fuller (ADF) unit root test (Dickey and Fuller, 1979) is conducted to test the stationarity of the series so as to ensure that relationship, if any, would not be spurious. Specifically, the ADF tests developed by Dickey and Fuller (1979) and extended by Said and Dickey (1984) are employed for this study, which is based on the following auxiliary regression:

$$\Delta y_t = \alpha + \delta\, t + \gamma\, y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \tag{1}$$

The variable Δy_{t-i} expresses the lagged first differences, u_t adjusts the serial correlation errors and α, β and γ are the parameters to be estimated. This augmented specification was used to test for $H_0 : \gamma = 0$ vs. $H_a : \gamma < 0$ in the auto-regressive (AR) process.

The specification in the ADF tests is determined by a 'general to specific' procedure by initially estimating a regression with constant and trend, thus testing their significance. Additionally, a sufficient number of lagged first differences are included to remove any serial correlation in the residuals. In order to determine the number of lags in the regression, an initial lag length of eight is selected, and the eighth lag is tested for significance using the standard asymptotic *t*-ratio. If the lag is insignificant, the lag length is reduced successively until a significant lag length is obtained. Critical values simulated by MacKinnon (1991) were used for the unit root tests.

If the GVCW and GDP series were non-stationary in level terms, the differenced terms of the time series will be used in the Granger causality test. Granger (1969) put forward the causality test by testing the null hypothesis that $\beta_{0\mathrm{i}} = 0$ in the following bivariate regressions:

$$\log GDP_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{0i} \log GDP_{t-i} + \sum_{i=1}^{n} \beta_{0i} \log GVCW_{t-i} + \mu_t \tag{2}$$

$$\log GVCW_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{0i} \log GVCW_{t-i} + \sum_{i=1}^{n} \beta_{0i} \log GDP_{t-i} + \mu_t \tag{3}$$

The causality test attempts to assess how much of the current GDP can be explained by past values of GDP itself and then to see whether adding lagged value of GVCW can improve the explanation, and vice versa. The economic growth is said to be Granger-caused by construction activities if GVCW helps in the prediction of GDP, or equivalently if the coefficients on the lagged GVCW are statistically significant (QMS, 2000). Since the number of lags in the causality model is arbitrary, the regression is run thrice by setting the order of lags at 4, 8 and 12 to ensure adequate relevance of past information.

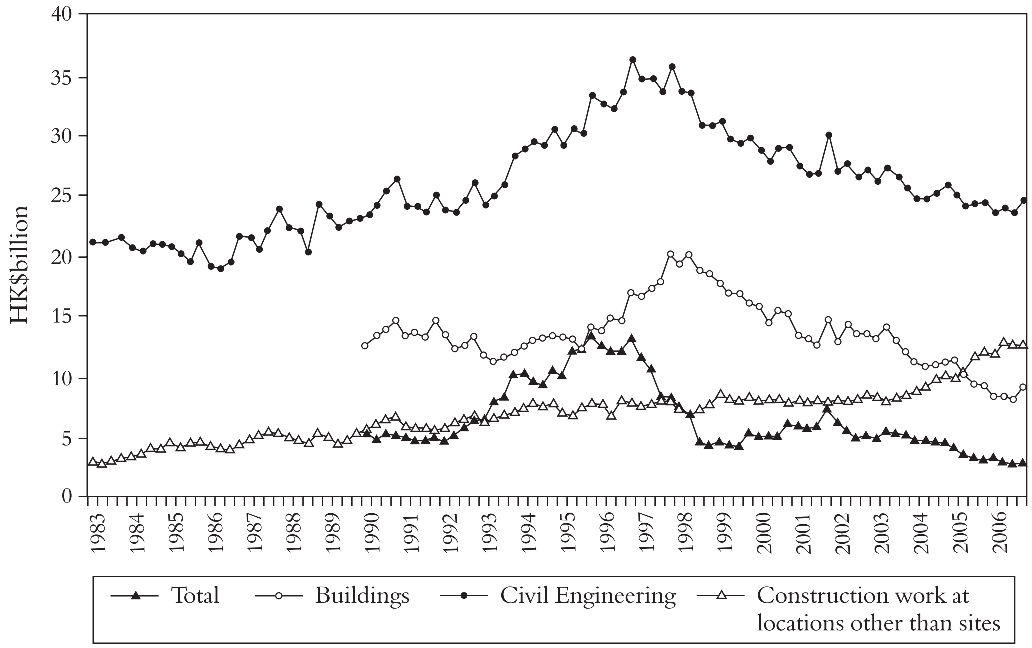
On the other hand, the role of construction in the economic development of Hong Kong is examined by relating GDP with various parameters including rate of construction growth, gross output of construction as a percentage of GDP and as per capita, fitted with the longitudinal quarterly data series. Regression technique was used as it is the most commonly used and versatile dependence technique, allowing the examination of the optimal causal relationship between the explanatory variable(s) and the dependent variable (Chatterjee and Hadi, 1988; Hair *et al.*, 1998).

Findings and discussion

Figure 4 depicts the trends of the volume of construction work (quarterly) in different sectors in Hong Kong over the past 25 years. Construction volume in Hong Kong was increasing along with early stages of economic development and industrialization in the 1980s. However, the volume of works has been declining since its peak in 1997 primarily because of the Asian financial crisis. The GVCW in 2006 shrank to HK$96 billion, which was only 64.7% of its peak of $139 billion in 1997.

By sketchily scrutinizing the construction volume of the territory, an inverted U-shaped pattern as advocated by Bon (1992) is evident showing that Hong Kong has transformed to a mature economy with a diminishing reliance on the construction sector. This proposition could be further validated by observing the decrease in the percentage contribution to the GDP (Figure 5). The construction sector was overtaken by the electricity, gas and water sectors in 2005 when, for the first time since 1980, it only ranked fourth among all sectors.

The historical trend of the overall construction output over the economic development process lays a solid foundation for further examination of the change in the mix of construction demand (i.e. buildings, civil engineering works; maintenance and repair works) as the city grows. A significant decrease in building works is noted to be mainly due to the combined effects of a superfluous supply of residential stocks, the Asian



Notes:

[a] Building sector includes residential, commercial, industrial & storage and service building works.

[b] Civil engineering sector includes structures & facilities for transport, environment, sports & recreation and other utilities & plant.

[c] Construction works at location other than site include decoration, repair and maintenance, and construction work at minor work locations such as site investigation, demolition, structural alteration and addition work, and special trades such as carpentry, electrical and mechanical fitting, plumbing and gas work.

Figure 4 Quarterly GVCW at constant (2000) market prices in Hong Kong (1983–2006) (Census and Statistics Department, various years)

economic turmoil in 1997 and the SARS outbreak in 2003. On the other hand, the volume of civil engineering works also decreased by more than two-thirds (69.5%) between 1997 and 2006, as a result of the completion of the new towns, the new airport and its road and rail links and associated infrastructure projects. Structural change appeared to have occurred in the civil engineering sector.

However, the maintenance and repair sector has been on an upward trend since the 1980s. The sector has climbed dramatically since 2004 reaching $48.3 billion in nominal terms in 2006, when it contributed 53.6% to the total construction market, i.e. up by 72.3% in real terms over the period since 1995. This reflects the increasing number of ageing buildings and changing demand in the construction industry. The share of new works and maintenance works changed from 77.9% to 47.9% of the gross value of construction output and from 22.1% to 52.1% respectively between 1997 and 2006. The change in demand mix not only lends support to the proposition made by Bon (1992) and Turin (1973), but also follows most of the post-industrial economies (Carassus, 2004).

ADF tests were initially conducted to determine the integrated order of the GVCW and GDP series. Table 1 reports the results of the unit root tests. These statistics indicate that the unit root can be rejected for the first difference but not the levels for the two data series at the 5% significance level. Hence, the output figures are integrated of order one, i.e. $I(1)$ series. This study therefore uses the first differenced terms of the time series for the Granger causality tests.

The results of the Granger causality tests, as shown in Table 2, indicate that construction activity does not Granger cause the GDP as its null hypothesis could be rejected. This implies that the growth of the construction sector leads to general economic growth but not vice versa, at least in the medium term (8 and 12 quarterly lags). The result also indicates that the past values of GVCW help predict the GDP in Hong Kong.

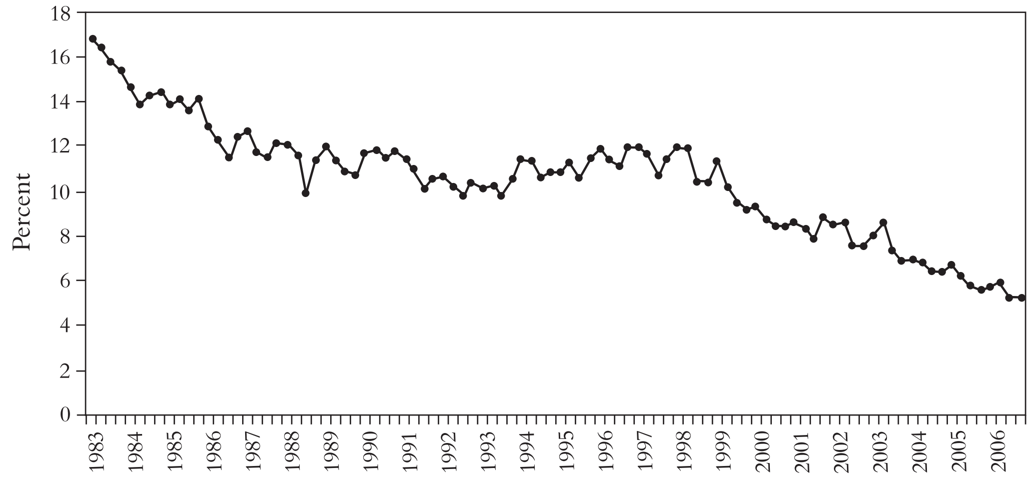


Figure 5 Contribution of GVCW to GDP in Hong Kong (Census and Statistics Department, various years)

Table 1 Augmented Dickey–Fuller (ADF) unit root tests

Variable	Test statistics	Critical values	Variable	Test statistics	Critical values
Log GVCW	0.2370 [8]	−1.9439	Δ log GVCW	−4.4448 [3]*	−1.9437
lOg GDP	−1.7874 [C,7]	−2.8943	Δ log GDP	−5.1045 [1]*	−2.8943

Notes: GVCW=gross value of construction works; GDP=gross domestic product. Δ is the first difference operator. The content of the brackets [·] denotes constant, trend and the order of augmentation of the ADF test equation, respectively. *=Rejection of the null at the 5% significance level.

The direction of the causality tests contradicts the findings of Yiu *et al.* (2004) and Tse and Ganesan (1997), primarily owing to the longer time series dataset covering more 'AIC period' with the longer time lags to observe the causation between the two variables. Causality tests were further conducted at the sub-sectors level (broadly categorized into building, civil engineering, and maintenance and repair). It was found that only the civil engineering sector Granger causes GDP (see Tables A1 to A3 in the Appendix). Analogous to the Japanese construction sector, the Hong Kong construction sector also has a strong 'pull effect', which is the reason why the SAR Government has launched large-scale public construction projects to stimulate the economy during the past few decades.

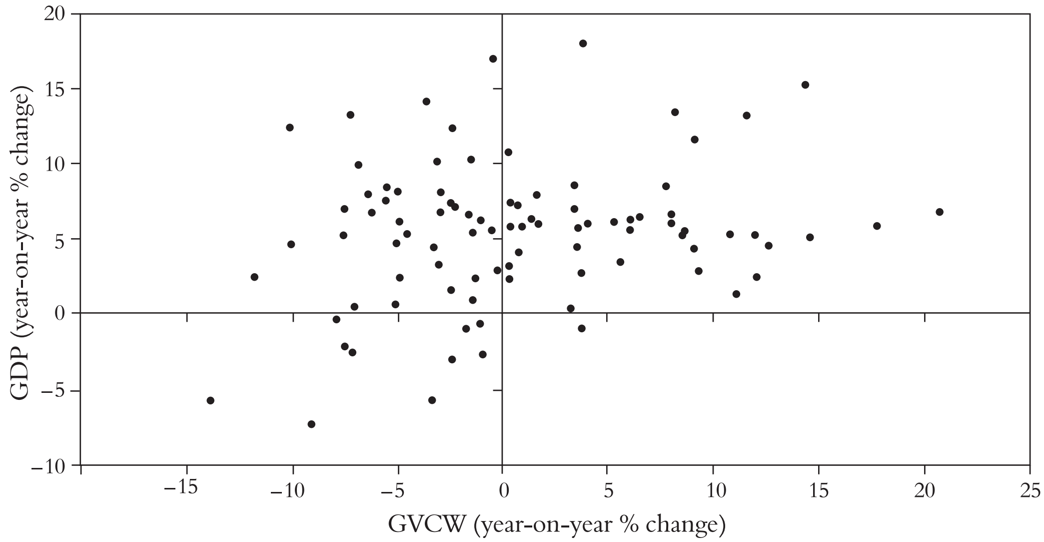
Table 2 Results of the Granger causality tests

	F-statistics		
Null hypothesis	At 4 lags	At 8 lags	At 12 lags
Δ log GVCW does not Granger cause Δ log GDP	3.2026*	2.3668*	2.2884*
Δ log GDP does not Granger cause Δ log GVCW	2.7247*	1.7969	1.2263

Note: * Significant at the 5% level.

The result echoes the proposition of the World Bank (1984) and Ofori (1990) that construction serves as an engine or a stimulus of growth throughout the economy. Hillebrandt (2000) also argued that investment in construction is important in fixed capital formation and thereby the economy. An increase in construction activity may cause an upsurge in income, employment and consequently the demand for other products. 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).

Figure 6 shows the relationship between GDP growth and construction output growth. The result of the linear regression analysis indicates that a 1% increase of construction output growth may bring 0.15% growth in GDP; however, the relationship is fairly weak. Although the linear relationship between the two indicators echoes the finding of Crosthwaite (2000), the construction growth explains a mere 4.9% of the variation in GDP growth. This implies that the growth of construction spending may not significantly drive the growth of construction output. However, the result shows that how construction growth relates to GDP growth primarily depends on the economic development stage. For instance, given the same



Summary of the regression of GDP growth rate (Y) and construction output growth rate (X):

Y = 5.282 + 0.150 X

T-ratios (10.963) (2.144)

$R^2 = 0.049$

N = 92 (1984Q1 – 2006Q4)

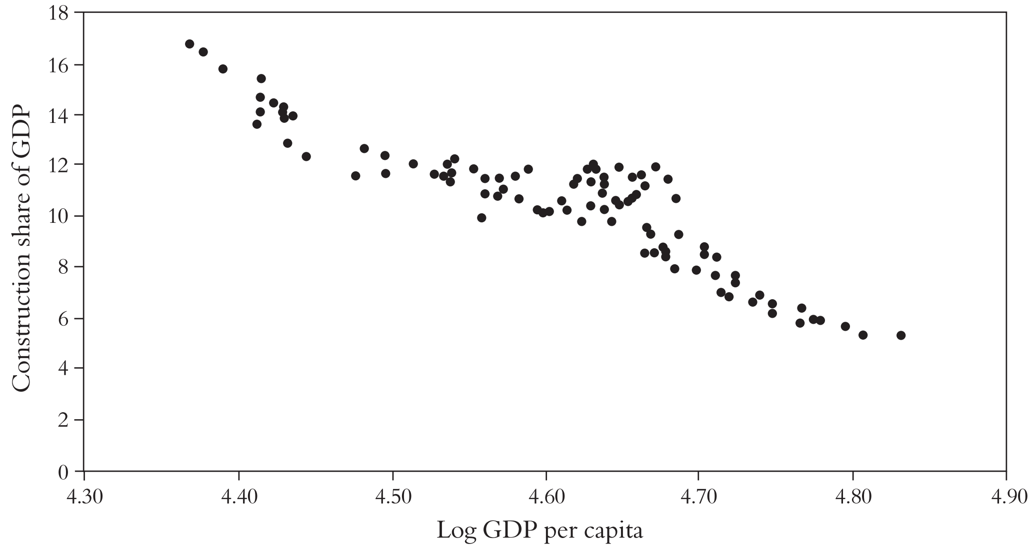
Figure 6 Relationship between GDP growth rate and GVCW growth rate

GDP growth, the construction growth at a time when Hong Kong is maturing as an AIC would be less than when Hong Kong was still a NIC. The result echoes the Bon curve and the notion advocated by Wells (1986) and Tan (2002) that contribution of construction to GDP diminishes as the economy matures.

Figure 7 shows the scatters of construction spending as a share of GDP and GDP per capita. A reasonably strong association is found between the two indicators, as revealed by the high *t*-ratios of the estimated coefficient and the coefficient of determination (R^2), between these two variables. The identified relationship (construction share of GDP=109.8 – 21.5 log GDP per capita) implies that the higher the GDP per capita in the general economic development, the lower the share of construction in GDP. The trend identified also corresponds with the 'later half' of Bon's inverted U-shaped curve, as the local construction share has been declining and reached a relatively low share in recent times, reflecting the transition of the Hong Kong economy from NIC to AIC across the study period (1983–2006).

The construction share in the GDP is maintained at about 5%, a level that has stabilized and been sustained in the highly developed countries (Carassus, 2004). Instead of diminishing further, construction share would remain at this relatively insignificant but stable level when an economy is highly developed. Even if Hong Kong has developed into an AIC, there is a continuing demand for construction works. Even a service-oriented economy such as Hong Kong still needs commercial development and logistics infrastructure to provide the services. In addition, population growth together with the higher national income would drive for investment and better standards of living and thereby the level of construction activity (Tse and Ganesan, 1997; Hillebrandt, 2000).

An inverted V-shaped relationship was found between construction spending per capita and GDP per capita as shown in Figure 8. The estimated regression equation (GVCW per capita=− 41.4 +19.6 log GDP per capita − 2.1 (log GDP per capita)^2) shows a non-linear relationship where the coefficient of (log GVCW per capita)^2 was significantly negative. This supports the hypothesis that construction investment is a marginal diminishing function with the GDP in the economic development process of an advanced industrialized city. The V-shaped rather than U-shaped curve is identified because of the substantial increase of construction work generated from the Port and Airport Development Strategy (PADS) and aggressive public housing programme launched by the government



Summary of the regression of GVCW as a share of GDP (Y) and GDP per capita (X):

Y = 109.784 – 21.525 log X

T-ratios (23.993) (–21.700)

$R^2 = 0.834$

N = 96 (1983Q1–2006Q4)

Figure 7 Relationship between GVCW as a share of GDP and GDP per capita

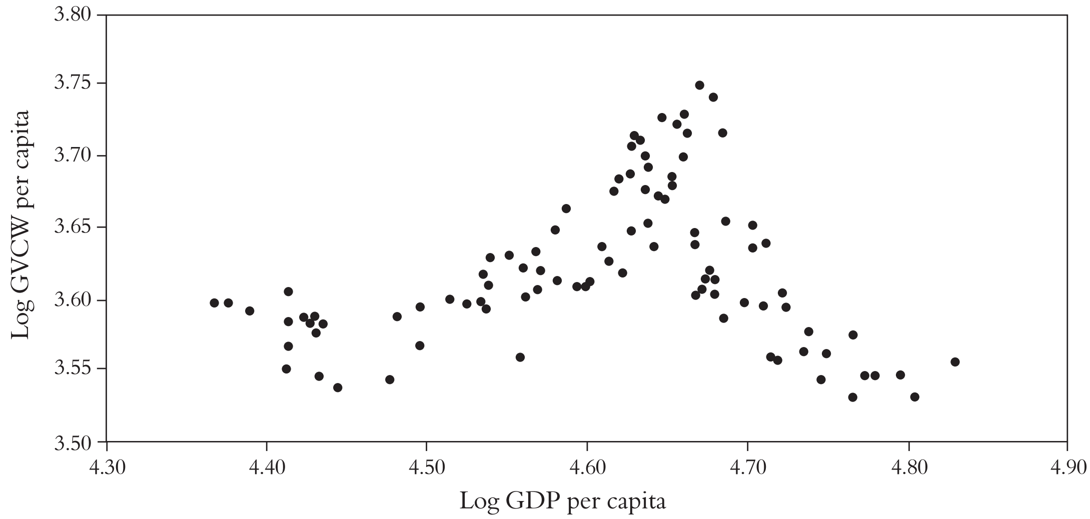
between 1994 and 1998 with construction volume above HK$120 billion. It is also interesting to note that although the GVCW followed the Bon curve as shown in Figure 2, the construction share has been decreasing as Hong Kong developed from a NIC to an AIC, because of the relatively low GDP in the early 1980s but steady growth in economic development.

The GVCW per capita is at its highest during a specific range of log GDP per capita (i.e. 4.6–4.7, primarily massed between 1992 and 2000). This period was the 'recovery period' after the Gulf War and before the Asian financial turmoil in 1997. Since construction activity is very sensitive to credit conditions (Tse and Ganesan, 1997), understandably investors became optimistic, which might have resulted in over-building. In Hong Kong, subsequent to the financial turmoil and the SARS outbreak, the local market essentially needed time to absorb the excess capacity and to adjust. However, it is observed from the recent data in Figures 4 and 8 that despite the shrinking volume of new building and civil engineering construction, the trend appears not to have supported Bon's (1992) proposition that the decline of construction industry activity switches from relative to absolute decline as the economy develops and matures (i.e. 'volume follows share'). Instead, this is consistent with the findings of Carassus (2004) and Ruddock and Lopes (2006).

Conclusions

The role of construction in economic development is an important issue facing the construction research community, government and international development agencies. A development pattern for the industry was presented based on various stages of development of an economy at a metropolitan level. Clearly from this study it transpires that there is a relationship between construction activity, economic growth and economic development. Based on the time series data in Hong Kong, the analysis shows that particularly the infrastructure sector drives the growth of general economy, and not vice versa. The trends of construction output in key sectors show that the construction expenditure in maintenance and repair is growing, indicating a noticeable transformation of the product mix in the industry across time.

The local construction share has been declining gradually as the economy becomes mature with developed infrastructure, housing and related facilities, suggesting that the role of construction changes as economic development transforms from NIC to AIC status. The trend of construction share in Hong Kong reveals that as economic development moves to its advanced mature stage, the share in GDP diminishes and therefore the importance of its role in economic development also declines. The comparison between the construction



Quadratic regression of GVCW per capita (Y) and GDP per capita (X)

$Y = -41.417 + 19.612 \log X - 2.134 (\log X)^2$

T-ratios (–5.087) (5.513) (–5.495)

$R^2 = 0.259$

N = 96 (1983Q1 – 2006Q4)

Figure 8 Relationship between GVCW per capita and GDP per capita

volume per capita and GDP per capita in Hong Kong further shows an inverted V-shaped relationship. However, the decreasing trend of the construction volume has been moderating, which may not comply with Bon's 'volume follows share' proposition.

This is evidence for the proposition that the Hong Kong construction sector is following a development path similar to that of construction sectors in other advanced industrial countries. The results are significant for policy makers in that, in the long run, it is government macroeconomic policy to stimulate the growth of the general economy via construction activity, but not vice versa. The benefits of physical investment on the construction industry are explored, especially for the NICs and maturing cities that are similar to Hong Kong. However, the limitation of time series analysis is the assumption of no structural change of the industry over time. It needs further study with panel data methodology to enable comprehensive analysis and validation using both cross-sectional as well as longitudinal analysis.

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Notes

1. GNP is same as GDP for non-tradable goods such as construction goods, according to Bon (1992).

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Appendix

Granger causality tests by broad construction sector

Table A1 Results of the Granger causality tests: building sector

	F-statistics		
Null hypothesis	At 4 lags	At 6 lags	At 8 lags
Log building works does not Granger cause log GDP	1.4272	1.6595	1.5988
Log GDP does not Granger cause log building works	1.9097	1.0889	1.5057

Note: * Significant at the 5% level.

Table A2 Results of the Granger causality tests: civil engineering sector

	F-statistics		
Null hypothesis	At 4 lags	At 6 lags	At 8 lags
Log civil engineering works does not Granger cause log GDP	0.5327	3.4345*	2.7908*
Log GDP does not Granger cause log civil engineering works	2.3880	1.8225	1.6063

Note: * Significant at the 5% level.

Table A3 Results of the Granger causality tests: repair and maintenance sector

	F-statistics		
Null hypothesis	At 4 lags	At 6 lags	At 8 lags
Log repair and maintenance works does not Granger cause log GDP	0.6508	0.5539	0.3682
Log GDP does not Granger cause log repair and maintenance works	1.6585	1.1273	0.8197

Note: * Significant at the 5% level.