The Hong Kong Polytechnic University

Department of Building and Real Estate

Construction Industry Development

and

Government Policy

By

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A thesis submitted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy

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CERTIFICATE OF ORIGINALITY

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Abstract of Thesis entitled

Construction Industry Development and Government Policy

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In August 2007

Recent researches for the economic causality relationships of infrastructure and building construction activities have produced mixed results. The general consensus is that different types of construction activity have different causality relationships with the economic growth. Some of them are economic "growth-initiating", whilst others are economic "growth-dependent". But, when it comes to identifying the "growth-initiating" construction activity and the "growth-initiating" one there is no agreement. There is no research done showing the causality relationships categorically.

This research establishes the intrinsic causality relationships of the detailed End-Use construction activities and the economic growth of Hong Kong for the period 1983 - 2002 by using Granger Causality Test method. It provides convincing proof that different types of infrastructure and building construction activities play different intrinsic economic roles. In particular, residential building and transport infrastructure construction activities of Hong Kong exhibited strong intrinsic economic growth-initiating character. This research also confirms the short-term role of transport infrastructure construction activity of Hong Kong is subject to change by the planning and implementation processes of its construction programmes. By manipulating the construction programmes, Hong Kong government has made transport infrastructure construction activity to play different social, economical and political roles at different period of time. Such manipulation of the implementation programme also led to many deleterious effects in the construction industry, nullifying its economic contribution and causing great damages to the industry and the society.

The research of this research suggests that a government has to take into consideration the different intrinsic role of each type of construction activities when formulating and implementing any development policies so that it could make the construction industry to contribute most to the society. It suggests a coherent development policy for the construction industry would strengthen the industry in handling the fluctuating workload and in managing the deleterious effects. It also suggests the Construction Industry Council can become Hong Kong's important institutional capacity and a surrogate for the government's development policy for the construction industry.

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Abbreviations and Symbols

AC	All Construction Activity
ACP	Airport Core Programme
ADF Test	Augmented Dickey-Fuller Test
AIC	Advanced Industrialised Country
A>B	"A" Granger Causing "B"
CIC	Construction Industry Council
CIRC	Construction Industry Review Committee
CITA	Construction Industry Training Authority
CM	Commercial Buildings Construction Activity
CTS-1	First Comprehensive Transport Study
CTS-2	Second Comprehensive Transport Study
d	Durbin-Watson d Statistic
DF Test	Dickey-Fuller Test
DPA	Direct Productive Activities
E(k)	Mean Number of Runs
EN	Environment Construction Activity
GDFCF	Gross Domestic Fixed Capital Formation

GDP	Gross Domestic Product
GV	Number of Goods Vehicles
HKSAR	Hong Kong Special Administrative Region
HSIC	Hong Kong Standard Industrial Classification
IS	Industrial & Storage Buildings Construction Activity
ISIC	International Standard Industrial Classification
KCRC	Kowloon Canton Railways Corporation
L	Total Labour Engaged in Transport & Communication Sector
LDC	Less Developed Country
Ln	Natural Logarithm
MIS	Modified Initial System
MTRC	Mass Transit Railway Corporation
NIC	Newly Industrialised Country
NIE	New Institutional Economics
PADS	Port and Airport Development Strategy
PCICB	Provisional Construction Industry Co-ordination Board
PR	Total length of Public Road
Q	Quarter (3 months)

RBD	Residential Buildings Construction Activity
RSS_R	Restricted Sum of Squares
RSS_{UR}	Un-restricted Sum of Squares
R^2	Multiple Coefficient of Determination
SB	Service Buildings Construction Activity
SCMP	South China Morning Post
SOC	Social Overhead Capital
SP	Sports & Recreation Construction Activity
te	Annual Private Sector Investment on Transport Equipment
T	Export Trading Output
TE	Servicing Transport Equipment Stock
TP	Transport Infrastructure Construction Activity
UP	Utilities b & Plants Construction Activity
σ^2	Variance

Chapter 1 Introduction

1.1 Construction Activities in Hong Kong

It is accepted universally that a society needs to invest in its infrastructures and facilities so as to sustain economic growth. These investments are usually reported as the Gross Domestic Fixed Capital Formation (GDFCF) in the society's National Account, which is a significant portion of the Gross Domestic Product (GDP) of most countries.

The GDFCF investment of Hong Kong has also been significant. In the period from 1973 to 1997, it has never fallen below 25% of the expenditure-based GDP[1] of Hong Kong. Whilst at its peak in 1997 when construction of the ambitious Airport Core Programme (ACP) projects was in full swing its share in the GDP has even surged to 36.75%. A major portion of the GDFCF investment in Hong Kong is infrastructure and building construction. The value of this type of investment in Hong Kong during the same period has never been less than 40% of the GDFCF. The fact that Hong Kong has attached great significance to investment in infrastructure and building construction shows that the government

[1] Annex 1

must have considered the construction activities important for its social and economic development.

Hong Kong's economic growth has been uninterrupted from 1973 to 1997. In those 25 years, its annual GDP has grown 4.7 times[2] and the per capita GDP 3 times[3]. Comparatively, the growth trend of investment in infrastructure and building construction has not been as steady during the same period of time. There were periods of time, such as the mid-1980s, when the investment had even declined. Nevertheless, an overall increasing trend in the annual construction volume has been maintained. As a result, the corresponding annual construction volume and per capita construction value in 1997 were 5[4] and 3.24[5] times greater than those in 1973 respectively. Despite the fact that the magnitudes of growth of the annual GDP and the overall investment in infrastructure and building construction seem to be comparable over the period 1973 to 1997, visual inspection of the two sets of economic data cannot confirm the existence of a correlative relationship between the increases in construction activities and economic growth.

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[2] The GDP in 1973 and 1997 were $174.8 billion and $829.0 billion respectively (both figures are in 1990 constant values, see Annex 1)

[3] The per capita GDP in 1973 and 1997 were $41,200 and $126,290 respectively (both figures are in 1990 constant values, see Annex 2)

[4] The annual Broad Category Construction Volume in 1973 and 1997 were $17.9 billion and $90.1 billion respectively (both figures are in 1990 values, see Annex 3)

[5] The annual per capita Broad Category Construction Volumes in 1973 and 1997 were $4,230 and $13,720 respectively (both figures are in 1990 value, see Annex 2)

Different types of infrastructure and facilities were constructed to meet different needs of society, which may be social or economic at different periods of time. It follows that some of the infrastructure and facilities might not be constructed for the sake of initiating economic growth and were expected to assume different roles. For example, the construction of a hospital would have been to meeting the medical and health care needs of a society, whilst the construction of a highway connecting the industrial districts would have been expected to benefit the economy. Even the same type of infrastructure construction, for example highways, may have different roles at different times. The construction of Lung Cheung Road and Ching Cheung Road in the early 1970s directly linking the industrial areas in Kwun Tong and the newly developed Kwai Chung container ports had the objective of facilitating the export trade. Whilst the construction of Tuen Mun Road, also in the 1970s, had been clearly for the purpose of meeting the transportation needs of the residents in the northern New Territories. It is also possible that some infrastructure and facilities were constructed to meet other social, or even political, needs of the society.

The role of each type of construction activity in the social and economic development of a society, therefore, is expected to be different and the government's policy behind the planning and implementation of the construction programmes may have also manipulated the roles. But, it is generally believed that each type of the construction activities, if left alone un-manipulated, has an intrinsic role, the understanding of which is important to the government in making investment and development policy of the infrastructure and facilities.

The knowledge of the overall effect of all construction activities on the economy is not enough because the intrinsic role of individual construction activity with respect to the economy would be masked by the dominant construction activity. Therefore, research on the roles that construction activities play in the economy should begin by studying the intrinsic role of each type of construction activity. Such intrinsic roles have to be proven by using rigorous analytical methods. A detailed study of the planning and implementation processes for each type of construction activity has also to be carried out so that its social and economic effects can be confirmed.

1.2 Hong Kong's Transport Infrastructure Construction

Wells (1985) suggested that transport infrastructure construction has an economic "growth-initiating" role. Wigren and Wilhelmsson (2007) found that even though public infrastructure policies of Western Europe countries had an effect on short term economic growth their long term effects were much weaker. Despite that, they suggested individual public infrastructure projects might have a positive impact on the long term economic development.

An improved transport infrastructure would be necessary to support Hong Kong’s important trading activities, which have been confirmed by Gapinski and Western (1999) to be the leading cause of economic growth. Stewart (1996) observed that transport infrastructure had been one of the elements of government actions of Hong Kong, directed towards the development of a manufacturing sector. It was also suggested by Knox Lovell and Tang (1999) that Hong Kong’s investment in transport infrastructure had enhanced its economic growth prospects.

All Hong Kong’s major transport infrastructure development projects are planned and initiated by the government. Private sector’s initiative in the area is insignificant. In the earlier years, all the planned transport infrastructure projects were constructed under the supervision of the government. In recent years, some of the major programmes are entrusted to quasi-government organisations, such as the MTRC, or franchisees who construct the projects on a build-operate-transfer contract arrangement.

The value of the transport infrastructure construction activities in Hong Kong is a substantial portion of the total construction activities. From 1983 to 2000, the annual construction value of transport infrastructure is at least greater than 10 – 15% of the total construction value[6].

Indeed, a study of the history of Hong Kong's transport infrastructure planning and construction confirms that continuous expansion of transport infrastructure has been a consistent government policy. This is show in the abridged history of Hong Kong's transport infrastructure planning and construction programme implementation processes in the 1970s to the 1990, which is attached to this thesis as Appendix 1[7]. It shows that it was around the 1970s when Hong Kong began constructing its transport infrastructure in a major manner. Programmes of major transport infrastructure construction were consistently emphasized in the policy addresses of the Hong Kong government simultaneously with other crucial policy priorities, such as education, housing and social welfare. It shows that although Hong Kong proclaims the practice of laissez-faire it is never shy of providing transport infrastructure facilities as public goods to serve the society and to enable its economic efficiency.

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[6] Annex 7

[7] Appendix 1

However, huge expenditure variations of transport infrastructure construction values did exist. Despite the fact that Hong Kong began to plan the transport infrastructure construction programme systematically and rationally from the late 1970s when it carried out the first Comprehensive Transport Traffic Study (CTS-1) the implementation process of the construction programmes was not immutable. The government had made use of its predominance, being the sole initiator and financier of these projects, to exercise budgetary control of the projects for the purpose of achieving other economic, social and political objectives. Such objectives included the mitigation of traffic congestion, demographic redistribution, facilitating trade movements, invigorating the economy and stabilising the confidence of society. Obviously, some of these objectives were not necessarily directed towards initiating the economic growth of Hong Kong at all.

The construction programme implementation processes can basically be separated into three phases. Before the 1980s, new transport infrastructure was constructed to ease the traffic congestion problems in the urban areas and to serve trading activities growth. The Lung Cheung Road, the Ching Cheung Road, the first cross harbour tunnel, the Tuen Mun Road and the Modified Initial System (MIS) of the Mass Transit Railways (MTR) were built in this period. In the 1980s, rationally planned transport infrastructure construction programmes were faithfully implemented and the planned projects were completed conforming to the forecast social and economic needs of the society. It was in this period that a substantial part of Hong Kong's modern transport infrastructure system, including the New Territories Circular Road and the Island Line of the MTR, was constructed. Finally, in the 1990s, political and social stabilisation took precedence over other considerations, and transport infrastructure projects were completed well ahead of the social and economic needs. During this period the monumental Airport Core Programme projects were completed.

Such a variation in implementing the transport infrastructure construction projects resulted in a hugely fluctuating transport infrastructure construction trend as shown in Annex 6[8]. Even if it was a result of the necessity to meet the imminent social and economic priorities, it might have affected the economic growth of Hong Kong. However, the growth pattern of the GDP[9] and the important export trading activities[10] did not seem to have been disrupted and their growth trends were comparatively stable throughout the period.

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[8] Annex 6

[9] Annex 1

[10] Annex 5

Given its perceived economic role and the government's dominance in its planning and construction processes the transport infrastructure construction activity is a good subject of research for its relationship with the economy. The fact that it is the biggest public works construction activity, representing more than 10 to 15% of the total annual construction value, and a convenient target of manipulation by the government for the fulfilling the imminent social and political objectives it is chosen for detail study in this research.

1.3 The Need for an Improved Construction Industry

The history of Hong Kong's transport infrastructure planning and construction shows that many public works construction projects were implemented for achieving the priority social and political objectives at the time with lesser regard to the current state and longer term development of the construction industry. The government of Hong Kong had not implemented many of the actions recommended by researchers, such as those by the precursory Turin (1974), to help the development of its construction industry, let alone an explicit industrial policy. The severe competitive environment of the industry and the lack of a coherent industry development policy had led to the recurrence of many deleterious effects in major construction programmes. The deleterious effects included a poor safety record, poor workmanship performance, shortage of skilled labour, and significant wage hikes. It is possible that the frequent recurrences of the deleterious effects have diminished the industry's contribution to the economy.

After several major construction scandals when the installed foundation piles of some public housing projects were found to be substantially shorter than the designed lengths the government finally commissioned the Construction Industry Review Committee (CIRC) to conduct a comprehensive review of the state of the construction industry[11]. The Committee published a report, entitled "Construct for Excellence", in 2001 and recommended many measures of improvement for the industry. Amongst these measures, the report recommended the setting up of a statutory industry co-ordinating body to lead the reform of the construction industry. Subsequently, the government of Hong Kong set up the Provisional Construction Industry Co-ordination Board (PCICB) to prepare for the formation of the statutory Construction Industry Council (CIC). Eventually the CIC was formally established on 1 February 2007.

The ability of CIC to improve the performance of the construction industry, thereby increasing its contribution to the society of Hong Kong, will depend on its

[11] 6 April 2000 SCMP

understanding of the roles of the construction industry and its activities in the society. The reform actions will have to address a wide spectrum of interrelated issues between the industry and the society. These relationships must be understood before effective reform programmes could be drawn up to improve the performance of the industry.

1.4 Objectives of the Research

It is believed that the knowledge of the intrinsic economic role of each type of the construction activities and the consequences of the planning and implementation processes to their roles will help the government to formulate appropriate capital investment policy so that the contributions of the construction projects can be enhanced. It will also help the government to recognise the need to implement a development policy for the construction industry so as to reduce the deleterious effects of the construction activities that would waste away their contributions to Hong Kong.

The first objective of this research is to verify the proposition that different types of infrastructure and building construction activities have different intrinsic economic roles. If this proposition is confirmed, it will justify the government to adopt different development policies for different types of capital investments. The second objective is to verify the proposition that the intrinsic economic roles of the construction activities can be changed by their planning and implementation processes. This proposition will be confirmed, or otherwise, by examining the effects of Hong Kong's transport infrastructure planning and construction programme implementation processes on the intrinsic economic role at different periods of time. If this proposition is confirmed, it will support the argument that the government should pay special attention to the planning and implementation processes of the infrastructure construction programmes so as to reap the most benefit from the construction activities.

The intrinsic economic role of transport infrastructure construction activity is chosen as a subject of detailed research because it is the largest type of capital works construction activity wholly controlled by Hong Kong government. If the government chose to do so, it could manipulate the planning and construction processes of the transport infrastructure development programmes to fully exploit the different roles of the construction activity so as to achieve other grander objectives.

Specifically, this research investigates the following questions:

1. What are the intrinsic causality relationships between different types of infrastructure and building construction activities and the economic growth of Hong Kong?

2. Whether transport infrastructure construction activity in Hong Kong has an intrinsic economic “growth-initiating” role?

3. Whether the planning and construction programme implementation processes have changed the economic role of transport infrastructure construction activity of Hong Kong?

4. What deleterious effects have been brought about by the planning and implementation processes of the transport infrastructure construction programmes?

Finally, the relevance of industry development policies recommended by previous researchers, such as those of Turin (1974), OEDC (1975), Drewer (1980), Etzkowitz and Brisolla (1996), Tan (2002), Bosch & Philips (2003), Anaman & Osei-Amponsah (2007) and others will be reviewed and the possible actions that the government of Hong Kong can take to develop the construction industry will be discussed.

1.5 Importance of the Research

Many researchers, as exemplified by Drewer (1980), believed that a government should implement a coherent policy to develop an indigenous construction industry and to remove the constraints within it so that it can contribute positively to economic growth. He pointed out that the contribution of construction activities to the economy depends on whether they are "growth-initiating" or "growth-induced". If this is the case, the government should not implement the same policy for different types of infrastructure and building construction activities because the eventual social and economic results might be different from its expectations. Therefore, different planning and construction programme implementation policies should be adopted for different types of construction activity so that social and economic roles would not be mitigated. A planning and construction programme implementation policy with no regard to the deleterious effects that would be triggered off by the construction activities would result in a waste of social resources, constraining the development of the construction industry and reducing its contribution to the society.

The research studies the planning and construction programme implementation processes of transport infrastructure construction activity in detail because of its expected predominant role in the economic development of Hong Kong. The other types of construction activity may assume other equally important roles, not necessarily economic related. Therefore, detailed research into the planning and construction programme implementation processes of other types of construction activity would be necessary to form a complete picture of the influences and contributions of the construction industry to the social and economic development of a society. By using transport Infrastructure construction activity, this research sets an example for these researches to be carried out.

A good understanding of the roles of all types of construction activity and the influences exerted by the corresponding planning and construction programme implementation processes is a significant advantage to the policy makers. It enables them to equitably allocate the limited social resources to the types of construction activity that can benefit the society most. This knowledge will also help them make the best use of the construction projects to achieve the intended objectives.

Secondly, the fluctuating construction workload could lower the efficiency of the construction industry, curbing its contribution to the society. This research could confirm whether such restraining effects have affected the construction industry of Hong Kong or not. If deleterious effects in Hong Kong's construction industry had been caused by the planning and construction programme implementation processes, the evidence would support the arguement that the government should make better policy that would benefit the development of the construction industry or, at the very least, avoid making incongruous policies that would lead to deleterious effects in the construction industry hence impeding its contribution to the society and its economy.

1.6 Summary

Hong Kong's investment in constructing its infrastructure and facilities has been significant. Over the period from 1973 to 1997, the magnitudes of the annual GDP growth of Hong Kong and the overall infrastructure and building construction output seem to be related, yet the causality relationships between the growths of construction activity and the economy in Hong Kong has remained to be proven by rigorous analyses.

It is believed that the causality relationships linking the construction activities and economic growth are not straightforward. Presumably, each type of construction activity is carried out to meet a particular need of the society, which may be social or economic at different periods of time. The roles of each type of the construction activities towards social and economic development are, therefore, expected to vary. Also, because the aggregate effect of all construction activities on the economy could be influenced by the dominant construction activity at the time or by the planning and implementation processes of the construction programmes for the purpose of achieving other imminent objectives, it is impossible to discern which type of construction activity was initiating economic growth, or vice versa. Therefore, research on the respective roles of construction activities in the economy should begin by studying the intrinsic role of each type of construction activity, and supplemented by a detailed study of the planning and implementation processes for their construction programmes to identify the economic roles they had played during the period of time.

Many researchers, such as Wells (1985), suggested that transport infrastructure construction activity has an economic “growth-initiating” role. Logically, the transport infrastructure construction activities in Hong Kong should be intrinsically economic “growth-initiating” because an improved transport infrastructure would have been necessary to support Hong Kong’s rapid growth of export trading activities in line with China's expanding manufacturing output, which has made Hong Kong an important entrepôt and transhipment centre. Although a study of the history of Hong Kong's transport infrastructure planning and implementation processes shows that continuous construction of transport infrastructure facilities has been a consistent policy since the 1970s the government had also made use of its ability, being the sole initiator and financier of this type of construction projects, to control the timing of implementing the construction programmes for the purpose of achieving other imminent social and political needs. Some of these needs were not directly related to the economic success of Hong Kong.

Given its perceived economic role and the fact that it is the biggest public works construction activity subjected to manipulation by the government of Hong Kong, transport infrastructure construction activity is a prime target for research on the implications of government policies for the construction industry.

All Hong Kong's major transport infrastructure development projects are planned and initiated by the government. They are the government's major government expenditure and their annual value is never lower than 10 to 15% of the total annual construction value in the years 1983 to 2000. However, the history of Hong Kong's transport infrastructure planning and construction programme implementation processes shows that construction projects have been implemented with little regard to the current state and longer-term development of the construction industry. The severe competitive environment of the industry and the lack of a coherent industry development policy had led to the recurrence of many deleterious effects in the construction industry. It is possible that frequent recurrences of these deleterious effects have diminished the industry's contribution to the economy.

The first objective of this research is to verify the proposition that different types of infrastructure and building construction activity have different intrinsic economic roles. If this proposition was confirmed, it would justify the government to adopt different project planning and implementation policies for different types of construction activity. The second objective is to verify the proposition that the economic roles of the construction activities can be changed by the planning and construction programme implementation processes. Transport infrastructure construction activity is chosen as a subject of detailed research because of the potential that Hong Kong government can reap by manipulating its planning and construction programme implementation processes so as to achieve other grander objectives. If this proposition is confirmed, it will support the argument that the government should pay special attention to the construction industry when planning and implementing the construction programmes.

Finally, the industry development policy recommended by previous researchers, will be briefly reviewed for the possible actions that the government of Hong Kong can take to reduce the deleterious effects of the construction activities and increase their contributions to the society.

Research into the roles of the other types of construction activity is equally important. This research will serve as an example for these researches to be done. Detailed research of the planning and construction programme implementation processes of all types of construction activity would be necessary to form a complete picture of the influences and contributions of all sectors of the construction industry to the social and economic development of a society.

A good understanding of the roles of all types of construction activity and the influences due to the corresponding planning and construction programme implementation processes would be a significant advantage to the policy makers. This knowledge will help them to make the best use of the construction programme to achieve the intended objectives. This knowledge will also help them to make better policy that would benefit the development of the construction industry or, at the very least, avoid making incongruous policies that would lead to deleterious effects in the construction industry and impede its contribution to the society and its economy.

The next chapter reviews the studies that have been done by other researchers to elucidate the roles of construction activities in an economy.

Chapter 2 Literature Review

In the last three decades, researchers have been trying to discover the relationships between construction activity and the total economy at different stages of development. This Chapter reviews the research work that has been done on the role of construction activities in the economic development process. It discusses the reasoning and limitations of the various studies. The review of researches by others has allowed a methodology to be chosen for the research described in this thesis.

2.1 Cycle Theory

In the early days there has been very little research devoted to the role of construction in the performance of the economy. But passing references are abundant. Researchers of general economics invariably entered into the domain of construction industry because expenditures on capital works have usually been significant in most major societies. Schumpeter (1954) concluded in his chapter on Non-Monetary Cycle Analysis that by 1914 most business cycle researchers had agreed that the activities of capital goods industries were the outstanding feature in cyclical fluctuation.

Cycle theory was a popular subject in the late 19th to early 20th centuries. Many researchers around that time were interested in the reasons causing movement of the economy. In searching for a general economic theory they also found that construction activities also moved up and down with the economy. The so-called "Long Swings" of building cycles were identified by Simon Kuznet in 1930.

Most of the researchers agreed that the fluctuation of capital goods industries have some relationships to the business cycles. One of the earliest researchers who made explicit conclusions about the relationships between building and the general business activities is Riggleman (1933). His research method was rudimentary. He studied the per capita building permit value of the United States for a long period of time spanning from 1875 to 1932. By superimposing the charts of general business activities and the per capita building permit value of the United States he concluded by observing that building activity movements had frequently preceded the general business cycles and the reverse relationship had happened much less frequently. He concluded that there were three major building cycles in the United States during this period of time, each lasting for about 20 years, which were several times longer than the general business cycles. Although he suggested that there is no marked correlation between the major building cycles and the general business cycles, he said the minor building movements within the major cycles had to do with the fluctuations of the general business activities. He concluded that building activity movements, which are the minor building cycles, preceded the general business cycles in the United States in most cases and the reverse relationship also happened but at a much lower frequency.

Many later researchers agreed with Riggleman's conclusion. However, Schumpeter (1954), although having made the above conclusion that the activities of capital goods industries were the outstanding feature in cyclical fluctuation, emphasised that the results did not mean the existing of a causal relationship between the building activities and the general economy. He argued that the cause for fluctuation of the economy and construction activities might be exogenous.

The relationship and the direction of causality between the general economy and construction has since been a keen subject of research.

2.2 Modernisation Paradigm for Construction and Development

One of the earlier researchers for the role of construction activities in economic development was the famous Professor Turin. The great son of construction, as acclaimed by Bon (1992), used a simple correlation method to show the relationships between construction activities and economic growth. Later researchers praised him for his insights based on the results of the analyses and the simplicity of his adopted method.

Turin (1974) analysed the data in the 1960s and 1970s, primarily from the United Nations (UN) Yearbook of National Account Statistics and the International Labour Office (ILO) Yearbook of Labour Statistics, for 87 countries and showed that construction activities had been growing in tandem with economic development. His analyses showed that:

a. The share of construction in the Gross National Product had grown with economic development;

b. Similarly, the value added in construction per capita had also grown with economic development;

c. The ratio of net output in construction to net output in manufacturing had decreased with economic development;

d. The share of infrastructure in total construction output had decreases with economic development;

e. The value added per person employed in construction and employment in construction per 1,000 population had grown with economic development, but with different rates of change;

f. The gap between construction and manufacturing, in terms of net output per person employed and hourly earnings, tends to close with economic development.

He also observed that the value added in construction as a share of Gross Domestic Product (GDP) also tended to be higher for a country with a higher GDP per capita and the rate of change was highest for countries in the middle GDP per capita range of the countries analysed. He surmised that if the observed relationship were valid not only between countries at a fixed point in time but also within a country over time, it would imply that the share of construction of a country in the national product should grow with its economic development and the highest growth rate should happen when it is in the middle GDP per capita range.

Turin's major suggestions were hinged on the existence of a relationship between the growth of construction activities and the economy. Based on the proposed relationship, he argued that construction is a principal agent of economic development, which would lead to an implicit growth of a country from less developed country (LDC) to newly industrialised country (NIC) and finally to advanced industrialised country (AIC). He concluded that construction should grow faster than the economy; otherwise the construction capacity could become a constraint on economic growth. He also recommended that the government should take some possible lines of action for the development of the construction industry in an economy.

Kafandaris (1980) applauded Turin's research as a vital element in the search for the role of construction industry in the context of development. In his opinion, although Turin had proposed neither a definite theory on the construction activity nor on the construction-development interface it was difficult to see any other research approach for the establishment of a relationship between construction activity and economic growth, other than the one adopted by Turin.

Later researchers have called the implicit growth relationship between construction activities and the economy advocated by Turin (1974) the Modernisation Paradigm.

2.3 Researches Subsequent to Turin

As a matter of fact, many researchers shared the same view as Kafandaris (1980) and they continued the research along Turin's direction, albeit some used the construction spending instead of the construction value added figures in the analyses. Most of them confirmed that construction activities had a positive relationship with economic growth and construction should grow faster than the economy. But, there were also disparate propositions.

In a study prepared for the ILO, Edmonds and Miles (1984) analysed the worldwide statistics for 1974 (97 countries) and 1979 (116 countries). They found that there was a positive relationship between GNP per capita and the value added in construction as a percentage of GDP. However, the regression analysis showed that the increase in GNP per capita only explained 20 per cent of the variation. Also, if only the countries with a GNP per capita of more than $2,000 were analysed the relationship was much weaker. They also found that above a certain level of GNP per capita the value added in construction as a percentage of GDP tended to tail off to between 7 and 8 per cent of GNP. Therefore, they concluded that rather than the value added in construction increasing as the GNP per capita increased, as was advocated by Turin, it was that the percentage value added in construction was generally higher in the countries with a high GDP per capita than in countries with a low GNP per capita and the increase is not linear. In other words, they saw a much more complicated relationship between construction and economic growth.

Edmonds and Miles (1984) also found that the value added in construction per capita had an extremely strong and linear relationship with GNP per capita, with GNP per capita explaining 90 per cent of the variation in the value added in construction per capita in the regression analyses. This result seems to support Turin's (1974) second observation. However, they suggested the result showed that construction activities were mainly needed to serve the population, rather than being initiated by the growth of the economy. They argued that it is dangerous to invest heavily in the industry based on the assumption that the construction activities would inspire economic growth. They also said a rapid growth in construction output was associated with hosts of deleterious effects, such as a disproportionate increase in the importation of construction materials, diverting scarce domestic savings from other productive sectors and imposing additional inflationary pressures on the economy. Their research was one of the many that ask the question of whether construction activities had initiated economic growth or vice versa.

Low and Leong (1992) replicated Turin's analyses using updated data for the period 1970 to 1984. Their objective was to find out any shift in the relationships between the economy and the construction activities over the time period. They found that the value added in construction as a percentage of GDP in the higher GDP per capita countries generally were higher than those in the lower GDP per capita countries. Their result seems to support Turin's first observation. However, the correlation between the two variables was weak, with the Coefficient of Determination (r^2) equal to 0.028 only. As for Turin's second observation, they found that the per capita value added in construction had also grown with the per capita GDP, with a high r^2 value of 0.786. They concluded that Turin's (1974) findings were still largely valid after twenty years, but the shift had still to be researched.

Bon (1992, 1998) suggested that construction is intimately related to industrialisation and urbanisation. He said as urban population first grows at an increasing rate and then at a decreasing rate, so is the demand for new construction. His suggestion is akin to that of Edmonds and Miles (1984). He argued that the changing in demand for new construction as the economy develops from LDC to NIC and finally AIC status would result in an inverted U-shaped profile of construction activity. And, the profile should be universal because the economic development process is generally unidirectional, with each country going through each of the three economic development stages sequentially. He suggested the inverted U-shaped profile occurs because construction "follows the economic destiny of manufacturing", declining together with it as the AIC status is reached. The inverted U-shaped profile, with the construction activity declining at the AIC stage of economic development, is different from that observed by Turin (1974). The distinction might be caused by the different sets of data used by the two researchers. Whilst Turin's observation was derived from the value added figures of construction activities Bon's research was more concerned with construction volume. But, the main reason might also be due to the stages of development that were represented by Turin's (1974) data. Bon (1992) suggested Turin's data sample was dominated by the LDC and NIC countries, therefore the decreasing trend at the AIC stage could not be observed.

The research approach adopted by Lopes (1998) for the Sub-Saharan Africa countries during the 1980s to the early 1990s was different from other previous researchers. He hypothesised that:

> "There is a minimum level of investment by the construction

> sector in developing countries, measured in terms of construction value added as a share of gross domestic product, required to achieve, in the long term, sustainable growth in the economy."

The data that he analysed were primarily from the Yearbook of National Account Statistics (United Nations, 1988, 1994) and the African Development Indicators (World Bank, 1992, 1994-1995). He found that the share of construction value added in the national output would grow faster than GDP in the first stages of a country's recovery from economic stagnation or decline. After the country had entered a period of sustained economic growth and development, the construction volume would grow at the same rate as the growth of GDP. The results show that the growth rate of construction activities may depend on the economic situation and it may accelerate or slacken.

Crosthwaite (2000) investigated the construction spending, instead of the value added, of 150 countries during 1996 – 1998 surveyed by the Engineering News Record (ENR, 1998). The results of his analyses showed construction spending as a share of the GDP first grew during the LDC status, peaked during the NIC status, and finally declined as the countries moved from NIC to AIC status. That is to say, the relationship between the construction's share of GDP and the per capita GDP exhibited an inverted U-shaped profile, as was advocated by Bon (1992, 1998). Also, the relationship between construction spending growth and GDP growth is linear and positive. Generally, they were the LDCs and NICs that had exhibited the highest rates of both GDP growth and construction spending growth. Finally, there was a strong association between GDP per capita and construction spending per capita. The linear regression analysis for these two variables showed a strong and positive relation between them. A small change in GDP per capita had resulted in a large change in construction spending per capita.

Based on these analyses, Crosthwaite (2000) concluded that the role of construction changes as economic development proceeds from LDC to AIC status and as economic development proceeds from NIC to AIC status construction fails to maintain its share of GDP, and therefore declines in importance. His conclusion was also based on the assumption surmised by Turin (1974) that the cross-sectional relationships identified, between countries at different income levels at a fixed point in time, are valid also within any one country over the period of its development from LDC to AIC status.

Ofori and Han (2003) argued that Turin’s (1974) observations could be tested in

China. They suggested the provinces of China were at different levels of development and, therefore, could be taken as proxies of nations in an analysis to test the hypotheses. Instead of testing the relationships of the value added in construction as a percentage of GDP and the per capita value added in construction with GDP per capita they analysed the relationships between:

- the annual rate of growth of GDP and that of construction value added;
- the annual rate of GDP growth and percentage contribution of construction value added;
- the absolute construction value added and annual GDP growth.

Their correlation analyses produced the following evidences:

(1) A correlation relationship existed between economic growth and annual rate of growth of construction value added.

(2) The growth of GDP and the contribution of construction to GDP had an inverse relationship, suggesting that a larger share of construction in the provincial economy was not associated with rapid economic growth.

(3) A significant correlation existed between construction value added, which represented the relative size of the construction industry, and the annual rate of growth of GDP in 1995-1998. However, no correlation relationship was

found for the 1990-1994 and the 1998-2000 periods.

Although the analyses had not produced results fully supporting Turin's (1974) observations, Ofori and Han (2003) concluded that construction had stimulated the economic growth of China and was an engine of growth. However, their results show that the intensity of construction's influence on economic growth was much more dynamic than the assumption of Turin.

2.4 Structuralist Paradigm for Construction and Development

Although many researchers subscribed to Turin's (1974) Modernisation Paradigm and claimed that his recommendations could be practically applied to facilitate a smoother process of national development, other researchers had questioned Turin's analytical methodology and disagreed with his conclusion.

One of the critics was Drewer (1980) who argued that Turin's (1974) research results did not satisfactorily explain the functional relationship between construction and the process of economic development. He said there was a serious identity problem with the positive relationship between construction and the economy identified by Turin. He questioned whether the role of construction in an economy is a function of per capita GDP or the reverse?

Drewer (1980) further said that Turin's (1974) research results, at best, provided a broad overview of construction's role in the development process. He criticised Turin's research work on three main counts: the quality of data used for statistical analysis, the analytical method, and the implicit philosophy of development.

Tan (1993) also criticised the statistical complacency of Turin's (1974) analytical method. He said Turin did not support the conclusion with statistics and some of the scatter diagrams presented by Turin appeared to show weak correlation only. Finally, Drewer criticised the implicit philosophy of using cross-sectional data to explain inter-temporal relationships. He argued that it is not reasonable to assume a developing country would naturally follow a development path analogous to that previously experienced by the developed countries.

It is not difficult to understand Drewer's criticisms because construction technologies, skills and experience of construction personnel, and plant and machinery available to the developing countries today are very different from those available to the already developed countries when they were at the comparable development stage at an earlier time. Also, economic development of each country has its own characteristics and limitations. No country would follow exactly the development model of another more developed country as was suggested by Turin and his followers, such as Bon (1992, 1998).

In other words, Turin's conclusion drawing from the cross-sectional data analyses may not be valid for every country. Given two countries in a comparable development stage with similar construction volume, value added and structure of construction outputs they may have different geophysical, social, cultural, and demographic conditions. These conditions may affect the relationship between construction output and the GDP and it is possible that the relationship is different for each country. Even if the construction volume of a country and its value added as a share of GDP may increase with GDP at the LDC and NIC stages its construction activities may increase, stagnate, or decrease when it has reached the AIC stage depending on the country's economic structure and policy, population growth, and other factors.

Drewer (1980) argued that there was no implicit sequence of development and some construction activities had stimulated economic growth whilst others were the consequence of growth. He suggested that in order to evaluate the role and function of construction in the process of economic development it is important to identify the nature and direction of the causality relationships of the increased construction activities and their stimulating effect on economic development. He coined the terms of the two construction-economy growth relationships as “growth-initiating” and “growth-induced”.

In Drewer’s (1980) opinion, “growth-initiating” construction activities are those that do not result in constraints on the construction industry, such as the consumption of resources that would create inflationary pressure on the total economy. He argued that an economy usually has a limited capacity to increase new construction volume especially at its earlier stage of development because of structural constraints such as a weak indigenous construction industry and a lack of foreign exchange. He suggested the structural constraints have to be identified so that selective intervention can be made to develop the indigenous construction capacity in line with local development criteria. It was its emphasis in addressing the structural issues of the construction industry that had led this approach to be known as the Structuralist Paradigm.

Wells (1985) supported Drewer's direction of causality theory, but again had not presented any proof scientifically. Initiatively she suggested that infrastructure, industrial and agricultural constructions are "growth-initiating", whilst housing is "growth-induced".

2.5 Neoclassical Paradigm for Construction and Economic Development

Tan (1993) used Singapore as an example to argue that construction activity alone cannot turn a country from a LDC to a NIC. He argued that the correlation relationship between construction output and national income asserted by the researchers of the Modernisation Paradigm was never proven. If construction projects were carried out indiscriminately social resources might be misallocated to the wrong construction activities, hence not able to initiate economic development. He also argued that the supply and structural constraints for increasing construction output emphasised by the Structuralist Paradigm researchers, whilst they existed, were exaggerated. He said despite the supply and structural constraints, Singapore had been able to vastly expand its construction output in support of the industrialisation. He suggested the key dynamics of Singapore's construction development were class structure and the manner in which its economy was integrated into global capitalism. He did not, however, consider the increased construction activities were sufficient to turn Singapore into a NIC. The economic success of Singapore, he suggested, had been buttressed by its manufacturing sector. His conclusions have an unmistakable Neoclassical tone.

Tan (2002) continued to examine the development dynamics of the construction industry and its relationship with the economy. He said the World Bank had advocated reform measures for the construction sector in the 1980s that were in line with the Neoclassical stance. The free market approach was a counterpoise to the intervention approach proposed by the Structuralist Paradigm researchers. He said, however, that the Neoclassical economics leaves out two important factors: class structure and institutions and he cited the researches related to the Political Economy perspective and the New Institutional Economics (NIE) perspective to elaborate the relevance of these two factors to the development of the construction industry and the economy.

Tan (2002) explained that the Political Economy perspective originated from the Marxism theory of Karl Marx, which emphasized class structure. The Political Economy perspective focuses on the articulation between the formal and informal sectors of the economy and the two forces, namely, class structure and the manner in which the economy was integrated into global capitalism, which had been identified by Tan (1993) as the driver behind Singapore's construction development. He said the strength of this investigation approach is its direct attention to the issues of class structure and the employer-worker strategies, from which some of the structural problems of the construction industry, not even identified by the Structuralists, such as subcontracting, were addressed.

The Neoclassical theory assumes transaction costs are zero. Citing the views of NIE perspective researchers that this assumption is not reasonable, Tan (2002) explained their attempt to relax it. He explained that the NIE perspective researchers do not believe economic development can be stimulated simply by investing in discrete projects. They consider institutions are needed to provide the administrative and intellectual infrastructure for the economic growth. Therefore, they advocated the need for the state to develop institutional capacity in rules, laws and social norms that constrain individual behaviour to help in minimising the compliance costs. In the context of construction, he cited the views of some NIE perspective researchers that the institutional capacity can be extended to include organisations such as professional bodies, trade associations, training institutions, and research and development institutions for the development of the construction industry and, implicitly, the economy.

Tan (2002) suggested that the Political Economy perspective and the NIE perspective take the middle ground between the Modernisation Paradigm and the Structuralist Paradigm. However, their non-intervention free market core values inherited from the Neoclassical doctrine should make them taking a completely different policy approach from that related to the two Paradigms. They do not subscribe to the theory that the government should make use of construction activities to stimulate the economy. Nevertheless, the Neoclassical economists also agree that the government has a duty to provide public goods, which include transport infrastructure, for the economic development of the society.

2.6 Analytical Methods

In the ensuing years since Turin (1974), many researchers have used different methodologies to confirm the relationships between construction and the general economy and used the results to support their policy recommendations. Turin's simple correlation analysis method is no longer considered adequate and more statistically rigorous analytical methods are used to ensure the reliability of the results. Alternative econometric methods were used to address the identity problem suggested by Drewer (1980).

2.6.1 Econometric Models

As research methodologies developed rapidly, researchers began to analyse the relationship of construction activities with the general economy using sophisticated econometric methods. As an example, Hickman (1974) used an econometric model of the housing market and building industry to analyse the fluctuation in housing construction and residential construction expenditures from 1927 to 1970 in the United States. The model consists of the housing demand and supply equations, the builder's production decision equation, the value of new housing construction equation, and identifiers that serve to relate the number of new housing construction started to the stock of dwelling units and its value. He performed simulations to the model by holding the exogenous variables constant. By doing so, he intended to find out whether the endogenous variables of the housing production function did cause the new housing construction number to fluctuate in a manner resembling a long swing. The simulation results show that the endogenous variables alone have caused the new housing construction number to approach a steady-state growth trend. There was no sign of cycle fluctuation. Therefore, he concluded that the building cycle by itself did not exist and the fluctuation of new housing construction during the period was caused by exogenous variables. In essence, he proposed that it was the economy that had caused the building activities to fluctuate.

Akintoye and Skitmore (1994) used a similar model to forecast the private sector quarterly construction demand of the UK. The data that they used spanned from 1974 to 1988. They found that the ex-post forecasting ability of the model was generally poor and unexpected. They concluded that their a priori model had missed out some important variables, such as the rational expectations of future economic conditions and the effects of the recession. They suggested that some expert subjective judgement should be included in the model. Their experience shows that the reliability of an econometric model to forecasting the relationships between construction demand and the economy depends on the variables included in the model and the ability of it to closely reflect the actual relationship mechanisms.

Coulson and Kim (2000) used a vector autoregression (VAR) model to investigate the effect of the four major components of GDP of the United States from 1959 to 1997 on the general economy. These major components are residential investment, non-residential investment, consumption and government spending. The VAR model consists of four equations that determine each of the components as a function of the lagged values of the four components, and a fifth equation, which identities GDP as the sum of these four components. They found that residential investment in the United States had a larger impact on the GDP than non-residential investment during the period studied, and therefore had a greater explanatory power in forecasting the GDP. They attributed this result to the reason that residential investment had a significant and positive effect on personal consumption, which was absence from non-residential investment.

It should be noted that even if a relationship between construction activities and the economy had been accurately captured in an econometric model it might not mean that there was a causality relationship between the two variables.

2.6.2 Granger Causality Test

Many recent researchers had used an econometric technique developed by C W J Granger in the 1960s to explore the causality relationship. The test is therefore commonly called the Granger Causality Test. Thomas (1997) defined Granger causality as follows:

> "X is said to be a Granger cause of Y if present Y can be predicted with greater accuracy by using past values of X rather than not using such past values, all other information being identical."

Ball & Wood (1996) used the Granger Causality Test to find out the relationships between the UK's investments in buildings, housings and equipment and its economic growth over a period of 140 years from 1856 to 1992. They found from the analyses that the relationships were different for the Pre-War (1856 – 1938) and the Post-War (1948 – 1992) periods. For the Pre-War period, the analyses showed that there were bilateral causality relationships between GDP per person employed and the value of non-residential buildings, equipments and aggregate investments. In other words, the causality relations existed in both directions between the two variables in the Pre-War period. For other types of investments, such as dwellings and structures, they were caused by GDP per person employed only. They also found that investment in equipments had caused a growth of non-residential buildings investment. For the Post-War period, the only relationship that Ball & Wood found was GDP per person employed had caused a growth of investment in equipment.

The result of Ball & Wood tells two stories. First, different construction activities may have different causality relationships with the economy. Second, the causality relationship may change with time.

Tse and Ganesan (1997) studied the Granger causality relationship between expenditure-based GDP and construction flow in Hong Kong, which comprised the value of all new construction and renovation/maintenance works, for the period from 1983Q1 to 1995Q1 and found that GDP had led to an increase of construction flow. They concluded explicitly that it was the economy that had caused the construction activities to grow. The conclusion drawn by Tse & Ganesan is dubious because they had aggregated in the analyses all types of construction activity masking the fact that different types might have different causality relationships with the economy. If Drewer (1980) is correct, there should be some construction activities of specific nature and purpose that are economic "growth-initiating" and some that are "growth-dependent". A broad overview of the role of overall construction activities in the economy is of limited help to government policy making and implementation.

Green (1997) focused his study on the causality relationships of residential and non-residential investments with the GDP in the United States from the year 1959 to 1992. He analysed a range of specifications of Granger Causality equations with two/three- and six-quarter-lags. He also checked the structural stability of the parameters of the equations across time. He found that residential investment had Granger-caused GDP whilst a reversed causality relationship had happened to non-residential investment. He suggested the causality direction of residential investment is initiated by exogenous forces, such as the income tax incentive of residential investment and the regulatory treatment of housing finance institutions. As for the non-residential investment the reversed causality relationship was probably due to the adjustment process of inventories in a business cycle. He also suggested since residential investment reflects the forward looking behaviour of the consumers it is a good predictor of GDP.

Chui and Chau (2005) also used the Granger Causality Test method to analyse the relationship between GDP, real estate investments, and real estate prices in Hong Kong. The data they used span from 1973 to 2003. They hypothesised that if there was a leading relationship between the three variables the real estate sector should be a leading sector of economic performance, and real estate investments and prices, which are good measures for reflecting expected real estate demand, should serve as good predictors of economic performance.

They concluded from the Granger Causality Test results that:

(1) Contrary to the findings by Green (1997) and Coulson and Kim (2000) for the United States, there was no relationship between real estate investment and GDP in Hong Kong during the period studied. Therefore, real estate investment is a poor predictor of GDP for Hong Kong.

(2) There was no lead-lag relationship between prices and the volume of investment of different types of real estate. Therefore, real estate investment is not a good measure of a market's expected demand for real estate at any point in time.

(3) Real estate prices, especially residential price, exhibited a strong leading relationship with GDP. Therefore, movement in residential prices can be used to forecast GDP growth.

Based on these conclusions they suggested government policies for stabilising residential prices would have the effect of stabilising economic growth also and any government policy for stimulating real estate prices would also stimulate the economy.

Anaman and Osei-Amponsah (2007) used the Granger Causality Test method to evaluate the causal links between the growth of the construction industry and the growth of the macro-economy of Ghana from 1968 to 2004. They found that growths in the construction industry had caused the growth in GDP with a leading period of three years, whilst the reverse causality direction also existed with the growth of GDP followed two years later by a decline in the output of the construction industry. They suggested the latter causality relationship was possibly due to the completion of major investment projects, such as roads and infrastructure, which had driven the growth of GDP in the subsequent years. Based on these Granger Causality Test results they argued that the government should make better use of the construction to drive the economic development.

However, Wigren and Wilhelmsson (2007) found a mix of Ganger causality relationships between the GDP and various construction activities from the analyses of the data for 14 Western European countries in the period of 1980 to 2004. They also found the causality relationships between GDP and individual construction activities were different in different countries. The overall results that they could draw from the results were public infrastructure policies have an effect on short-run economic growth but only a weak effect on the long run and residential construction does have a long-run effect on economic development.

2.6.3 Cobb-Douglas Production Function

Aschauer (1989) used the Cobb-Douglas Production Function to examine the effect of public sector capital accumulation and other government expenditure on goods and services to the productivity of the United States private sector economy in 1945 -1985. He assumed that given a technology level the real aggregate output of goods and services of the private sector was a function of the aggregate employment of labour services, the aggregate stock of non-residential private capital sector investment and the service given by the government, which could be public capital stock and/or other public goods and services.

He tested the regression equations of the private sector output per capita against the various private and public inputs for the constant return to scale constraint assumption for all the input factors and found that the elasticity coefficients of non-military public capital input were higher than those of the non-military equipments and other government goods and services. The non-military public capital included the core infrastructure, office buildings, educational buildings, hospitals, police and fire stations etc. The results suggested that the non-military public capital investment in the US during that period of time had a larger stimulating effect on private sector productivity than other government expenditures.

He also calculated the respective elasticity coefficients of the public non-military capital investment with respect to private sector output and found the core infrastructure, which included highways, mass transit, airport and public utilities, were more productive than the other categories of capital investment.

The result led him to conclude that public capital investment had a marked effect on the productivity of the private sector in the US in 1945-1985 and the general decline in the growth rate of productivity in the US in the last 15 years could have been caused by the decrease in public capital investment beginning in the early 1970s.

He said the research results showing the highly productive effect of public expenditure in non-military capital investment on economic growth and productive improvement suggested that the government should attribute sufficient weight to additions to the stock of non-military structures such as highways, streets, water systems, and sewers.

Although the research results had shown the productive nature of public infrastructure the causality relationship with the economy remained unproved.

2.7 Construction Industry Development Policy

Seventy-two years have passed since Riggleman (1933) concluded that building activity movements preceded the general business cycles and researchers today are still trying to confirm the economic role of construction activities. The increasingly sophisticated research methods used by these researches have not increased the certainty of the conclusions.

Despite that, many of them support the government to assist in development of the industry. Researchers of both the Modernisation and Structuralist Paradigms were amongst this category. Even the NIE perspective researchers of the Neoclassical Paradigm advocated that governments should develop the institutional capacity of the construction industry.

One of these researchers is Turin (1974), who suggested governments should recognise the importance of construction activities in the national economy and made many recommendations to improve the construction industry. He suggested government and public clients should encourage the industry to use adequate technology, strengthen small and medium-sized local contractors, establish suitable training schemes and encourage innovation. He also suggested government should abandon meaningless statutory instruments and regulations.

Anaman & Osei-Amponsah (2007) recommended government should assist construction contractors to enhance their performance by providing a conductive industry environment and coordinating its investment on infrastructural projects, such as roads, water and electricity supply, so that they could have a bigger impact on economic growth. They also recommended supporting construction contractors in staff development and training, and encouraging researches in the construction industry.

Bosch & Philips (2003) summarised the research findings for nine countries[12] and concluded that regulation is one of the crucial determinant factors, in addition to institutions and customs, for the development of the construction industry. They argued that government should set rules to help shaping the degree of risks and the competition environment in the construction industry. They suggested if there is no government regulation, the industry would be flooded by many small companies with limited fixed capital and competitive subcontracting practice would thrive. This would worsen workers' employment conditions, reducing their training possibilities and making them less skilled. In addition to these, technology investments would be reduced. They suggested government regulations would overcome these shortcomings and would assure the long-term interests of the industry.

Many of these recommended development policies for the construction industry

[12] The nine countries are the Netherlands, Germany, Denmark, Spain, the United Kingdom, the United States, the province of Quebec in Canada, Australia and South Korea.

are generic, such as labour skill and training, and can be implemented without causing too much dispute. But, some of them, such as government regulations, could arouse controversy. Whether the society would accept their implementation would depend on the importance of the construction activities in social and economic development.

2.8 Approaches to infrastructure Development

For any government, infrastructure development is always an important decision. Hirschman (1973) suggested Social Overhead Capital (SOC) investment, to which infrastructure construction belongs, is essential for the development of any economy but the extent of SOC investment leading or following Direct Productive Activities (DPA) investment has been difficult, if not impossible, to measure. With regard to deciding the approaches for the SOC development, he suggested they might be different for the advanced and less developed economies.

For the advanced economies, he suggested, there were many unpredictable external factors affecting policy decisions not applying to the developing and under-developed economies. Although he had not been explicit in naming the factors one would expect them to include social, economic and political priorities in addition to financing, which were always a problem in the less developed economies.

Hirschman suggested making SOC development decisions for the developing or under-developed economies could be simpler because they had the benefit of the accumulated experience and technologies of the advanced economies from which they could draw. Their actual difficulty was getting to know which investment they should make, given the substantial unmet demand, and how to turn them into reality, given the limited financing resources.

Hirschman suggested the "Balanced Growth" approach of SOC and DPA investment. Constructing the SOC just in time to meeting the needs generated by the DPA, would result in the most economical use of the society's resources. However, in his view the under-developed economies usually do not have the ability to achieve this optimal point. Therefore, he suggested there were two choices of policy approach that governments of the less developed economies could select:

1. Building ahead of demand; and
2. Building compelled by demand.

According to Hirschman, "building ahead of demand" creates a permissive investment environment. With the necessary SOC already in place the economy, although less developed, would be attractive to new DPA operators and reinforce investment motivation of the existing ones. It could attract a large flow of DPA investment. But it could also be wasteful if the DPA investment never arrives.

The second approach, “building compelled by demand”, is more conservative, although it could be less orderly than the “building ahead of demand” approach. A government would not invest in new SOC until a pressure induced by its shortage on the society and economy compels it to do so. This pressure serves as an assuring signal that this type of SOC is needed and its construction would not be wasteful. With the need of the new SOC apparent any resistance against its construction would be reduced and the development speeded up.

Whilst the first approach may make an economy more attractive to investors Hirschman argued that the proposition could be a risky one for a less developed country because the arrival of the potential investors may not occur as predicted and the expected economic progress not guaranteed. The safer approach for the less developed economy, he argued, was “development via shortage” of SOC. He suggested moderate shortages of SOC did not seem to affect the economy too much and if it happened it could be taken as an assuring proof of a strong economic development and a convenient reason to support the investment of the SOC.

2.9 Summary

The role of construction activities in economic development has long been a subject of research. In the search for a general economic theory researchers have found that construction activities seemed to move up and down with the economy. The first researcher who identified the existence of a cyclical pattern of building activities was Simon Kuznet in 1930. He called it the "Long Swings" of building cycles. Roughly around the same time, Riggleman (1933) found that the building activity movements in the United States from 1875 to 1932 had frequently preceded the general business cycles. Despite these research findings, which led most business cycle researchers to conclude that the activities of capital goods industries were the outstanding feature in cyclical fluctuation, Schumpeter (1954) concluded that there might not be a causal relationship between the building activities and the general economy. He suggested that the cause for fluctuation of both the economy and construction activities might be exogenous.

Turin's (1974) research results rekindled interests in the subject. He concluded that construction should be a principal agent of economic development, which would implicitly lead to economic growth of a society. The conclusion had led later researchers to call Turin's (1974) proposition the Modernisation Paradigm, which connotes a natural implicit consequence of economic modernisation induced by construction activities. Because of the perceived importance of construction activities Turin recommended that the construction industry should be treated as equal to other industries and the government should pay special attention to the development of the industry. Many later researchers, including: Kafandaris (1980), Edmonds and Miles (1984), Low and Leong (1992), Bon (1992, 1998), Lopes (1998), Crosthwaite (2000), and Ofori and Han (2003), agreed with the general conclusion of Turin and carried further researches along his direction or with different variations. They confirmed the existence of relationships between construction activities and economic growth although many of them also concluded that the relationship is more complicated.

Despite many researchers subscribed to the Modernisation Paradigm and claimed that Turin's (1974) recommendations could be practically applied to facilitate a smoother process of national development other researchers had questioned Turin’s analytical methodology and disagreed with his conclusion. One critic was Drewer (1980), who argued that Turin's research results did not satisfactorily explain the functional relationship between construction and the process of economic development and suggested that there was no implicit sequence of development. He suggested some construction activities had stimulated economic growth whilst others were the consequence of growth. He called these two types of construction activities “growth-initiating” and “growth-induced” respectively. He also argued that an economy usually would have a limited capacity to increase new construction volume especially at the earlier stages of development because of the structural constraints, such as a weak indigenous construction industry and a lack of foreign exchange. He suggested the structural constraints had to be identified so that selective interventions could be made to develop the indigenous construction capacity in line with local development criteria. It was its emphasis in addressing the structural issues of the construction industry that had led this approach to be known as the Structuralist Paradigm. Wells (1985) had also supported Drewer's direction of causality theory and suggested that infrastructure, industrial and agricultural construction should be "growth-initiating", whilst housing should be "growth-induced".

Tan (1993) used Singapore as an example to argue that construction activity alone cannot turn a country from a LDC to a NIC. His argument was slanting to the Neoclassical stance. He did not consider the increased construction activities had been sufficient to turn Singapore into a NIC, and he suggested the economic success of Singapore had been buttressed by its manufacturing sector. As regards the forces influencing the development of the construction industry he (2002) considered the Political Economy perspective and the New Institutional Economics (NIE) perspective relevant. The Political Economy perspective focuses on class structure, the manner in which the economy is integrated into the global capitalism and the articulation between formal and informal sectors of the economy, whilst the NIE perspective advocates the need for the state to develop institutional capacity in rules, laws, social norms and organisations such as professional bodies, trade associations, training institutions, and research and development institutions. He suggested the key dynamics of Singapore's construction development were class structure and the manner in which its economy was integrated into global capitalism.

The Neoclassical Paradigm, which Tan (2002) had investigated, is a completely different policy approach from the Modernisation and Structuralist Paradigms. It does not subscribe to the theory that the government should make use of construction activities to stimulate the economy. Despite that, the Neoclassical economists also agree that the government has a role to play in providing public goods, which include transport infrastructure, for the economic development of the society.

In the ensuing years since Turin (1974), many researchers have used different methodologies to establish the relationships between construction and the general economy. Alternative econometric methods have been used to address the identity problem suggested by Drewer. The following three statistical methods have generally been used by recent researchers in search of the roles and contributions of construction activities.

(1) Econometric Models

Hickman (1974) used an econometric model to analyse the fluctuation in housing construction and residential construction expenditures in the United States from 1927 to 1970. The simulation results show that the endogenous variables alone have caused the new housing construction number to approach a steady-state growth trend. There was no sign of cycle fluctuation. He concluded that building cycle by itself did not exist and the fluctuation of new housing construction during the period was caused by exogenous variables. In essence, he proposed that it was the economy that had caused the building activities to fluctuate. Akintoye and Skitmore (1994) used a similar model to forecast the private sector construction demand of the UK from 1974 to 1988. They found that the ex-post forecasting ability of the model was poor because they had missed out some important variables from the a priori model. It shows that the reliability of an econometric model depends on the variables included and the ability of the model to closely reflect the actual relationship mechanisms. Coulson and Kim (2000) used a vector autoregression (VAR) model to investigate the effect of the four major components of GDP of the United States from 1959 to 1997 on the general economy. They found that residential investment in the United States had a larger impact on the GDP than non-residential investment during the period studied, and therefore had a greater explanatory power in forecasting the GDP.

(2) Granger Causality Test

Ball & Wood (1996) used the Granger Causality Test to investigate the relationships between UK's capital investments and its economic growth over a period of 140 years from 1856 to 1992. They found different construction activities may have different causality relationships with the economy and that the causality relationship may change with time. Tse and Ganesan (1997) studied the Granger causality relationship between expenditure-based GDP of Hong Kong and the value of all new construction and renovation/maintenance works for the period from 1983Q1 to 1995Q1. They concluded explicitly that it was the economy that had caused the construction activities to grow. However, their conclusion is dubious because they had not segregated the construction activities into those which might have different causality relationships with the economy and assume all types of construction activity would have the same effects. A broad overview of the role of construction activity taken overall is of limited use to help government policy making and implementation. Green (1997) found that residential investment had Granger-caused GDP whilst a reversed causality relationship had happened to non-residential investment. He attributed the two different causality relationships to the effects of exogenous forces and the adjustment process of inventories in a business cycle respectively. Chui and Chau (2005) based on the Granger Causality Test results for Hong Kong’s real estate sector to suggest government policies for stabilising residential prices would have the effect of stabilising economic growth also and any government policy for stimulating real estate prices would also stimulate the economy. Anaman and Osei-Amponsah (2007) found that growths in the construction industry in Ghana had caused the growth in GDP with a leading period of three years, whilst the reverse causality direction also existed with the growth of GDP followed two years later by a decline in the output of the construction industry. They suggested that the government should make better use of the construction to drive the economic development.

Wigren and Wilhelmsson (2007) found different Ganger causality relationships between the GDP and various construction activities for 14 Western European countries as a whole and individually in the period of 1980 to 2004. The overall results that they could draw from the results were public infrastructure policies have an effect on short-run economic growth but only a weak effect on the long run and residential construction does have a long-run effect on economic development.

(3) Cobb-Douglas Production Function

Aschauer (1989) used the Cobb-Douglas Production Function to examine the effect of public sector capital accumulation and other government expenditure on goods and services to the productivity of the United States private sector economy in 1945 -1985. He concluded that public capital investment had a marked effect on the productivity of the private sector in the US in 1945-1985 and the general decline in the growth rate of productivity in the US in the last 15 years could have been caused by the decrease in public capital investment beginning in the early 1970s. He also concluded core infrastructure, which included highways, mass transit, airport and public utilities, were more productive than the other categories of capital investment.

The above review shows that researchers are still trying to verify the causality relationship between construction and economic growth ever since Riggleman (1933) concluded that building activity movements proceeded the general economy cycles. The increasingly sophisticated research methods used by these researches have not increased the certainty of the conclusions.

Despite that, many of researchers of the Modernisation and Structuralist Paradigms support the government to assist in development of the industry. Even the NIE perspective researchers of the Neoclassical Paradigm advocated that governments should develop the institutional capacity of the construction industry.

Many of the recommended development policies for the construction industry are generic, such as labour skill and training, and can be implemented without causing too much dispute. But, some of them, such as government regulations, could arouse controversy. Whether the society would accept their implementation would depend on the importance of the construction activities in social and economic development.

As regards the construction projects implementation methods Hirschman (1973) suggested that the approaches to deciding Social Overhead Capital (SOC) development, to which infrastructure construction belongs, and Direct Productive Activities (DPA) investment might be different for the advanced and less developed economies. He suggested three alternatives:

1. “Balanced Growth” approach, by constructing the SOC just in time to meeting the needs generated by the DPA, which would result in the most economical use of the society’s resources.

2. “Building Ahead of Demand”, by creates a permissive investment environment, which would be attractive to new DPA operators and reinforce investment motivations of the existing ones. But it could also be wasteful if the DPA investment never arrives.

3. “Building Compelled by Demand”, by not investing in new SOC until a pressure induced by its shortage on the society and economy compels it to do so, which would assure the construction would not be wasteful.

He suggested the first approach is difficult to achieve. Therefore, the real choices for the less developed economies are the latter two. In his opinion, the safer approach would be the third choice, also known as “Development via Shortage” of SOC. He suggested moderate shortages of SOC did not seem to affect the economy too much and if that did in fact happen it could be taken as an assuring proof of a strong economic development and a convenient reason to support the investment of the SOC.

The next chapter proposes the hypotheses and describes the methodology that is used in this research in pursuit of the objectives described in Chapter 1.

Chapter 3 Hypotheses and Research Methodology

The objectives of this research, described in Chapter 1, are to verify the propositions that different types of infrastructure and building construction activities in Hong Kong have different intrinsic economic roles and these intrinsic roles can be temporary changed by the construction planning and implementation processes. If evidence is found that the intrinsic role of a construction activity is temporary changed by the planning and implementation processes of its construction programmes knowledge can be gained to making best use of the construction activity to achieve intended objectives. This chapter describes the hypotheses and research methodology used in pursuit of these objectives.

3.1 Hypotheses

The first two hypotheses are therefore to verify that different types of construction activities in Hong Kong have different intrinsic economic roles and in particular that transport infrastructure construction in Hong Kong has an intrinsic economic "growth-initiating" role. The types of construction activities refer to in the hypotheses are the "detailed end-use" construction activities, consisting of residential buildings, commercial buildings, industrial & storage buildings, service Buildings, transport, other utilities & plants, environment, and sports & recreation, which serve different development and social functions of Hong Kong.

Hypothesis 1

The growths of different types of construction activity in Hong Kong have different intrinsic causality relationships with the economic growth in the period 1983-2002.

Hypothesis 2

The growth of transport infrastructure construction activity in Hong Kong has an intrinsic economic "growth-initiating" role in the period 1983-2002.

The general perception of the social functions of the construction activities is that:

1. Residential buildings were constructed primarily to meet the needs for shelter of the people. Their construction should have brought more social, rather than direct economic benefits to the society. Ball & Wood (1996) found for the Pre-War period in the UK, dwellings and structures were caused by GDP per person employed. However, Green (1997) found that residential investment had Granger-caused GDP.

2. Better commercial buildings should improve the efficiency of business and commercial activities. Since commerce is a major economic driver of Hong Kong the construction of commercial buildings should have a beneficial effect on the economy. But, this is not Green's (1997) conclusion for commercial building construction activity. He found non-residential building construction had been caused by GDP growth. Ball & Wood (1996) also found there were bilateral causality relationships between GDP per person employed and the value of non-residential buildings for the Pre-War period in the UK.
3. Improved industrial and storage buildings should improve the efficiency of the manufacturing industry and benefit the economy of Hong Kong.
4. Improved service buildings should allow better education, health care and other services to be given to the people Hong Kong. In the long run, they should improve the quality and productivity of the population, which would lead to improvement in the economy.
5. A more efficient transport infrastructure should improve the efficiency and productivity of the manufacturing and commercial activities of Hong Kong. The construction of transport infrastructure should bring direct benefits to

the economy of Hong Kong. Wells (1985) also suggested that transport infrastructure construction has an economic "growth-initiating" role.

6. New power plants and other industrial facilities should improve the efficiency of the manufacturing and commercial industries. Their construction should also directly benefit the economy of Hong Kong.
7. Construction of environmental facilities was generally for rectifying the ill effects resulting from the damaged environment. For example, the construction of a sewage treatment system is to remedy the water pollution problem. They would have improved the living environment, rather than improving the economy, of Hong Kong.
8. Construction of sports and recreational facilities would improve the quality of life of the people of Hong Kong. The consequential effect of improved productivity of a happier people might not be immediate.

The results from testing Hypothesis 1 will form the bases that the government can rely on should it wish to formulate policies that aim to improve the construction industry's contribution to the society and its economy.

Riding the phenomenal economic growth of Mainland China, Hong Kong's external trade activities had double-digit growth for most parts of the period in the

1980s and 1990s as shown in Annex 5[13]. Rapid growth of export trading activities in line with China's expanding manufacturing output has made Hong Kong an important entrepôt and transhipment centre. It is, therefore, logical to assume that the transport infrastructure construction activities in Hong Kong should be intrinsically economic "growth-initiating". The result from testing Hypothesis 2 will confirm whether transport infrastructure construction did play a special role in Hong Kong's economic development.

Although Hong Kong's expenditures on transport infrastructure construction have been substantial since the early 1980s the pattern of the expenditures as shown in Annex 6[14] had not been steady for much of the period from 1983 to 2002. During the mid 1980s to the early 1990s, the real annual value of transport infrastructure construction lingered at around $6 billion per year. However, starting from 1992, the value surged rapidly upwards and peaked in 1996 at nearly three times the average value of the previous 10 years. At its peak in 1996, the value of transport infrastructure construction was $17.9 billion, which was about 28.49% of the total value of construction in that year. The value then fell back to the $6 billion level in a matter of three years. The

[13] Annex 5
[14] Annex 6

disparate construction patterns in 1983 – 1992 and 1993 – 2002 would have been influenced by different investment policy formulation and the construction processes causing transport infrastructure construction activities to play different economic roles. The third hypothesis is therefore to verify the influences of different construction patterns on the economic roles of transport infrastructure construction activities in these two periods of time.

Hypothesis 3

The economic role of transport infrastructure construction activity is different in the periods 1983-1992 and 1993-2002.

If this hypothesis is proven, it would suggest the short-term economic role of transport infrastructure construction activity can be changed by external influences, such as a different construction pattern in this case. If the different construction patterns are the results of different transport infrastructure policy formulation and implementation processes then it can be argued that government policy does have an effect on the economic role of transport infrastructure construction activity.

3.2 Methodology

Many researchers have used Granger Causality Test method to confirm the causality relationships of construction activities and the economy. This research will also make use of the Granger Causality Test method to test the three hypotheses. By using the same econometric analysis method the testing results for the hypotheses in this research can be compared with those concluded by previous researchers and, if the results are different, the reasons will be discussed.

It is considered by many researchers that the period of time lag of the variables of a Granger Causality Test equation has an effect on the causality result. They have used various methods to determine the selection of lags used in the causality analyses. Chiu and Chau (2005) first performed the Granger Causality Tests with six-quarter lagged variables, which is the most optimal period of lag suggested by Guilkey and Salami (1982), and then performed the tests again with four- and five-quarter lagged variables to confirm the robustness of the results. They found the test result was not sensitive to the choice of lagged period around the optimal time lag.

The period of time lag used by Anaman and Osei-Amponsah (2007) in the

Granger Causality Tests was three years, which they explained was based on the Schwarz Bayesian information criterion (SBIC). Their results show that growth in the construction industry Granger-caused growth in real GDP with a three-year lead period.

Green (1997) used different time lag periods in his analyses, including 3-quarter-lag period and the 6-quarter-lag period suggested by Guilkey and Salemi (1982). He found the results are substantially the same.

The period of time lag of the variables in a Granger Causality Test equation may have effect on the result. But, the test results of aforementioned researchers, who used different time lag periods around the theoretical optimal one, suggest it may be necessary in some occasions to analyse different time lag scenarios in order to get a more complete understanding of the causality relationships. The periods of time lag in their researches have stretched from 3-quarters to 12-quarters. Since one of the objectives of this research is to understand the causality relationships of the construction activities and the general economy under different time lag scenarios the analyses in this research are, therefore, done for the scenarios with variables ranging from 2- to 12-Quarter lagged periods. The level of significance for confirming the hypotheses is set at a relatively high 5%.

The results from testing Hypotheses 1 and 2 will answer the first two questions asked in Chapter 1. Question 3 will be answered by comparing and correlating the policy formulation and the construction implementation processes of the transport infrastructure programmes in the 1983-1992 and 1993-2002 with the results from testing Hypothesis 3.

The research of policy formulation and construction implementation processes of the transport infrastructure programmes will be carried out to assess the influences of the government's policy on the short-term roles of Hong Kong's transport infrastructure construction. This analysis together with the test result of Hypothesis 3 will verify the second proposition that the causality relationship for transport infrastructure programmes may change by their planning and implementation processes.

In studying the planning and implementation processes of the transport infrastructure programmes the deleterious effects induced by the construction processes will also be identified. The study is to show the extent of the deleterious effects caused by the construction implementation processes that have disrupted the development of the construction industry and the society. Based on these studies, there will be a better understanding of the economic and social roles of the transport infrastructure construction activities and the effects that government policy has impressed on them. Then, the relevance of government's development policy for the industry will be reviewed and commented.

3.3 Granger Causality Test

According to Gujarati (1995), Granger Causality Test assumes the information relevant to the prediction of the respective variables is contained solely in the time series data on these variables.

The Granger Causality Test involves the following regression equations:

$$\boldsymbol{Y_t} = \sum_{i=1}^{n} \alpha_i \boldsymbol{X_{t-i}} + \sum_{j=1}^{n} \beta_i \boldsymbol{Y_{t-j}} + \boldsymbol{u_{1t}} \qquad \text{Equation 1}$$

$$\boldsymbol{X_t} = \sum_{i=1}^{m} \lambda_i \boldsymbol{X_{t-i}} + \sum_{j=1}^{m} \delta_i \boldsymbol{Y_{t-j}} + \boldsymbol{u_{2t}} \qquad \text{Equation 2}$$

where the disturbances ***u***'s are assumed to be uncorrelated.

Equation 1 postulates that the current Y is related to the past values of Y itself as well as that of X. Equation 2 postulates a similar behaviour for X.

The meaning of Equation 1 is: If variable X "Granger" causes variable Y, then changes in X should precede changes in Y. Therefore, in a regression of Y on other variables, including its own past variables, if the inclusion of past, or lagged, values of X significantly improves the prediction of Y, then it can be said that X "Granger" causes Y.

There are four Granger causality possibilities:

1. Unidirectional causality from X to Y – If the estimated coefficients on the lagged X in Equation 1 are statistically different from zero as a group (i.e. $\Sigma\alpha_i$ is not equal to 0) and the set of estimated coefficients on the lagged Y in Equation 2 is not statistically different from zero (i.e. $\Sigma\delta_j$ equals to 0).

2. Unidirectional causality from Y to X – If the estimated coefficients on the lagged X in Equation 1 are not statistically different from zero as a group (i.e. $\Sigma\alpha_i$ equals to 0) and the set of estimated coefficients on the lagged Y in Equation 2 is statistically different from zero (i.e. $\Sigma\delta_j$ is not equal to 0).

3. Feedback (bilateral causality) – When the sets of Y and X coefficients are statistically different from zero in both regressions (i.e. $\Sigma\alpha_i$ and $\Sigma\delta_j$ are not equal to 0).

4. Independence – The sets of Y and X coefficients are not statistically different from zero in both the regressions (i.e. $\Sigma\alpha_i$ and $\Sigma\delta_j$ are equal to 0).

In the analyses of the Granger Causality relationship of economic growth and a specific construction activity of Hong Kong Equations 1 and 2 can be re-written as:

$$\boldsymbol{E_t} = \sum_{i=1}^{n} \alpha_i \boldsymbol{C_{t-i}} + \sum_{j=1}^{n} \beta_i \boldsymbol{E_{t-j}} + u_{1t} \qquad \text{Equation 3}$$

$$\boldsymbol{C_t} = \sum_{i=1}^{m} \lambda_i \boldsymbol{C_{t-i}} + \sum_{j=1}^{m} \delta_i \boldsymbol{E_{t-j}} + u_{2t} \qquad \text{Equation 4}$$

where ***E*** equals the growth values of GDP and ***C*** equals the growth values of a type of the “detailed end-use” construction activities of Hong Kong.

The equations for testing causality direction running from a construction activity growth to economic growth are:

$$\boldsymbol{E_t} = \sum_{j=1}^{n} \beta_i \boldsymbol{E_{t-j}} + \boldsymbol{u_{1t}} \qquad \text{Equation 3a (Restricted)}$$

$$\boldsymbol{E_t} = \sum_{i=1}^{n} \alpha_i \boldsymbol{C_{t-i}} + \sum_{j=1}^{n} \beta_i \boldsymbol{E_{t-j}} + \boldsymbol{u_{1t}} \qquad \text{Equation 3b (Un-restricted)}$$

Regression analyses are performed for the restricted and un-restricted Granger Causality equations for each type of construction activity. The null hypothesis of the analysis is H_0: $\sum_{i=1}^{n} \alpha_i = 0$, which means the lagged construction activity growth data in the un-restricted equation do not significantly improve the prediction of the present economic growth. If the null hypothesis is rejected, then $\sum_{i=1}^{n} \alpha_i \neq 0$, which means that past construction activity growth had "Granger" caused the economic growth.

The way to test that the inclusion of variables C significantly improves the prediction of E is by applying the F statistic test. From the restricted regression and the un-restricted regression equation, the restricted residual sum of squares RSS_R and the un-restricted sum of squares RSS_{UR} are obtained. The F statistics is calculated by the following formula:

$$\boldsymbol{F} = \frac{(\boldsymbol{RSS_R} - \boldsymbol{RSS_{UR}})/\boldsymbol{m}}{\boldsymbol{RSS_{UR}}/(\boldsymbol{n}-\boldsymbol{k})} \qquad \text{Equation 5}$$

where ***m*** = number of lagged C variables; ***n*** = number of observations; ***k*** = number of parameters estimated in the un-restricted regression

If the computed F value exceeds the critical F value at 5% level of significance the null hypothesis that $\Sigma\alpha_i = 0$ will be rejected, which means the lagged C variables significantly improve the prediction of E. In this case, the construction activity is said to "Granger" causes economic growth.

The equations for testing causality direction running from economic growth to a construction activity growth are:

$$C_t = \sum_{i=1}^{m} \lambda_i C_{t-i} + u_{2t} \qquad \text{Equation 4a (Restricted)}$$

$$C_t = \sum_{i=1}^{m} \lambda_i C_{t-i} + \sum_{j=1}^{m} \delta_i E_{t-j} + u_{2t} \qquad \text{Equation 4b (Un-restricted)}$$

Likewise, to find out whether past economic growth "Granger" causes the growth of a construction activity the null hypothesis H_0: $\sum_{j=1}^{m} \delta_i = 0$ is tested. If the null hypothesis is rejected then it can be argued that past economic growth "Granger" causes the construction activity.

3.4 Granger Causality Test Data

Comprehensive construction output statistics are published by the Census and Statistics Department of Hong Kong. They include statistics for broad trade group[15], broad end-use group[16], detailed end-use group[17], and main contractors'

[15] The broad trade group includes construction work at private sector and public sector construction sites, and work of general trades and special trades at locations other than construction sites.

[16] The broad end-use group includes buildings and structure & facilities construction activities,

[17] The detailed end-use group includes the construction activities of residential buildings, commercial buildings, industrial & storage buildings, service buildings, transport, other utilities & plant, environment, and sports & recreation.

work classified by nature of construction activity[18]. The survey for these data covers all main contractors at construction sites. In surveys before 1992, the economic activities of establishments were classified according to the International Standard Industrial Classification (ISIC). Starting from the first quarter of 1992, the Hong Kong Standard Industrial Classification (HSIC) is adopted, which was devised with the ISIC as a framework incorporating features of the local economy.

Since the objective of this research is to confirm the economic role of each type of construction activity, which serves different needs of the society, the detailed end-use group statistics will be used in the Granger Causality Tests. The detailed end-use construction activities are:

1. Residential buildings, which include public housing estates, private residential premises, government home ownership schemes, private sector participation schemes, government staff quarters, and composite commercial/residential buildings.

2. Commercial buildings, which include office buildings, hotels and boarding houses, and multi-purpose commercial premises.

[18] The activities are site formation & clearance, piling & related foundation work, erection of architectural superstructure, and civil engineering construction.

3. Industrial and storage buildings, which include flatted factory blocks, specialised factory buildings, warehouses, cold storages, and composite industrial/office buildings.

4. Service buildings, which include buildings for law & order, educational & training, medical & health, social welfare, religion, cultural & recreational, athletic, and other services.

5. Transport, which includes railways & mass transit systems, roads, highways, flyovers, bridges, tunnels, piers, wharves, container berths, other port works, and airport.

6. Other utilities & plants, which include electricity, gas, water, communication, dock works, and other industrial structures & facilities.

7. Environment, which includes drainage, refuse and sewer treatment, land formation and reclamation, landscaping, and slope protection.

8. Sports and recreation, which include gardens and parks, open playground, swimming pools and beach facilities.

As shown in Annex 4, the annual construction volume of each type of these activities has varied greatly. Residential buildings has been consistently the biggest construction activity in Hong Kong, followed by transport infrastructure construction and then by commercial buildings. Comparatively, other types of construction activity have been small in extent.

Quarterly data for the period from 1983 to 2002 will be used in the Granger Causality Tests. Quarterly data of the detailed end-use construction activities were first published in nominal values form by the Census and Statistics Department of Hong Kong in 1983. Constant values of the data were not available. Therefore, the constant 1990 values of the quarterly data will be calculated by applying the deflators derived from the annual broad end-use construction data, which broadly classifies the construction activities into buildings and structures & facilities categories. The building deflator will be used in the calculations for residential, commercial, industrial & storage, and service buildings construction activities; whilst the structures & facilities deflator for the remaining types of detailed end-use construction activities.

Using the quarterly data makes available 80 data in each data series, which is long enough to allow a lagged period of up to 12-quarters in the Granger Causality Tests.

The constant 1990 values of most types of the detailed end-use construction activities, as shown in Annex 4, remain fairly stable for the period studied in this research. The common upward increasing trend property of time series data seems not present in these data series. Closer inspection of their data in Annex 8 reveals that there is a degree of randomness, which suggests the data may be stationary. The stationary property of the data series, however, will be confirmed by the Dickey-Fuller Unit Root Tests and the level of significance is chosen to be 5%.

Also, the year-on-year absolute growth values of the construction activities, which are used for the Granger Causality Tests, did not exhibit an increasing trend. In other words, the magnitude of the growth values and the volatility of changes did not increase as the base values became larger. Therefore, it is considered acceptable to use the numeric difference of two consecutive periods to represent the growth of the construction activity in the Granger Causality Test equations. As a result, the Granger Causality Test equations of each type of the construction activities represent the direct relationships of the real growths of that construction activity and the general economy.

General economic growth will be represented by the real increase, or decrease, of GDP in two consecutive periods. GDP data are published by the Hong Kong Census and Statistics Department since 1961. However, the nominal quarterly GDP data are only available since 1973 and their corresponding constant 1990 values are not available until 1986. Therefore, the constant 1990 values of pre-1986 GDP data will be derived from the Volume Indices taken from the 2000 Gross Domestic Product published by the C&S Department. The constant 1990 GDP, as shown in Annex 1, exhibits an upward increasing trend. This is a sign that the data may not be stationary. Therefore, the data series will also be tested for the stationarity property by using the Dickey-Fuller Unit Root Tests. The level of significant chosen is also 5%.

Despite that the construction activities of transport infrastructure in the earlier period also exhibits a stable pattern, as shown in Annex 6, its construction activities began to surge upward in 1992 and peaked at 1996. The significant deviation from their past stable pattern suggests they were subjected to underlying influences that require examination. Therefore, the data series is broken down into 2 sub-periods, 1983 – 1992 and 1993 -2002, for Granger Causality Test analyses and the programme planning and construction implementation processes of these two periods are investigated.

3.5 Testing of Autocorrelation among the Disturbance Variables

It is important that the disturbance variables of the Granger Causality equations are uncorrelated. If they do, in addition to the influences of the independent variables in the equations, other influences might act on the dependent variables as a result of possible inter-correlations among the disturbances. To check for the existence of any autocorrelation of the disturbance variables of the Granger Causality Tests the Runs Test, which is also known as the Geary Test, is used.

A run is an uninterrupted sequence of "+" (positive) or "-" (negative) disturbances of the equations. The criteria for upholding the null hypothesis of randomness of the disturbances with 95% confidence is:

$$E(k) - 1.96\,\sigma_k \leq k \leq E(k) + 1.96\,\sigma_k \qquad \text{Equation 6}$$

Where k = number of runs

Mean: $E(k) = \frac{2n_1 n_2}{n_1 + n_2} + 1$

Variance: $\sigma_k^2 = \frac{2n_1 n_2 (2n_1 n_2 - n_1 - n_2)}{(n_1 + n_2)^2 (n_1 + n_2 - 1)}$

n = total number of observations = $(n_1 + n_2)$

n_1 = number of "+" disturbances

n_2 = number of "-" disturbances

3.6 Testing of Stationary Property of Data

Another very important pre-requisite of the Granger Causality Test is that the time series data must be stationary. If the data are not stationary the regression result would be spurious.

To test whether the data series are stationary Dickey-Fuller Unit Root Test is used. The basic Dickey-Fuller equation is expressed as:

$$\boldsymbol{D_t = \rho\, D_{t-1} + u_t} \qquad \text{Equation 7}$$

where $\boldsymbol{D}$ = the respective dependent and independent variable data; $\boldsymbol{u_t}$ is the stochastic error term that has zero mean, constant variable $\boldsymbol{\sigma^2}$, and is not auto-correlated.

If $\rho = 1$, then D_t is said to have a unit root and the time series is a non-stationary time series.

Equation 7 can be expressed in an alternative form:

$$\boldsymbol{\Delta D_t = \beta_1 + \delta D_{t-1} + u_t} \qquad \text{Equation 7a (without trend variable)}$$

$$\boldsymbol{\Delta D_t = \beta_1 + \beta_2 t + \delta D_{t-1} + u_t} \qquad \text{Equation 7b (with trend variable)}$$

where $\boldsymbol{\delta = (\rho - 1)}$; $\boldsymbol{t}$ = time or trend variable

If the error term u_t is auto-correlated, Equation 7b is modified, becoming the Augmented Dickey-Fuller equation:

$$\Delta D_t = \beta_1 + \beta_2 t + \delta D_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta D_{t-i} + \varepsilon_t \qquad \text{Equation 8}$$

In each case the null hypothesis is $\delta = 0$, or $\rho = 1$, which means an unit root exists and the time series D_t is non-stationary. To prove the hypothesis, the computed τ (tau) statistic of the D_{t-1} variable is compared with the MacKinnon (1991) Dickey-Fuller (DF) critical τ values. If the absolute value of the computed τ statistic is smaller than the absolute value of MacKinnon DF critical τ values the null hypothesis is not rejected, which means the given time series is not stationary.

3.7 Testing of Cointegration of the Time Series Data

If a time series is not stationary the regression result may be spurious. One method to overcome the nonstationarity problem is to use the first, or higher-order, difference of the time series data in the regression analyses.

Another method to address the nonstationarity problem of the time series data is to find out whether the time series are cointegrated, i.e. they are trending together. If the time series are cointegrated the regression equation for the time series data might be stationary and the regression result is not spurious.

To find out whether the time series are cointegrated or not the stationarity property of the disturbance values, u_t, of the regression equation is studied. If the disturbance values are stationary then the time series data of the regression equation are cointegrated.

For the Granger Causality Test equations the disturbance values are calculated by the following equations:

$$u_{1t} = E_t - \left(\sum_{i=1}^{n} \alpha_i C_{t-i} + \sum_{j=1}^{n} \beta_j E_{t-j}\right) \qquad \text{Equation 9}$$

$$u_{2t} = C_t - \left(\sum_{i=1}^{m} \lambda_i C_{t-i} + \sum_{j=1}^{m} \delta_j E_{t-j}\right) \qquad \text{Equation 10}$$

The test for the stationarity property of the disturbance values is similar to the Dickey-Fuller Unit Root Test. However, the critical significance values are those developed by Engle and Granger. This is why the test is called Engle-Granger (EG) Test. The Engle-Granger Test equation is expressed in the following forms:

$$\Delta u_t = \delta u_{t-1}$$ Equation 11a (without trend variable)

$$\Delta u_t = \beta t + \delta u_{t-1}$$ Equation 11b (with trend variable)

The null hypothesis is $\delta = 0$, which means an unit root exists and the time series u_t is non-stationary. To prove the hypothesis, the computed τ (tau) statistic of the u_{t-1} variable is compared with the Engle-Granger critical τ values[19]. If the absolute value of the computed τ statistic is smaller than the absolute value of critical value the null hypothesis is not rejected, which means the given time series is not stationary and the respective time series are not cointegrated.

3.8 Summary

Different types of construction activities serve different development and social functions of Hong Kong. This research will use the Granger Causality Tests to test the following hypotheses for the "detailed end-use" construction activities of Hong Kong, which consist of residential buildings, commercial buildings, industrial & storage buildings, service Buildings, transport, other utilities & plants, environment, and sports & recreation:

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[19] Engle and Yoo (1987)

Hypothesis 1

The growths of different types of construction activity in Hong Kong have different intrinsic causality relationships with economic growth in the period 1983-2002.

Hypothesis 2

The growth of transport infrastructure construction activity of Hong Kong has an intrinsic economic "growth-initiating" role in the period 1983-2002.

Hypothesis 3

The causality relationship of the growth of transport infrastructure construction activity with the economic growth has been different in the periods 1983-1992 and 1993-2002.

If Hypothesis 1 is proven, it would form the bases for the government to formulate different policies for different types of construction activity that aim to improve the construction industry's contribution to the society and its economy.

Hypothesis 2 would confirm whether the transport infrastructure construction activity in Hong Kong also posses the special economic initiating role that has been advocated by other researchers.

Hypothesis 3 intends to prove the economic role of transport infrastructure construction activity could be temporarily changed by external influences, such as different construction programme implementation approaches. If this hypothesis is confirmed and the different construction programmes implementation processes are the results of different government policies then it can be argued that government policy does have an effect on the economic role of the transport infrastructure construction activity.

Quarterly detailed end-use construction activities data of Hong Kong for the period from 1983 to 2002 will be used in the Granger Causality Tests. In total there are 80 data in each data series, which is long enough to allow a lagged period of up to 12-quarters in the Granger Causality Tests.

Before carrying out the Granger Causality Test the data series will be tested for their property of stationary by the Dickey-Fuller Unit Root Tests with the level of significance at 5%. If the data series are not stationary, there is possibility that the Granger Causality Test results would be spurious, and then it will be necessary to check whether the two data series are cointegrated. If the two data series are cointegrated they would be trending together and regression results would not be spurious. The mitigating measure for data series that are not stationary and not cointegrated is to carry out the regression analysis of the first, or higher-order, difference of the time series data.

Geary tests, otherwise known as Runs tests, will also be used to confirm that the disturbance variables are uncorrelated, and therefore not exerting any influences on the independent variables of the regression equations.

The research will then make reference to the history of Hong Kong's transport infrastructure planning and construction processes, an abridged history is in Appendix 1, to analyse the influences of these processes on the roles of the transport infrastructure construction activity with respect to the economic growth of Hong Kong in the 1983-1992 and 1993-2002. This will allow the influences of the government's policy on the short-term roles of Hong Kong's transport infrastructure construction activity to be interpreted. The analysis together with the test result of Hypothesis 3 will verify the second proposition of this research that the economic causality relationship of transport infrastructure construction may change due to the influence of its planning and construction processes.

The extent of the deleterious effects that have disrupted the development of the construction industry and the society due to the construction implementation process of the transport infrastructure programmes will also be investigated. This will give a more complete understanding of the economic and other roles of transport infrastructure construction activity and the effects that government policy have impressed on them. Based on this knowledge, the relevance of Hong Kong government's development policy for the industry will be reviewed and commented upon.

The next chapter presents the results of the Granger Causality Tests.

Chapter 4 Results and Findings

This chapter presents the results of the Granger Causality Test. All the regression analyses were done by using statistical programme SPSS 12.0. A discussion of the results with respect to the propositions described in Chapter 1 is given in Chapter 5.

4.1 Granger Causality Relations between the Growths of Construction Activities and GDP in the Period 1983-2002

Regression analyses of the Granger Causality Test equations were done for the 2-, 4-, 6-, 8- and 12-Quarter lagged data series. To ensure that the results are not spurious the stationary properties of the data series were tested and the autocorrelation of the disturbance values of the unrestricted Granger Causality Test equations were checked before the Granger Causality Test results were commented. The calculations are shown in the respective annexes and the results are summarised in the following sections.

4.1.1 Testing of Autocorrelation of the Disturbance Values

The disturbances values of the unrestricted Granger Causality Test equations were calculated and the numbers of runs (k), which are the number of uninterrupted sequence of positive or negative disturbances, were counted. The calculations for the 95% confidence limits of the run numbers (i.e. $E(k)-1.96\sigma_k \leq k \leq E(k) + 1.96\sigma_k$) are shown in Annex 9 and the results of the autocorrelation tests are summarised in Tables A and B.

Table A

Runs test results of the unrestricted Granger Causality equations
Construction Growth Causing GDP Growth

	2Q Lags	4Q Lags	6Q Lags	8Q Lags	12Q Lags
AC > GDP	–	–	–	–	–
RBD > GDP	–	÷	–	–	–
CM > GDP	–	–	–	–	–
IS > GDP	–	–	–	+	+
SB > GDP	–	–	–	÷	–
TP > GDP	–	–	–	–	–
UP > GDP	–	–	–	–	–
EN > GDP	–	–	–	–	–
SP > GDP	–	–	–	+	+

Table B

Runs test results of the unrestricted Granger Causality equations

GDP Growth Causing Construction Growth

	2Q Lags	4Q Lags	6Q Lags	8Q Lags	12Q Lags
GDP > AC	–	–	–	–	–
GDP > RBD	–	–	–	–	–
GDP > CM	–	–	–	–	–
GDP > IS	–	–	–	–	–
GDP > SB	–	–	–	÷	–
GDP > TP	–	–	–	–	–
GDP > UP	–	–	–	–	–
GDP > EN	–	–	┼	–	–
GDP > SP	–	–	–	–	–

Notes for Tables A and B:

– = Numbers of runs are within the 95% confidence limits. The hypothesis of randomness is not rejected.

÷ = Numbers of runs are marginally outside the 95% confidence limits. Assume the hypothesis of randomness is not rejected.

┼ = Numbers of runs are outside the 95% confidence limits. The hypothesis of randomness is rejected.

The numbers of runs of the disturbance variables of three Granger Causality Test equations are marginally outside the 95% confidence limits. The disturbance variables of these equations are assumed uncorrelated:

1. The 4-Quarter Lagged equation from Residential Building Construction growth to GDP Growth; and
2. The 8-Quarter Lagged equations between GDP growth and Service Buildings.

The numbers of runs of the disturbance variables of five Granger Causality equations are outside the 95% confidence limits. The disturbance values of these equations may be autocorrelated, therefore the Granger Causality Test results of these equations have to be viewed with care:

1. The 8- and 12-Quarter Lagged equations from Industrial & Storage Construction growth to GDP growth;
2. The 8- and 12-Quarter Lagged equations from Sports and Recreation Construction growth to GDP growth; and
3. The 6-Quarter Lagged equation from GDP growth to Environment Construction growth.

Overall, the autocorrelation analyses show that the disturbance values of majority of the Granger Causality Test equations for the period in 1983 to 2002 are not autocorrelated. Subject to the confirmation that the data series are stationary the results of the Granger Causality Tests can then be analysed with confidence.

4.1.2 Testing of Stationarity of Data

All data used in the Granger Causality Tests are tested for the stationary property by Dickey-Fuller Unit Root Tests. Since some of the causality equations have their disturbance values showing autocorrelation property the Augmented Dickey-Fuller Tests are also run for these data series. The computed τ (tau) statistics of the parameter δ for the respective regressions are shown in Annex 10 and are reproduced in Table C.

The null hypothesis of the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) Unit Root Tests is H_0: $\delta = 0$. The significance level chosen is 5%.

It is found that all τ values of the parameter δ for the respective DF and ADF Tests are greater than the 5% significant values. This means all data series are stationary, which allows the Granger Causality Test results to be analysed with confidence.

Table C

Dickey-Fuller Unit Root Tests, 1983-2002

	τ (tau) statistic of DF Tests		τ (tau) statistic of ADF Tests	
D	no trend	with Trend	no Trend	with Trend
GDP	-8.53*	-8.47*	-24.71*	-24.58*
AC	-14.54*	-14.50*	---	---
RBD	-14.01*	-13.98*	-7.70*	-7.71*
CM	-9.85*	-9.80*	---	---
IS	-12.38*	-12.31*	-5.31*	-5.30*
SB	-11.91*	-11.97*	-8.24*	-8.34*
TP	-8.65*	-8.59*	---	---
UP	-9.99*	-9.92*	---	---
EN	-11.33*	-11.26*	-7.98*	-7.93*
SP	-11.59*	-11.61*	-8.65*	-8.69*

Note:

***** = τ values greater than the 5% significant Critical Values

4.1.3 Granger Causality Test Results

The Granger Causality Test results are shown in Annex 11 and the corresponding F Value calculations are shown in Annexes 12 and 13 respectively. The computed F Values for the respective Granger Causality relationships are summarised in Annex 14 and are reproduced in Table D and E.

The null hypothesis of the analyses is H_0: $\sum_{i=1}^{n} \alpha_i = 0$ for the proposition that the growths of detailed end-use construction activities of Hong Kong had Granger caused the growths of GDP. The significance level is 5%. If the computed F value exceeds the critical F value at 5% significance the null hypothesis that $\sum_{i=1}^{n} \alpha_i = 0$ is rejected, which means the detailed end-use construction activity growth had been Granger causing GDP growth in the period 1983-2002.

For the reverse causality relationship, the null hypothesis is H_0: $\sum_{i=1}^{m} \lambda_i = 0$. Again, if the computed F value exceeds the critical F value at 5% significance the null hypothesis that $\sum_{i=1}^{m} \lambda_i = 0$ is rejected, indicating that GDP growth of Hong Kong had Granger caused the growth of the detailed end-use construction activity.

Table D

Detailed End-Use Construction Growth Causing GDP Growth, 1983-2002

	2Q Lags	4Q Lags	6Q Lags	8Q Lags	12Q Lags
AC > GDP	10.32*	5.53*	4.93*	6.60*	4.97*
RBD > GDP	7.75*	3.94*‡	3.33*	4.26*	3.91*
CM > GDP	1.85	2.10	0.70	0.94	1.66
IS > GDP	1.61	2.41	1.70	1.77†	1.59†
SB > GDP	3.61*	4.63*	1.76	1.53‡	1.06
TP > GDP	6.00*	1.21	2.83*	3.40*	1.92
UP > GDP	6.73*	2.88*	1.55	1.02	0.74
EN > GDP	1.27	1.29	0.78	0.49	0.80
SP > GDP	2.71	0.74	1.40	0.81†	1.00†

Table E

GDP Growth Causing Detailed End-Use Construction Growth, 1983-2002

	2Q Lags	4Q Lags	6Q Lags	8Q Lags	12Q Lags
GDP > AC	22.58*	2.43	1.44	0.92	1.03
GDP > RBD	10.78*	1.63	1.26	1.15	1.21
GDP > CM	6.94*	2.41	1.10	1.06	1.70
GDP > IS	5.81*	3.31*	2.81*	1.83	1.67
GDP > SB	2.61	3.27*	2.25*	2.03‡	1.97
GDP > TP	2.97	1.43	2.01	1.12	1.25
GDP > UP	1.64	2.81*	1.98	2.04	0.90
GDP > EN	3.05	2.84*	2.54*†	1.33	1.36
GDP > SP	5.12*	2.15	2.13	1.46	1.27

Notes for Table D and E:

* = 5% significance

† = Disturbances autocorrelated

‡ = Number of Runs of the disturbances marginally outside the limits, assume no autocorrelation

§ = Time series not stationary

The analyses show that growths of different types of construction activity in Hong Kong have had different causality relationships with the GDP growth in the relatively long period of 20 years from 1983 to 2002. Transport infrastructure construction activity, in particular, has shown a clear "growth-initiating" property, which suggests that this could be the intrinsic role of transport infrastructure construction activity with respect to the economic growth.

4.2 Granger Causality Relations between the Growths of Transport Infrastructure Construction Activity and GDP in the Periods 1983-1992 and 1993-2002

Regression results of the Granger Causality Test equations of transport infrastructure construction activity growth and GDP growth in the periods 1983-1992 and 1993-2002 are shown in Annexes 18 and 19. Again, before the results are analysed the autocorrelation property of the disturbance values of the Granger Causality Test equations and the stationary property of the time series data for the two periods of time were tested.

4.2.1 Testing of Autocorrelation of the Disturbance Values

The Runs Test results are presented in Annexes 15 and 16 and are summarised in Tables F and G. The null hypotheses of randomness of the disturbances with

95% confidence is accepted if the number of runs (k) are between the limits

$E(k)-1.96\sigma_k \leq k \leq E(k)+1.96\sigma_k$.

Table F

Runs test results of the unrestricted Granger Causality equations
Between Transport Construction growth and GDP Growth, 1983 - 1992

	2Q Lags	4Q Lags	6Q Lags	8Q Lags	12Q Lags
TP > GDP	–	–	–	–	+
GDP > TP	–	–	–	–	–

Table G

Runs test results of the unrestricted Granger Causality equations
Between Transport Construction growth and GDP Growth, 1933 - 2002

	2Q Lags	4Q Lags	6Q Lags	8Q Lags	12Q Lags
TP > GDP	–	–	–	–	–
GDP > TP	–	–	–	–	–

Notes for Tables F and G:

– = Numbers of runs are within the 95% confidence limits. The hypothesis of randomness is not rejected.

+ = Numbers of runs are outside the 95% confidence limits. The hypothesis of randomness is rejected.

The results show that the Hypothesis of Randomness of the disturbance variables cannot be rejected for all the unrestricted Granger Causality Test equations, except the 12-Quarter lagged equation from transport infrastructure construction activity growth to GDP growth in the period 1983 – 1992. Therefore, subject to the confirmation that the data series are stationary the results of the all Granger Causality Test equations between the growths of transport infrastructure construction activity and GDP in the periods 1983 – 1992 and 1993 -2002, except this one, can then be analysed with confidence.

4.2.2 Testing of Stationarity of Data

The Dickey-Fuller Unit Root Test results are presented in Annex 17 and are reproduced in Table H. Since the disturbance values of 12-Quarter lagged Granger Causality Test equation for the growths of transport infrastructure construction activity and GDP in the period 1983 – 1992 are autocorrelated the Augmented Dickey-Fuller Unit Root Test are performed for the data series in this period. Again, the null hypothesis of the Dickey-Fuller and Augmented Dickey-Fuller Unit Root Tests is H_0: $\delta = 0$. The significance level chosen is 5%.

Table H

Dickey-Fuller Unit Root Tests

		τ (tau) statistics (DF Tests)		τ (tau) statistics (ADF Tests)	
Period	D	no trend	with Trend	no Trend	with Trend
1983-1992	GDP	-6.03*	-5.95*	-17.32*	-17.06*
	TP	-7.02*	-7.12*	-4.78*	-4.90*
1993-2002	GDP	-5.76*	-5.68*	---	---
	TP	-5.65*	-5.63*	---	---

Note: * = 5% significance

The absolute values of all the computed τ (tau) statistics are found to exceed the absolute value of MacKinnon DF and ADF critical values. The null hypothesis is therefore not rejected. The result means the respective time series are stationary. Therefore, the Granger Causality Test results are not spurious.

4.2.3 Granger Causality Test Results

The calculations for the F Values of the Granger Causality Test equations for the growths of transport infrastructure construction activity and GDP in the periods 1983 – 1992 and 1993 - 2002 are shown in Annexes 20 and 21 respectively. The computed F Values for the respective Granger Causality relationships are summarised in Annex 22 and are reproduced in Tables I and J. Again, the null hypotheses are H_0: $\sum_{i=1}^{n} \alpha_i = 0$ and H_0: $\sum_{i=1}^{m} \lambda_i = 0$. The significance level is 5%.

Table I

Transport Construction Growth Causing GDP Growth

Period	2Q Lags	4Q Lags	6Q Lags	8Q Lags	12Q Lags
1983-1992	1.43	1.00	1.60	2.12	2.13†
1993-2002	4.37*	0.43	1.67	1.56	0.73

Table J

GDP Growth Causing Transport Construction Growth

Period	2Q Lags	4Q Lags	6Q Lags	8Q Lags	12Q Lags
1983-1992	2.47	0.92	1.82	1.06	0.47
1993-2002	1.79	0.87	0.96	0.47	11.94*

Notes for Tables I and J:

* = 5% significance

† = Disturbances autocorrelated

The results show that the Granger causality relationships between the growths of transport infrastructure construction activity and GDP during the two periods of time are different. Whilst in 1993 – 2002, the growth of transport infrastructure construction activity had caused GDP growth with a 2-quarter leading period, the reverse relationship also existed with GDP growth leading by 12-quarter. There was no causality relationship between the two variables in the 1983 – 1992. They show that although the intrinsic economic role of transport infrastructure construction activity is growth-initiating its shorter-term role is not so definite. The results suggest that short-term economic role of transport infrastructure construction activity, and by extension other types of construction activities, could be also be changed.

4.3 Summary

The analyses show that growths of different types of construction activities in Hong Kong, as represented by the detailed end-use construction activities data, have had different causality relationships with the GDP growth in the relatively long period of 20 years from 1983 to 2002.

Transport infrastructure construction activity, in particular, has shown a clear economic “growth-initiating” property in the period 1983 - 2002, which suggests that this could be its intrinsic economic role. However, its shorter-term economic roles are different and only in 1993 – 2002 that it maintain the “growth-initiating” property. In 1983 -1992, there is no causality relationship between this type of construction activity and the GDP. This phenomenon could be caused by the different construction activity patterns, which were changed by the planning and implementation processes of the construction programmes.

The results suggest that although transport construction activity has caused economic growth of Hong Kong in the long-term its shorter-term effect is not so definite. It indicates that short-term causality effect could be influenced by the government’s policies, which change the implementation of the construction programmes. Therefore, if the government wishes to reap the most benefits from the transport infrastructure construction activity it should pay special attention to the construction programme planning and implementation processes.

A discussion of the intrinsic economic roles of different construction activities will be made in the next chapter. The influences of the planning and implementation processes on the construction programmes of the transport infrastructure construction activity and the effects on the economic growth of Hong Kong in the 1983-1992 and 1993-2002 will be analysed. The deleterious effect of the construction activities, induced by the construction programme implementation processes, will also be identified. Based on the analyses, the relevance of the recommendations of previous researchers with regard to the development policy of Hong Kong's construction industry will be reviewed and commented.

Chapter 5 Economic and Non-economic Roles of Transport Infrastructure and Other Construction Activities

Granger Causality Test results presented in Chapter 4 show that different types of construction activity in Hong Kong have different economic roles in the period from 1983 to 2002. The results also show that the economic role of transport infrastructure construction activity is clearly "growth-initiating". However, this economic "growth-initiating" property has been muted in the shorter periods of 1983 – 1992 and 1993 – 2002, the reasons of which will be investigated in this chapter.

This chapter presents a discussion of the probable bases of the economic roles of the different types of construction activity of Hong Kong and the reasons of transport infrastructure construction activity shifting from its intrinsic economic "growth-initiating" role in different periods of time. It discusses the proposition that it is the planning and implementation processes of the construction programmes that change the short-term economic role of transport infrastructure construction activity of Hong Kong. The discussion refers to the planning and construction implementation processes of Hong Kong's transport infrastructure construction programme, an abridged history of which is presented in Appendix 1.

It also identifies the non-economic roles played by Hong Kong's transport infrastructure construction activity as a result of the planning and construction programme implementation processes.

5.1 Intrinsic Economic Roles of Construction Activities

Table K below shows a complete picture of the economic roles of all types of detailed end-use construction activity of Hong Kong in the period of 1983 -2002 concluded from the Granger Causality Tests. As 20 years is a relatively long period of time during which the economic roles of the construction activities are subjected to the influences of many social and economic factors it is probable that the results reflect the intrinsic economic roles of the construction activities. The shaded cells indicate where causality relationships exist between the growths of the construction activities and GDP with the F statistics that are at 5% or higher significant level. The results confirm that the growths of different types of construction activity in Hong Kong have different intrinsic causality relationships with GDP growth in the period 1983-2002. Therefore, Hypothesis 1 cannot be rejected. As each type of detailed end-use construction activity serves different social and economical needs of Hong Kong it is not illogical that their intrinsic economic roles are different.

Table K

Detailed End-Use Construction Activities of Hong Kong
Intrinsic Economic Roles (1983 – 2002)

Detailed End-Use Construction Activities	Leading/Lagging period (No. of quarters)									
	Economic "Growth Initiating" Role					Economic "Growth Dependent" Role				
Residential Buildings	**2**	**4**	**6**	**8**	**12**	**2**	4	6	8	12
Commercial Buildings	2	4	6	8	12	**2**	4	6	8	12
Industrial & Storage Buildings	2	4	6	8	12	**2**	**4**	**6**	8	12
Service Buildings	**2**	**4**	6	8	12	2	**4**	**6**	8	12
Transport	**2**	4	**6**	**8**	12	2	4	6	8	12
Other Utilities & Plants	**2**	**4**	6	8	12	2	**4**	6	8	12
Environment	2	4	6	8	12	2	**4**	**6**	8	12
Sports & Recreation	2	4	6	8	12	**2**	4	6	8	12
All Construction	**2**	**4**	**6**	**8**	**12**	**2**	4	6	8	12

Note: Shaded cells indicate where causality relationships exist between the construction activities and GDP growth with the F statistics that are at 5% or higher significant level.

The results also show that the leading/lagging periods between the causality relationships are different. These are evidences confirming that the leading/lagging relationships between different construction activities and economic growth take different time duration to work out. It is expected that investment confidence riding on economic growth would lead to speedier capital investment decisions of the private developers. This is usually the case in the private sector of Hong Kong where astute businessmen are very sensitive to market movement. For residential, commercial and industrial & storage buildings, the response period is as quickly as 2-quarters. Comparatively, the decision making process of the public sector is more circumspect and the planning and development period for public works construction, such as service buildings and environmental construction, are longer. On the other hand, the economic "growth-initiating" effect of the construction activities takes longer period of time to happen, because full economic causality effect would not happen until the whole project is completed and fully operational. For example, the period of response for transport infrastructure construction activity is 6 to 8 quarters. This is one additional effect that the government has to take into account when launching a massive construction programme.

The intrinsic economic roles of Hong Kong's construction activities in the period 1983 – 2002 are discussed in the following sections.

Residential Buildings

Granger Causality Test results of all equations from 2-quarter to 12-quarter lagged periods show residential buildings construction activity of Hong Kong had caused the growth of GDP in the period 1983 – 2002. The results agree with the conclusion of Green (1997). They, however, are contrary to the common belief that residential buildings construction activity is economic "growth-dependent", as was suggested by Wells (1985) and Ball & Wood (1996). They show that this type of construction activity in Hong Kong is intrinsically economic "growth-initiating".

This is an example showing that the economic role of a construction activity is not immutable. The reason for the economic role of Hong Kong's residential buildings construction deviating from the normally expected one is probably due to the strong desire of Hong Kong people, following an old Chinese custom, for owing their permanent base of residence. Such desire, coupled with the population growth in the 1970s to 1990s, drove a strong demand for new housings. Residential buildings construction, therefore, was the largest type of construction activity in Hong Kong during this period of time. In the mid 1980s to 1990s, residential buildings construction activity was consistently more than 40% of the total construction output[20] and was the most significant economic activity. Such an incessant demand for residential buildings drove the

[20] Annex 4

construction activity to become an economic initiator of the time.

In addition, residential buildings construction activity in Hong Kong is more than just providing housings for the people. The residential buildings are also a major, and sometime speculative, investment of the people. The fervent investment activity has caused a marked inflation of the housing prices as shown in Annex 23[21], which has also a boosting effect on the economy.

Although the residential buildings construction activity in Hong Kong shows a strong economic “growth-initiating” role, its economic “growth-dependent” character also exists. The result shows that residential buildings construction growth in Hong Kong lags behind GDP growth by a 2-quarter period. The short responding period suggests the property developers are quick at initiating new residential construction projects in a strong economic growth period.

Commercial Buildings

Contrary to the finding of Ball & Wood (1996) that non-residential buildings had bilateral economic causality relationships with GDP per person employed in the UK during the Pre-War period Granger Causality Test results show that the intrinsic economic role of Hong Kong’s commercial buildings construction is

[21] Annex 23

“growth-dependent only, as was found by Green’s (1997). The result that commercial buildings construction activity does not initiate economic growth is at odds with the belief that better office and commercial buildings should improve the efficiency of commercial activities, which should lead to economic growth. It suggests the influence of Hong Kong’s commercial buildings on the productivity of the commercial activities is probably insignificant. The construction activity of commercial buildings is also probably too small anyway to invoke any economic growth.

The results that GDP growth has led commercial buildings construction activity growth by a 2-quarter period attests to the economic “growth-dependent” role of commercial buildings constriction activity in Hong Kong. It confirms that property developers in Hong Kong are quick at launching new commercial buildings construction projects in response to an economic growth environment.

Industrial and Storage Buildings

The intrinsic economic role of industrial and storage buildings construction activity in Hong Kong is different from the result of Ball & Wood (1996). It is also contrary to the belief that the economic role of the construction activity should be “growth-Initiating”, which might be the case for the industrialized economies.

Nevertheless, it is reasonable that industrial and storage buildings construction activity in Hong Kong does not have an intrinsic economic “growth-initiating” role. The manufacturing industry in Hong Kong has shrunk since the mid-80s and its contribution to the economy has dwindled. As a result, the number of persons engaged in the sector has drastically decreased[22]. Also, the construction activity of industrial and storage buildings is too small to initiate any direct economic growth anyway.

The intrinsic economic “growth-dependent” role of industrial and storage buildings construction activity is unmistakably clear from the Granger Causality Test results. It shows manufacturers in Hong Kong are conservative in investing in industrial and storage buildings and has done so only when they see the economy prospering.

Service Buildings

The intrinsic economic role of service buildings construction activity in Hong Kong is both “growth-initiating” and “growth-dependent”. The dual-role property of this type of construction activity can be explained by the reason that Hong Kong government has adopted a conservative policy for providing and improving

[22] Annex 24

this kind of public facilities, resulting in their quality standard lagging behind the society's economic development. Because of this policy, the government has inadvertently adopted the "development-via-shortage" strategy as was advocated by Hirshman (1958), which causes the potential labour productivity to accrue. When better facilities, such as those for health care and education, are provided the quality of labour force is also improved. Eventually the potential labour productivity is released in a relatively short period of time, hence revealing its economic "growth-initiating" role.

The reversed economic "growth-dependent" role confirms Hong Kong government's conservative financing policy for this type of facilities, resulting in the construction of these facilities to lag behind Hong Kong's economic development by a 4 to 6-quarter period.

Transport

The intrinsic economic role of transport infrastructure construction activity in Hong Kong is evidently "growth-initiating". This is shown by the Granger Causality Test results that transport infrastructure construction activity had been leading GDP growth by 2-, 6- and 8-quarter periods. Hypothesis 2, therefore, cannot be rejected.

The results confirm that Hong Kong's effort to continuously modernise its transport infrastructure is pivotal to the growth of its economy. Improvement to transport infrastructure helps the development of social and economic activities, such as facilitating movements of goods and people, hence improving the efficiency of the economy. Logically, one can assume that this effort has facilitated the dramatic growth of Hong Kong's important trading activity since the 1980s[23]. This should be the case because trading activity involves the movement of goods for which an efficient transport infrastructure is absolutely essential.

Although rapid economic growth puts pressure on the existing transport infrastructure, a society may not be able to improve it promptly because of many constraints, such as other social and political considerations and the lack of resources. The history of planning and implementation processes of Hong Kong's transport infrastructure construction programmes bears out the complex situation that Hong Kong government has faced in the development process. Also, hindrance and delay to the construction programme can happen because of the long gestation period and the complex delivery process. Any blunder in planning and construction of the projects can delay their completion dates.

[23] Annex 5

Hong Kong's economic development must have been restricted by these short-term delays. However, when the bottleneck is removed Hong Kong's economic growth would surge ahead. Despite of these short-term impediments the government's adherence to the perennial transport infrastructure improvement policy has assured its intrinsic "growth-initiating" role.

Other Utilities & Plants

The intrinsic economic role of other utilities and plants construction activity is also both "growth-initiating" and "growth-dependent. This is shown by the Granger Causality Test results that the construction activity leads GDP growth by 2- and 4-quarter periods, and in turn lags GDP growth by a 4-quarter period. The "growth-initiating" role is expected of this type of construction activity. But the "growth-dependent" role would have been caused by the conservative "development-via-shortage" strategy of Hong Kong government and the private developers.

Environment

The result of the 6-quarter lagged equation is dubious, due to autocorrelation of the disturbance values of this equation. However, the result of the 4-quarter lagged equation cannot be disputed. Therefore, the intrinsic economic role of environment construction activity in Hong Kong is “growth-dependent”.

Environmental protection has not been an important social development priority of Hong Kong until recently. Before the 1990s the expenditure on this type of construction activity has been very small and was always lagging behind the economic development. As environmental protection becomes an important public policy of Hong Kong its related construction activity will increase with economic growth in the future.

Sports & Recreation

As is expected, the intrinsic economic role of sports and recreation construction activity is “growth-dependent” because Granger Causality Test results only show the growth of this type of construction activity lags behind GDP growth by a 2-quarter period. The result is not surprising because Hong Kong has invested very little in this type of public facilities. As economy of Hong Kong grows the people would demand better quality of life, which prompts the government to build more sports and leisure facilities.

All Construction

Granger Causality Test results show that the growth of all construction activity had been causing the growth of GDP in Hong Kong for all the equations with different time-lagged periods ranging from 2 to 12 quarters. The results show conclusively that the intrinsic economic role of the construction activity in Hong Kong, as a whole, is “growth-initiating”. However, the conclusion, though in agreement with the view of the Modernists, is not helpful to the formulation and implementation of the development policies for the society and the construction industry. With different construction activities each possessing a different intrinsic economic role it is natural to expect that result of the policies would have precarious results if an arbitrary construction programme is chosen to initiate the economic growth. If the government wishes to revive a depressed economy by embarking on a substantial construction programme, the type of construction activity of the programme has to have an intrinsic economic “growth-initiating” role. Otherwise, it cannot accomplish the objective and the society’s valuable resources would be wasted.

In the case of Hong Kong, the intrinsic economic “growth-initiating” role of the construction activity as a whole is exactly the same as that of the residential buildings construction activity. The resemblance suggests a strong influence of residential buildings construction activity on the overall intrinsic economic role of construction activity in Hong Kong. But, since the government has little control of the private sector, which constructs most of the residential buildings, it is unlikely that it can use the residential buildings construction activity to stimulate the economy. Therefore, transport infrastructure construction activity, which is the biggest construction activity in terms of values subjected to manipulation by the government and with an intrinsic economic "growth-initiating" role, is a *de jure* economic invigorator.

5.2 Short-term Economic Role of Transport Infrastructure Construction Activity

Although transport infrastructure construction activity of Hong Kong has a clear intrinsic economic "growth-initiating" role, Granger Causality Test results for the shorter periods of 1983 – 1992 and 1993 – 2002 show that its short-term economic role is not as definite. The results are summarised in Table L below.

Table L

Transport Infrastructure Construction of Hong Kong

Short-term Economic Role

(1983 – 1992 and 1993 – 2002)

Transport Infrastructure Construction	Leading/Lagging period (No. of quarters)									
	Economic "Growth Initiating" Role					Economic "Growth Dependent" Role				
1983 – 1992	2	4	6	8	12	2	4	6	8	12
1993 – 2002	2	4	6	8	12	2	4	6	8	12

Note: Shaded cells indicate where causality relationships exist between transport infrastructure construction activity and GDP growth with the F statistics that are at 5% or higher significant level.

The results show that there is no causality relationship between transport infrastructure construction activity and the economic growth in 1983 – 1992, whereas in the 1993 – 2002 the economic role of transport infrastructure construction activity is both "growth-initiating" and "growth-dependent". The economic role of transport infrastructure construction is, therefore, different in the two periods of time and Hypothesis 3 cannot be rejected.

Obviously, the economic role of transport infrastructure construction activity in these two periods of time had been changed by some important reasons. Although the planning process of the transport infrastructure projects was basically the same in the 1983 – 1992 and 1993 – 2002, the government had to adjust the implementation process of the construction programmes in order to meet the commanding needs of the society at various points in time. These were not always economical needs and in many occasions they were social and political. The differences in the implementation process of the construction programmes manifested by the greatly varying expenditure patterns, which are evidently shown in Annex 6, had caused the short-term roles of transport infrastructure construction activity to deviate from its intrinsic economic "growth-initiating" role.

5.2.1 Short-term Economic Role in the 1980s

Because of the underlying transport demand-forecasting methodology of the first comprehensive transport study (CTS-1), the proposed transport infrastructure construction programme for the 1980s was essentially development-led and economic-driven. For example, the demand for major road system to serve the New Territories was impelled by the development of seven new towns in Northern New Territories, of which six of them were in full swing at that time. As distributing large concentrations of population and manufacturing industries to the New Territories would create huge demand for transport services, many roads projects in the programme were to link the new town to each other and to the urban centres[24].

According to Kwong (2001), decisions for transport infrastructure construction in the 1980s were made purely from the government's perception of the best solution for serving the public at large. The transport infrastructure construction projects were to meet the transport needs of the society and were not necessarily aimed at economic development.

At a time in the 1980s when Hong Kong was set about a phenomenal expansion and a major demographic redistribution to the new towns the proposed projects in CTS-1 were enthusiastically welcome by the people of Hong Kong. They believed that the projects would ease traffic congestion, bringing to them convenience. There was little impediment to the transport infrastructure construction programme as other considerations, such as environmental protection, were less important to the society at that time. The enthusiasm of the public for a better transport infrastructure system was shown clearly in 1980 when they won the plea for a full mass transit Island Line in favour of a light rail that was originally proposed by the government[25]. This social environment was conducive to the full implementation of the proposed transport infrastructure

[24] 20 Nov 1976, SCMP, "$10 billion in 5 years to boost transport"
[25] 20 May 1981, HK Standard, "Island line work starts in October, MTR man says"

construction programme roughly in the timeframe proposed in the White Paper on Internal Transport Policy (1979) in a controlled manner with little social or political interference. By 1985, many of the major projects in the programme had already begun[26].

The importance that Hong Kong government attached to these transport infrastructure construction projects is also indisputable. It was not that the economy had always been prosperous enough to support this level of expenditure. During this period, Hong Kong's economy had been disturbed by several major social and economic incidents such as the World recession in 1982, Sino-British talk on the future of Hong Kong in 1983, the World's stock crash in 1987, and the Beijing Tinanmen incident in 1989. These incidents had battered the confidence of the people badly and slowed down Hong Kong's economic growth greatly. Yet, during these times of less robust economy, the government did not reduce significantly the investment in transport infrastructure construction. For example, despite a forecast budget deficit of $2.2 billion in 1985/86 the government still pledged full financial support to the construction of public works for the new towns[27].

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[26] 31 Oct 1985, SCMP, "Transport policies on the move"
[27] 17 May 1985, SCMP, "All systems go for new towns"

The government had in some occasions, such as during the Sino-British talk on the future of Hong Kong in 1983 and 1984, expanded significantly the transport infrastructure construction expenditure when it felt necessary to shore up public confidence[28].

Yet, the government was also prudent to make sure that the physical and financial capacity was not exceeded during the construction of these transport infrastructures. It would not construct a less imminent project that would strain the financial situation of Hong Kong. Sir Brembridge's comment that the government should not keep pouring money into the MTRC and his decision with regard to stopping the expansion of the mass transit system after the Island Line until the debts were repaid is a strong evidence of this transport infrastructure programme implementation policy[29]. On the other hand, it had not intentionally used the transport infrastructure construction programmes to spur short-term economic growth in this period either.

The government, however, was also careful not to allow a plethora of construction activities to overburden the economy. When the economy was running very close to its full capacity resulting in a tight labour market and

[28] 12 Jan 1983, SCMP, Billions earmarked for road projects
[29] 24 May 1986, HK Standard, "Bittersweet finale for Island Line"

accelerating inflation in 1988 the government had restrained public spending on transport infrastructure construction.

During this period of time, the government faithfully implemented the rationally planned construction programme proposed in CTS-1, which helped it to successfully achieving its goal of meeting the social and economic needs for transport infrastructure timely. The reckoning process for the forecasted demand and anticipated additional capacity of the new transport infrastructure essentially connotes that the transport infrastructures were constructed just-in-time to fulfil the transport needs in tandem with social and economic growth. As observed by Chan (1990), the approach adopted by CTS-1 signifies a move towards forward rational planning in the formulation of transport policy for Hong Kong.

The implementation process by constructing the new transport infrastructure just-in-time obscured the causality relationships of transport infrastructure construction activity with the economic growth and paled its economic "growth-initiating" role in this period of time. Granger Causality Test results show that the causality relationship between transport infrastructure construction activity and the economic growth was tenuous. None of the test results in either causality direction shows a significant level of 5% or higher. Nevertheless, the just-in-time approach had resulted in a persistent investment pattern of transport infrastructure that was one of the bases supporting the economic growth during this period of time and the transport infrastructure constructed in this period of time is still a substantial part of Hong Kong's modern transport system serving the society and economy well.

5.2.2 Short-term Economic Role in the 1990s

The implementation process of the transport infrastructure construction programme in the 1990s was obviously different from that in the 1980s. Although the second comprehensive transport study (CTS-2) was also carried out by the same rational demand matching approach used in CTS-1, the transport infrastructure construction programme included in the White Paper on Transport Policy (1990) was drafted up differently from the previous one. When the government finalised writing the second White Paper it did not only include the rationally planned transport infrastructure projects proposed in CTS-2. In addition, projects of the massive Port and Airport Development Strategy (PADS) programme were also added. The decision was a political one, intended to shore up public confidence shattered by the June 4 incident in Beijing in 1989[30].

[30] 25 Sept 1989, South China Morning Post, "Governor's speech looks to the future"

Although the port projects of PADS were eventually postponed and political negotiation between the UK and China governments had delayed commencement of several major airport related projects, the Airport Core Programme (ACP) projects still dominated the transport infrastructure construction programme in the 1990s.

The pre-1997 government had originally intended to complete the ACP projects before the unification of Hong Kong with China. In order to achieve this importance political mission the government had to defer some rationally planned transport infrastructure projects in CTS-2 so as to reduce the pressure of profuse construction activities on the economy. The deviation from the rational implementation approach of the transport infrastructure construction programme, as was in the 1980s, had the effect of changing the economic role of the construction activities during the 1993 – 2002.

Firstly, the rush to complete the massive ACP projects before the 1997 reunification date had heightened the transport infrastructure construction volume from less than $6,000 million in 1991 to almost $18,000 million in 1996[31]. The abounding construction activities had considerable short-term invigorating effects on the economy and continued to buoy the economy growth for several

[31] Annex 6

consecutive years during the construction of the ACP projects[32]. The invigorating effect is confirmed by the Granger Causality Test results showing transport infrastructure construction activities initiated an almost immediate GDP growth in this period of time, with a leading period of 2 quarters. This confirms that the transport infrastructure construction activity in the 1990s fulfilled the intended economy actuating role that the government had wished them to take.

Secondly, although the government had pushed ahead the ACP projects aggressively, protracted negotiation between the UK and China delayed the construction of Chek Lap Kok Airport, the airport railway and Route 3 highway. By the end of 1993, construction of seven other government financed ACP projects had started and was achieving good progress[33]. However, it was not until June 1995 that the two governments fully settled their differences on the financial arrangement of the remaining three projects, allowing their construction programmes to proceed in full speed[34]. By that time, the abounding construction activities had already sustained a thriving economy. The construction industry was working above its full capacity and a serious construction worker shortage problem had appeared. There were already calls

[32] 22 Jun 1994, SCMP, "Building supports HK GDP"
[33] 16 Dec 1993, SCMP, "PAA chief remains optimistic"
[34] 14 Jan 1996, SCMP, "Chek Lap Kok set for second boom"

for importation of foreign construction workers in order that the completion deadlines of the ACP projects could be met[35]. The additional construction activities of the three remaining ACP projects made the situation even worse. Granger Causality Test results show that transport infrastructure construction activities were dependent on the economic growth in the 1990s, with a lag of 12 quarters. As a matter of fact, it was political haggling that had delayed the construction activities by three years.

Giving priority to the ACP projects was not the only reason that delayed other rationally planned transport infrastructure projects in CTS-2. Kwong (2001) attributed the significant slippage to the construction of the strategic highways to public voices and environmental restraints. She argued that unlike previous objective of the government to solely improve and maintain traffic mobility the second White Paper on transport extended the objective to embrace social and environmental sustainability. This change in policy made the transport infrastructure construction programmes no longer purely economic led and development driven. Indeed, as it became more apparent later, public opinions supporting environmental protection greatly influenced all future transport infrastructure construction programmes.

[35] 28 Oct 1993, South China Morning Post, “PAA urges fast import of labour”

5.3 Basis of the Intrinsic Economic "growth-initiating" Role

It is clear from this research that Hong Kong government's transport infrastructure construction planning has been consistently development led in the three decades from the 1970s to the 1990s, as transport infrastructure projects were planned to support the social and economic development of Hong Kong. This objective was achieved in CTS-1 and CTS-2 for the 1980s and 1990s respectively by reckoning the transport demand of the society with the additional potential capacity of the planned transport infrastructure projects.

Despite the rational development led planning policy the actual construction implementation process was different in different periods of time. In the 1970s, it was ad hoc and aimed at meeting the pressing social and economic needs. During the 1980s, the transport infrastructure construction programme was rationally implemented, whilst in the 1990s, political decisions dominated the implementation process. As discussed in Sections 5.2.1 and 5.2.2, the different implementation approaches of the construction programmes made transport infrastructure construction activity playing different economic roles in the 1980s and 1990s. The evidence is a manifestation of the influence of policy planning and construction programme implementation processes on the short-term economic role of the transport infrastructure construction activities in Hong Kong.

In reality, it is impossible for a government not to adjust the rationally planned transport infrastructure construction programme so that it can direct the resources to other usages for meeting the imminent social needs arising from the prevailing social, economical and political situation. Hong Kong government has faced the same dilemma many times in the 1980s and 1990s, and was obliged to adjust the short-term construction programme of transport infrastructure projects. Nevertheless, its resolution in continuously constructing and improving the transport infrastructure for the overall long-term social benefits has assured the long-term economic growth of Hong Kong. In other words, despite that the government has to manipulate the construction programmes in response to short-term imminent needs of the society, the long-term intrinsic economic "growth-initiating" role of transport infrastructure construction activities should not be mitigated as long as the government practises a perennial transport infrastructure improvement policy. However, short-term manipulation of the construction programmes can temporarily muted the intrinsic economic "growth-initiating" role of the transport infrastructure construction activity.

5.4 Economic and Non-economic Roles of Transport Infrastructure Construction Activity

The analyses in Section 5.2 suggest that Hong Kong government has exploited various economic and non-economic roles of transport infrastructure construction activity to serve various needs of the society. The various economic and non-economic roles of transport infrastructure construction activity that have served Hong Kong in the three decades from 1970 to 2000 are discussed in the following sub-sections.

5.4.1 Providing Public Facilities for the Society

The role of transport infrastructure construction activity in the three decades from 1970 to 2000 is providing public facilities to serve the society. The government consistently plans and constructs transport infrastructures as public facilities to improve the mobility of both people and goods. This purpose is demonstrated by its rational planning approach in CTS-1 and CTS-2 for the 1980s and 1990s, and in particular its close adherence to the proposed construction programme in CTS-1 to have the required transport infrastructure constructed just-in-time.

Even in a less robust economic situation, the government has rearranged other less urgent construction projects to allow the construction of the much needed transport infrastructure to go ahead. The determination of the government to construct transport infrastructure as public facilities to serve the society was seen in the 1980s when it continued constructing the transport road network to serve the new towns even in poor economic situation with a big budget deficit of $2.2 billion in 1985 – 1986[36]. Earlier in 1975, the government began construction of the Modified Initial System (MIS) of the Mass Transit Railway (MTR) in the midst of economic recession, based on the decision to making the MTR the backbone of Hong Kong's transport network[37].

These examples show that Hong Kong government's decision for construction of the transport infrastructure projects is based on the compelling needs for that public facility of the society, which may not necessarily be held off by the ongoing poor economic situation. When economic situation is poor and public finance is tight the government is always prepared to resort to other alternative financing means, such as private sector's financial resources as in the case of the MTR MIS programme, to finance a much-needed infrastructure project.

There were periods in the 1970s that transport infrastructure construction lagged behind the needs of the society. This kind of slack without exception has

[36] 17 May 1985, SCMP, "All systems go for new towns"
[37] 8 May 1975, SCMP, "Tube: the last legal hurdle is removed"

caused serious public outcries[38]. Even Sir Murray MacLehose, Hong Kong's Governor at that time, admitted in his 1981 policy address that such was a problem and aimed at clearing major traffic congestion by constructing the MTR Island Line, the Eastern Corridor, the Kowloon Corridor, the Tsuen Wan by-pass and the New Territories circular road between 1984 and 1986[39]. His affirmative statement saying that an effective transport system is an essential part of Hong Kong's development and the subsequent formation of a Transport Branch responsible for making transport policy are evidences confirming the importance that Hong Kong government attests to the construction of transport infrastructure as a public facility.

Although the government attaches great importance to providing the transport infrastructure as public facilities to serve the society it is also prudent in implementing the construction programmes. It insists that major transport infrastructure construction projects have to be financially viable. For example, despite construction of the ACP projects was a political decision their financial viability was justified by rigorous financial analyses. The Second Railway Development Strategy published in May 2000 also emphasised that the proposed projects must provide a commercial return.

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[38] 24 Jan 1982, SCMP, "Road plans 'bungled'
[39] Policy Speech of Governor Sir Murray MacLehose, 1981

5.4.2 Contributing to the Economy

Despite that Hong Kong government has not deliberately pursuit Hirschman's (1973) "Building Ahead of Demand" approach to create a permissive investment environment Granger Causality Test results in this research still show that transport infrastructure construction activity played an intrinsic economic "growth-initiating" role in the 1980s to 1990s. The result confirms the long-term economic contribution role of transport infrastructure construction activity in Hong Kong.

But, as suggests in Section 5.2, the short-term economic contribution of transport infrastructure construction activity is dependent on the implementation process of the construction programme. In the 1980s, the rationally planned programme adopted in CTS-1 was followed closely, resulting in the transport infrastructure construction activity being carried out in tandem with economic growth. Logically, this is the most efficient way to implement the infrastructure construction programme and the economic contribution of the construction activity should be maximised.

However, in the 1990s, the rationally planned programme was frequently upset by the need to meet imminent social priorities. As a result, the planned transport infrastructure projects in ACP and CTS-2 were constructed either ahead or behind of the economic needs. As discussed in Section 5.2.2, such deviations from the planned programmes changed the short-term economic role of the transport infrastructure activity in the 1990s. Firstly, the significant delay to constructing a major portion of ACP caused by the political negotiation between Chinese and the UK governments made the transport infrastructure construction activity appear to have been induced by economic growth. Secondly, the clustering of the ACP projects to be completed in an extremely ambitious timeframe had an inducing effect of the economy. This is not the most efficient implementation approach and it should have reduced the economic contribution of the construction activity.

Occasionally, some of the rationally planned transport infrastructure construction projects are delayed by some inadvertent reasons. This kind of situation happens many times in the development history of Hong Kong's transport infrastructure, even in the 1980s[40/41]. The situation would result in a transport infrastructure construction programme that is slightly lagging behind the social and economic needs, and therefore temporarily restricts the productivity growth of the society. When the projects are constructed and the public facilities are

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[40] 24 Jan 1982, SCMP, Road plans 'bungled'

[41] 8 Nov 1985, SCMP, No cheer for commuters

available to service the society the restrained productivity of the society would be released, resulting in a surge of economic growth. Such situation is similar to Hirschman's (1973) proposed "Development via Shortage" approach, which has also been experienced by Hong Kong.

In all these circumstances, transport infrastructure construction activity continues to contribute to economic growth. But, its degree of contribution depends on the implementation processes of the construction programme.

5.4.3 Strengthening Public Confidence

Kafandaris (1980) suggested public works was the national programme for achieving stability. The launching of major transport infrastructure construction projects also has the effect of strengthening public confidence in Hong Kong at times of economic depression. This happened in the 1970s when the construction of MIS of the MTR and the Tuen Mun Road buoyed up the public sentiment almost immediately. Soon after the construction of these two projects began, economic revival followed. Even the then Governor, Sir Murray MacLehose, spoke with hindsight in 1975 that it was a prudent act of confidence to have pressed on with building the Tuen Mun Road[42].

[42] 9 Oct 1975 SCMP, "Overseas Investment must be encouraged"

At times of political uncertainty, Hong Kong government has also used major transport infrastructure construction projects to boost the confidence of the society. When public confidence of Hong Kong people plummeted after the tragic incident on June 4, 1989 in Beijing and with the sovereign handing-over looming in the not too distant future it was a prerequisite of the pre-1997 government to maintain stability of the society and reaffirm the confidence of the society about its future. Governor Wilson had intended to achieve such objective when he announced the construction of the Ports and Airport Development Scheme (PADS) projects on October 11, 1989. The effect was conspicuous. Although only the ACP programme in PADS were eventually constructed, the programme already provided a prominent target for the society to achieve in unison and the massive construction projects had actuated the economy right up to the date when Hong Kong was reunited with Motherland China on 1 July 1997.

Soon after Hong Kong's re-unification with Motherland China, the Asian economic crisis began to take its toll in Hong Kong's economy. As a strategy to reinforce confidence at the time of the handing-over, the Hong Kong Special Administrative Region (HKSAR) government decided to implement the West Rail and MTR Tseung Kwan O Extension projects[43]. Again, such decision was made in a less than favourable time when the Asian economic crisis had dissipated the liquidity in the financial market. Kowloon Canton Railways Corporation (KCRC) had found it difficult to raise all the finance commercially and the HKSAR government had to inject $29 billion of equity into KCRC to allow the project to start[44]. The financing position of MTRC was much stronger and it was able to finance the 10-kilometre long railway partly from its own resources and partly from borrowing[45].

These examples show that transport infrastructure construction projects had been used by Hong Kong government as a political confidence stabilizer. By launching a major construction project at a trying time the government can let the people know that it is confident about the future and the people should also as well.

5.4.4 Invigorating the Economy

Major transport infrastructure construction projects launched at a time of economic depression to strengthen public confidence have the preponderant

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[43] 15 Jun 1997, SCMP, “West Rail set to get SAR approval; Contractors told to start preparing tenders for $ 80b construction project”

[44] 5 Jul 1998, SCMP, “KCRC seeks bidders for West Rail project”

[45] 24 Oct 1996, SCMP, “MTR: no chance of row on finances”

effect of invigorating the depressed economy. The government of Hong Kong has taken advantage of this effect of transport infrastructure construction activity in at least two occasions in the last 30 years.

The construction of the MTR MIS and Tuen Mun Road in the 1970s, which were launched to strengthen public confidence during economic depression[46] as discussed in Section 5.4.3, provided ample employment opportunities for the workers and sustained the labour wages. Half way through the construction of these projects the invigorating effect began to show. The construction of these projects had also buoyed the confidence of the private sector, which was translated into consumption power and speeded up the economic recovery.

In 1989, the launching of the ACP projects had also enormous invigorating effect on the economy. The immediate effects of the ACP projects to the economy were considerable and significantly boosted the construction industry. Economists suggested that ACP projects would turn around Hong Kong's economic recession in 1989 and would be the main contributor to the territory's strong economic growth in the following years[47]. In 1994, before the transport infrastructure construction activity had reached its peak value, a Hang Sang Bank publication estimated that Hong Kong’s GDP growth would be boosted by

[46] 2 Jun 1974, SCMP, “Tough for job-seekers”
[47] 21 Jun 1995, SCMP, “$ 158bn scheme centre of attention”

0.9, 1.3 and 0.1 percentage points in 1995, 1996 and 1997 respectively. It also forecasted that the inflation would rise by an annual average of 0.5 percentage points in the first two years[48]. In the end, the economy of Hong Kong was revived as predicted by the economists. The invigorating effect to the economy caused by the substantial increase of the transport infrastructure construction is obvious and indisputable.

5.5 Summary

This chapter reviews the Granger Causality Test results for the economic roles of the detailed end-use construction activities of Hong Kong. The econometric analyses confirm that the growths of different types of construction activity of Hong Kong have different causality relationships with economic growth in the period 1983-2002. As 20 years is a relatively long period of time during which the economic roles of the construction activities are subjected to the influences of many social and economic factors it is probable that the results reflect the intrinsic economic roles of the construction activities. In the review, it finds that the economic roles of some construction activities, such as residential buildings and industrial & storage buildings, do not concur with the conclusions of previous

[48] 3 Dec 1994, SCMP, “Airport deals to fuel growth, says bank”

researchers. It suggests that the results are not illogical, as the same type of construction activity may serve different social needs in different societies and is subject to the influences of different government policies.

Hong Kong's construction activity as a whole is found to have an intrinsic economic "growth-initiating" role, which conforms to the result advocated by the Modernists. But, this information is of limited value to the policy makers. The policy makers need to know the intrinsic economic role of the type of construction activity in their society. Otherwise, they may be wasting the society's valuable resources on the wrong construction programme and not achieving what they intend to achieve with the programme.

The intrinsic economic role of Hong Kong's transport infrastructure construction activity is a resounding "growth-initiating" one. Being the largest public works construction activity in Hong Kong, transport infrastructure activity can therefore act as a *de jure* economic invigorator if the government chose so. But, its short-term economic role is not as definite, and is affected by the implementation process of the construction programmes.

In the 1980s, Hong Kong's social environment was conducive to the full implementation of the proposed transport infrastructure construction projects roughly in the proposed timeframe of the rationally planned project programme. The transport infrastructure projects were constructed just-in-time to fulfil the transport needs in tandem with social and economic growth. The economic “growth-initiating” role of transport infrastructure construction activity in this period of time is therefore obscured by the just-in-time implementation approach of the construction programmes.

In the 1990s, the transport infrastructure construction programme was dictated by the political decision to complete construction of the ACP projects before reunification of Hong Kong with Mainland China in 1997. The invigorating effect of abounding construction activities and political haggling in the process made transport infrastructure construction activity to possess both short-term economic “growth-initiating” and “growth-dependent” roles.

The possibility for Hong Kong’s transport infrastructure construction activity to change its short-term economic role is a manifestation of the influence of policy planning and construction programme implementation processes on the economic roles of construction activities. But, its long-term intrinsic economic “growth-initiating” role remains unchanged because the government has practiced a perennial transport infrastructure construction policy.

In reality, it is impossible for a government not to adjust the rationally planned transport infrastructure construction programme so as to meeting the imminent needs arising from the prevailing social, economical and political situations. This research confirms that Hong Kong government has faced the dilemma many times and is obliged to adjust the construction programme of transport infrastructure projects, making the transport infrastructure construction activity to play the following economic and non-economic roles:

- Providing Public Facilities to Serve the Society
- Contributing to the Economy
- Strengthening Public Confidence
- Invigorating the Economy

The next chapter discuss the deleterious effects of the construction activities caused by the planning and construction programmes implementation processes of Hong Kong's transport infrastructure and the relevant development policies that could enhance the performance of Hong Kong's construction industry.

Chapter 6 Construction Industry Development Policy for Hong Kong

In exploiting the various economic and non-economic roles of transport infrastructure construction activity Hong Kong government either delayed or advanced the construction programmes. This resulted in significant fluctuations of the transport infrastructure construction activity and changing of its short-term economic role. The construction programme implementation processes also triggered off many deleterious effects in the construction industry. Although Hong Kong government had tried to implement mitigating measures to reduce the pressure of the deleterious effects the industry was still adversely affected and its economic contribution was negated. It is possible that similar effects would be inflicted by other public works construction activities, such as public housings. Therefore, Hong Kong government should seriously consider adjusting its laissez-faire approach and implement relevant development policies for the construction industry. This chapter investigates the consequential deleterious effects and recommends the development policies for the construction industry of Hong Kong.

6.1 Deleterious Effects of Construction Activities and Government Policy

The most frequent deleterious effects of a highly fluctuating construction workload in Hong Kong are labour shortage, inflation, poor site safety, wage disputes and poor quality of construction work, though the last problem did not plague the transport infrastructure construction as much as public housing[49].

To deal with labour shortage and inflation problems the government had to postpone other less urgent public works projects in favour of the important transport infrastructure construction programme and to allow the importation of foreign workers to make up for the labour shortage. When the government decided to push ahead with the MTR MIS and Tuen Mun Road projects it was already mindful about the effect of the construction worker shortage problem. In 1977, despite contraction in export growth, the construction activities had spurred the domestic economy, leading to full employment of local labour. The buoyant construction sector drove up economic growth, about which the Financial Secretary said he was worried that the economy would not be sustainable when the building boom abated[50]. Against this backdrop, there was a shortage of construction workers resulting in construction workers' wage

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[49] 23 Jan 2003, SCMP, "Officials blamed for piling scandal"
[50] 13 Sep 1977, SCMP, "Official worries over the economy"

escalation. Eventually, foreign construction workers were imported to supplement the local shortage[51]. At its peak, the MTR MIS projects were providing employment for some 7,000 workers, which represented roughly 10 to 11 percent of the Hong Kong's labour force[52]. Still, progress of the projects was affected[53].

In 1980, the government had to respond to the escalating expenditure of the public works programme and the private sector investment projects that had overstrained the economy again. The Secretary for the Environment said publicly that some of the essential road projects and the vital railways construction works would be rephrased so as to slow down the growth rate of public works expenditure[54].

Again in the 1990s, when the government decided to bring forward the construction of the ACP projects it worried that the construction activities might over-stretch the construction industry and the economy. In order to avoid any labour shortage problem, it deviated from the rational implementation approach and rescheduled many overtly emphasised construction projects in the second

[51] 20 Dec 1977, SCMP, "Thais fill jobs gap at $600m estate"
[52] 30 Oct 1977, SCMP, "MTR: under budget and on schedule"
[53] 30 Mar 1978, SCMP, "Job delays – no workers"
[54] 5 Nov 1980. SCMP, "Development scenario – pint pot or widow's cruse"

White Paper on Transport, including the West Rail and the MTR Tseung Kwan O Extension projects, to after the completion of the ACP projects.

Yet, due to the colossal scale of ACP projects this arrangement was not enough to alleviate the problem completely. Like the MTR MIS projects in the 1970s, the ACP projects had caused a serious construction worker shortage situation in 1993[55]. Economists had forecasted that strong demand for construction workers would be muted because the government had planned to import 27,000 construction workers[56]. But, protracted negotiation of the Chinese and British governments on the financing arrangement of the projects had delayed the starting dates of the construction works and squeezed the construction programmes, which worsened the labour shortage problem. Although foreign workers were imported the wages of local construction workers still escalated outrageously. Eventually, the cumbersome labour importation procedures suppressed the imported workers number and delayed the completion date of the Chek Lap Kok Airport to 1998.

Such deleterious effects could have been reduced if Hong Kong government had implemented the transport infrastructure construction programme with greater regard to the state and capacity of the industry. A coherent development policy

55 28 Oct 1993, SCMP, "PAA urges fast import of labour"
56 3 Dec 1994, SCMP, "Airport deals to fuel growth, says bank"

would strengthen the industry so that it could cope with the fluctuating workloads and reduce the damaging deleterious effects.

As a matter of fact, fluctuating workload is a common characteristic of construction industry worldwide. Edmonds (1979) explained that the fluctuating workload situation is caused by governments using construction activity as an economic regulator. Because of the industry environment, he said, contractors are reluctant to provide long-term employment to the workers, therefore inhibiting the emergence of a skilled and experienced labour force. He attributed the shortage of skilled workers problem to the industry structure and he also advocated a coherent policy for the construction industry.

In this regard, Singapore government seems to have recognised the importance of maintaining a stable workload in the construction industry and puts in place a more coherent development policy to address the quality issue of the industry. Low and Tan (1996) observed that Singapore government used its massive public housing programmes to stabilise the workload in the industry. They found empirical evidence to support that Singapore government did that through the timely release of public sector projects, which helped alleviating the troughs and peaks situations in the construction industry. It also encouraged and assisted local Singapore contractors to develop overseas markets so as to counter the cyclical trend of the local construction market.

Compared to Singapore, Hong Kong government has taken little coherent measure to address the poor quality problem in the construction industry. The mitigating measures for labour shortage and wage hikes were also fragmentary. Therefore, the deleterious effects happened recurrently and hampered the quality and site safety of the construction industry. In many instances, the quality and site safety problems escalated to become major social concerns.

The strategy that Hong Kong construction contractors adopt to avert their risks in a cyclical market is by subcontracting most of the production activities. Many of these subcontractors are small and weak financially. When market competition is severe and contract prices are driven down there are many insolvency and wage arrears cases, resulting in many workers not getting paid for their work done[57]. As a result of the wage disputes progress of the construction projects are delayed.

In all, the deleterious effects have abated the economic contribution of the construction activities, including that of the intrinsically economic

[57] 8 April 2006, SCMP, “$2m raised for unpaid workers”

"growth-initiating" transport infrastructure construction activity.

6.2 Core Issues of a Coherent Development Policy

Knox Lovell & Tang (1997) suggested Hong Kong's economy was developed within a freewheeling laissez-faire framework, whilst Singaporean economy was guided by an interventionist government policy. This explains the reason for the different approaches of Hong Kong and Singapore governments in dealing with the deleterious effects of the construction industry. The lacking of a coherent development policy for the construction industry, however, is not unique for Hong Kong as Moavenzadeh (1978) suggested many other countries also do not consider the development of their construction industry in national planning.

Nevertheless, Stewart (1996) found in her research for nine countries, including Hong Kong and Singapore, that all of them had selective interventions at crucial development stages of their manufacturing industry. The interventions include policies aiming at influencing market demands, price and availability of capital; transport infrastructure; development and acquisition of technology; and labour skill training and rewards. Her finding shows Hong Kong's industry policy is not at all obstinately laissez-faire. OEDC (1975) also reported that whilst OEDC members rely on market mechanisms to shape their industrial development, they all use industry policy to bring about the required structural adaptation when market forces fail to do so. Therefore, it is not surprising that Hong Kong government intervenes to facilitate industry reform when the construction industry cannot resolve a grave structural problem itself.

The sub-standard foundation works scandals in public housing projects in 1999 exposed the construction industry's weaknesses. It prompted Hong Kong government to take actions to improve the performance of the construction industry because if the deleterious effects were left to fester its contributions to the society would be negated. Soon, the whole construction industry would be spoiled. The setting up of CIRC to help contemplating the problems of the construction industry displays the government's readiness to take actions to rectify any structural problems of the industry.

The recommendations of CIRC show that it tries to strike a balance between recommending direct supports to the construction industry and the free market principle that the government favours. The co-ordinating body that it recommends to set up would become a surrogate for the government's leadership if it successfully improves the five targeted areas[58] it identifies as important for the development of Hong Kong's construction industry. The five key issues[59] that the proposed change programmes address are same as those considered important by researchers such as Turin (1974), OEDC (1975), Drewer (1980), Etzkowitz and Brisolla (1996), Tan (2002), Anaman & Osei-Amponsah (2007) and Bosch & Philips (2003) et al although their recommendations may be quite dissimilar.

These issues are the core issues for the development of Hong Kong's construction industry. But, to successfully developing these issues to become a coherent policy for the industry will depend on the government's disposition to the recommended change programmes and the leadership of the construction industry co-ordinating body.

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[58] The five targeted areas are fostering a quality culture, achieving value in construction procurement, nurturing a professional workforce, an efficient, innovative and productive industry; and a safer workplace and an environmentally responsible industry.

[59] The five key issues are technology and management, labour Skill and training, industry structure, government as a client, and government as a regulator. The proposed changed programmes are summarised in Appendix 3.

6.2.1 Technology and Management

Turin (1974) suggested that a government should promote the construction industry to use locally available technologies. He argued that the use of advanced technologies not available locally would not benefit the local construction industry or the society. Anaman & Osei-Amponsah (2007) recommended a government should encourage researches in the construction industry. Etzkowitz & Brisolla (1996) suggested it was research and development for imported technologies improvement and human capital investment that makes the Asian countries surpass Latin America in economic development. However, the government of Hong Kong had not encouraged the construction industry to use local technologies nor had it encouraged construction technology researches.

The construction industry in Hong Kong is not slow in applying new technologies to the projects. For example, during the construction of the new Chek Lap Kok Airport the world's most advanced trailer suction dredgers and earth moving machines were employed. The Strategic Sewage Disposal Scheme currently being built also uses the world's most advanced tunnel boring machines. The famous Hongkong Bank Building in Central was built using many state-of-the-art technologies at that time. The technologies used for construction of Hong Kong's major transport infrastructure are also mostly imported from the advanced countries. Since Hong Kong is deficient in natural resources, astute usage of imported technologies had helped to expedite the transport infrastructure construction programmes and reduce the deleterious effects of labour shortage and poor workmanship.

Unfortunately, these new technologies seem to be used for unique major projects only. The experiences are not always shared and repeated after these projects are completed. As the majority of construction works, which are the more common building projects, traditional construction methods and technologies are still being used. These traditional methods include bamboo scaffoldings, timber formwork shutters, in-situ concreting, and wet finishing trades, which are labour intensive and not environment friendly.

The CIRC report recommends using new and available technologies and research and development initiatives to improve the performance of the construction industry. Given the successful experience of Hong Kong's construction industry in using imported technologies it should have little problem to continue doing so. The plan of the Committee on Environment and

Technology of CIC is to allocate funds to finance practical research and development projects directly related to the needs of the industry. But, in order that the research efforts of all industry stakeholders, including the universities, can deliver the best results a co-ordinated research and development policy should be decided by CIC. Otherwise, the industry would continue to develop along the haphazard track and the intrinsic economic “growth-initiating” role of its activities would be waned.

6.2.2 Labour Skill and Training

Almost all researchers of construction industry policy emphasise the importance of skill and training for construction workers. Drewer (1980) suggested a government should increase the supply and quality of indigenous construction labour and assign them to the “growth-initiating” construction activities.

Bosch & Philips (2003) suggested the government should regulate the construction industry so that the industry environment is conducive to skill training of its workers. He suggested the regulation can be done in two ways: first, labour market regulation by imposing compulsory workers training and licensing requirements and second, product market regulation by imposing quality standards on construction works. He argued government and public sector clients have direct interest in maintaining and developing the quality of construction workers whom they frequently rely on for their construction projects.

It is a legal obligation that Hong Kong construction contractors have to contribute 0.25% of their construction project values to the Construction Industry Training Authority (CITA)[60] for construction workers training. CITA is running 5 training centres offering management and craftsman skills training courses. However, high wastage figure of the basic craft trainees is a problem. About 50% of the graduates of these courses do not continue to work in the industry one year after graduation. With such a high dropout the resources put in training by the industry is largely wasted, as most of the workers in the industry are still not properly trained.

Hong Kong needs to increase the supply and quality of its construction labour force. As discussed in Section 6.1, there were always serious labour shortages and wage escalations whenever a major public works construction programme was embarked, In many occasions, the labour shortage problem has led to workmanship problem as well. These consequential deleterious effects testify that the number of skilled construction labour in Hong Kong is limited, which is

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[60] Now subsumed under CIC and re-named as Construction Industry Council Training Academy

quickly absorbed by a sudden surge of construction activities. When the local construction industry has an unemployment situation it is always transient. It happens only during the ebbing period of the construction market and is usually not long lasting. The issues that the construction industry in Hong Kong has to address are, therefore, training for the workers to improve their quality and retaining them during the depressed market.

Starting from December 2005, all workers in Hong Kong's construction sites are legally required to have a registered worker qualification. The objectives of this new regulation are to ensure the quality of construction works and raise the social status of construction workers. This statutory requirement concurs with the labour market regulation strategy recommended by Bosch & Philips (2003). But CIC still have to decide a coherent labour skill training and retention policy for construction industry.

6.2.3 Industry Structure

Although both Turin (1974) and the CIRC consider the fragmentary structure of the construction industry needs addressing their perceptions of the circumstances are different. Turin (1974) suggested the industry's fragmentation is characterised by the variety and feature of its products. He suggested the government should make the best use of local skills, materials and techniques to meeting the economic and development objectives of the society, instead of attempting to standardising and economising the construction processes. Although his recommendation may be useful to the less developed economies it is of less relevance to Hong Kong because of its extremely open economy and its lack of local resources in both labour and materials.

The CIRC's attention, on the other hand, focuses on the relations between stakeholders of the industry. It suggests it is the adversarial approach of the project stakeholders and the absence of teamwork culture in the industry that causes the fragmentation of the industry and such undesirable industry structure has affected its efficiency.

The local construction industry depends heavily on the subcontracting system. It is very common that most builders and civil engineering contractors contract out most of the production processes to sub-contractors. In doing so, they have the benefits of a smaller overhead and a flexible production capacity to survive the lean periods.

The subcontracting system is not all advantageous to the contractors. Firstly, they are not in direct control of the production processes hence their performances are affected directly by the ability and capability of their subcontractors. Whilst most sub-contractors are small and financially strapped they cannot retain their workers for a long period of time and give them training to improve their performance and efficiency. Secondly, although they and their subcontractors may have the common objective in making good construction progress, the interest of the contractors in other areas, such as quality and site safety, are in conflict with their sub-contractors who obviously wish to save money by delivering the minimum quality and safety standard. The wage disputes malady also become serious social conflicts that the government had to address[61].

Consequently, rampant subcontracting in Hong Kong's construction industry is one of the main reasons leading to poor performance of the industry attenuating the economic "growth-initiating" role of the construction activities. It also leads to an antagonistic culture of the industry and is an obstacle of its development. It is a situation that the industry cannot improve by itself.

Therefore, radical improvement to the industry structure is needed to make it conducive to the industry's development. A policy for equitable sharing project

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[61] 7 June 2005, SCMP, "Blueprint to resolve wage disputes"
11 August 2005, SCMP, "Ex-police sought to help catch wage cheats"

risks amongst the project stakeholders and improving the contractor - subcontractor relationships should be a priority of the CIC.

6.2.4 Government as a Client

Turin (1974) suggested the government can use its role as the client of public works projects to implementing improvement initiatives for the construction industry in the areas of technology, innovation, training, and nurturing small and medium local contractors. Bosch & Philips (2003) also argued that governments should use its leverage as the industry's frequent customers to lead changes. Similarly, CIRC also suggests public sector clients can set good examples for the construction industry by adopting good practices and new technologies for public works construction projects. It recommends a whole spectrum of improvement actions for the public sector clients [62] so as to exemplify the good practices for all five targeted improvement areas that are identified in its report.

Before the CIRC report, public sector clients in Hong Kong seldom consider it is their duty to improve the performance of the construction industry. They consider their primary objective is to oversee the public works construction

[62] Appendix 3

projects, making sure that they are completed on time and to the right quality to serve the society. As discussed in Section 5.4, this is the case for the transport infrastructure construction projects, which are primarily constructed to meet the transportation needs of Hong Kong. But, when the structural problems of the construction industry seriously hamper the performance of the public works projects, negating their economic and non-economic contributions, the government as public works clients should deal with the problems more proactively. Indeed, there is a lot that Hong Kong government, as the client of Hong Kong's public works construction projects for public housings and transport infrastructure, can achieve by exemplifying good construction practices. These good practices would heighten the contribution of the public works construction activities to the economy, as well as providing an impetus for culture change and significant improvement of the whole industry.

Since the publishing of the CIRC report there is a change of government's policy on their role as a public works client. When there is a serious structural breakdown in the industry's practices, such as wage dispute cases in 2005, it is more willing to implementing good practices[63], which serve as examples for the construction industry to follow. The role of CIC is to publicize the best practices

[63] 7 June 2005, SCMP, "Blueprint to resolve wage disputes"

and encourages the private sector clients to require compliance by their contractors.

6.2.5 Government as a Regulator

Turin (1974) suggested the government should abandon the obsolete regulations so as to allow healthy development of the construction industry. This is also the view expressed in the CIRC report. CIRC suggests the multitudinous, and sometimes conflicting, regulations have imposed heavy burden on Hong Kong's construction industry and have impeded its development. It proposes that the government should resolve the conflicting requirements among public authorities and regularly review the basis of the legislative requirements. It also proposes the public authorities should, in addition to vigilantly enforcing the regulations, respond promptly and constructively to industry's requests for assistance.

However, the regulations would not be enacted in the first place if the society is satisfied with the performance of the construction industry. The construction processes have caused much nuisance to the society and the local news media are highly critical of the performance of the industry, especially in the areas of construction site safety, environmental protection, and subcontractors / workers management. They cite the industry as the biggest environment polluter and criticise harshly the industry's poor site safety records.

The industry has itself to blame for the poor image. Construction site safety is a good example. Some contractors have responded to the society's expectation by putting in place good safety management systems that helps them to reduce their accident incident rates to a level comparable with the developed countries. But a lot more other contractors have done very little to make any significant improvement. This is why the overall accident incident rate of Hong Kong's construction industry is still as high as 60 per 1,000 workers in 2007. Therefore, regulations are necessary to ensure the industry performs to a minimum acceptable standard.

But, as CIRC rightly points out, the industry is always caught in between conflicting requirements by different authorities. Take road construction as an example, the Transport Department is reluctant to allow construction works at day time on the busy roads, whilst the Environmental Protection Department always refuse granting night work permits on environmental grounds. This kind of conflicts always leads to construction programme delays.

CIRC suggests the regulatory authorities to shorten the applications processing time, streamline the inspection procedures, and foster a service culture so as to assist the development of the industry.

Although the multitudinous and incongruous statutory requirements can be streamlined and harmonized by better co-ordination of the statutory authorities the government has to be careful that in taking up the “facilitating regulator” role it does not infringe the sacrosanct of the free market policy that has made the economy of Hong Kong so successful. The law enforcement agencies have to strike a delicate balance between the regulating role and the benevolent role.

On the other hand, Bosch & Philips (2003) have shown labour market regulation and product market regulation can be a strategy to develop a highly skilful and stable workforce for the construction industry. This strategy is close to the stance of the Structuralist Paradigm researchers.

CIC should recommend to the government the limits of the free market policy that it should relent and the equilibrium point of the regulator role that does not make the facilitating measures discordant with overall industry policy.

6.3 Developing a Coherent Development Policy for the Construction Industry

The recommendations of CIRC for reforming Hong Kong’s construction industry are not all congruence with Turin’s (1974) lines of actions for the industry.

Whilst Turin's recommendations were made 30 years ago and intended to be generic the CIRC recommendations are for addressing the present construction industry environment of Hong Kong.

The five key issues addressed by CIRC actually constitute the core of a coherent development policy for Hong Kong's construction industry. The setting up of CIC by the government to co-ordinate the industry reform process reflects its stance towards the implementation of the CIRC's recommendations. It shows that the government is willing to shift from the laissez-faire stance, vis-à-vis the industry policy for the construction industry, to a more pro-business stance and yet maintain its free market policy, letting the market forces to resolve most of the industry's maladies.

The NIE perspective researchers advocated mobilising the society's institutional capacity to address the zero transaction cost fallacy of the Neoclassical Paradigm for economic development. If the CIC could engage all stakeholders of the industry to thrash out the strategic issues and to develop a holistic industry development policy it will become Hong Kong's important institutional capacity. It can become the surrogate for the government in development of the construction Industry.

6.4 Summary

The significant fluctuations of the transport infrastructure construction activity had caused serious deleterious effects. With highly fluctuating workload, contractors are reluctant to invest in the workers, hence inhibiting the emergence of a skilled and experienced labour force. It leads to the consequential deleterious effects of poor site safety, poor workmanship and quality of construction work, and constant labour disputes. In many instances, the quality and site safety problems have escalated to become major social concerns.

The deleterious effects happened recurrently and hampered the development of Hong Kong's construction industry. The government, whilst practising a laissez-faire policy for the construction industry, has taken little co-ordinated measures to address the deleterious effects, which eventually abated the economic contribution of the construction activities.

But, the scandalous sub-standard foundation works found in public housing projects in 1999 prompts the government to take actions to improve the construction industry. As a consequence, CIC was set up to implement the change programme recommended by CIRC.

The five key issues, namely technology and management, labour Skill and training, industry structure, government as a client, and government as a regulator, addressed by CIRC's recommendations constitute the core of the development policy for Hong Kong's construction industry. The setting up of CIC by the government to co-ordinate the industry reform process reflects its stance towards the implementation of CIRC's recommendations. It shows that the government is willing to shift from the laissez-faire stance, vis-à-vis the industry policy for the construction industry, to a more pro-business stance and yet maintain its free market policy, hence allowing the market forces to resolve most of the industry's maladies.

If CIC could engage all stakeholders of the industry it can become Hong Kong's important institutional capacity responsible for thrashing out the strategic issues and developing a holistic construction industry development policy. It will become the surrogate for government in development of the construction industry.

Chapter 7 Conclusions

This research argues that the intrinsic economic roles of infrastructure and building construction activities are elusive. They are different for each type of construction activities, which can be economic “growth-initiating” or “growth-dependent”. In addition, their short-term economic roles can be changed by the government manipulating the construction programmes for fulfilment of other imminent social priorities. Therefore, the knowledge of the intrinsic economic roles of the construction activities and how their short-term roles are changed can help the government to recognise the importance of a government policy on the development of the construction industry. This chapter reviews the analyses results for the economic roles of Hong Kong’s construction activities and concludes the discussions of government policy on the development of Hong Kong’s construction industry.

7.1 Economic Roles of Hong Kong’s Construction Activities

Granger Causality Tests for Hong Kong’s detailed end-use construction activities in the period from 1983 to 2002 confirm Hypothesis 1 of this research that different types of construction activity of Hong Kong played different economic roles. As 20 years is a relatively long period of time they are considered as the long-term intrinsic economic roles of the respective construction activities. The tests also confirm Hypothesis 2 and 3 that Hong Kong's transport infrastructure construction activity has an intrinsic economic "growth-initiating" role and its short-tern roles in the periods 1983 – 1992 and 1993 - 2002 are different. The research on the planning and implementation processes of Hong Kong transport infrastructure construction programmes as outlined in Appendix 1 confirms that the shorter term roles are changed by the construction programmes implementation process.

7.1.1 Intrinsic Economic Roles

The Granger Causality Test results confirm construction activities of Hong Kong as a whole has an indubitable economic "growth-initiating" role. This is in agreement with the Modernist's belief. However, as the results also confirm each of its constituents, which are the detailed end-use construction activities, plays different intrinsic economic roles the government cannot take this causality relationship as a basis to formulate and implement any meaningful development policies for the construction industry.

The test results confirm that the intrinsic economic role of residential buildings, transport infrastructure, and utilities & plants construction activities are "growth-initiating"; whereas commercial buildings, industrial & storage buildings, environment, and sports & recreation construction activities are "growth-dependent". As for service buildings and utilities & plants construction activities, they are both economic "growth-initiating" and "growth-dependent". The results are not all in agreement with previous researchers. Such deviations are brought about by the government's policy prerequisites, the stage of economic development and other possible factors not identified in this research. Because of these reasons the intrinsic economic roles of construction activities may differ from economy to economy.

The results of this research, therefore, provide convincing proof that different types of construction activity play different economic roles and they do not naturally lead to economic growth. Therefore, a government has to consider the different economic roles of the construction activities before it can formulate and implement any meaningful development policies for the society and the construction industry.

7.1.2 Effects of Construction Planning and Implementation Processes

Although the Granger Causality Tests confirm that the intrinsic economic role of Hong Kong's transport infrastructure construction activity is found to be unmistakably "growth-initiating" the test results also show its short-term economic roles were less definite. In 1983 – 1992 the test results do not show any economic role played by transport infrastructure construction activity, whilst in 1993 – 2002, the results show transport infrastructure construction activity is both economic "growth-initiating" and "growth-dependent". The results suggest that short-term economic role of transport infrastructure construction, and by extension other types of construction activities, could be changed.

Indeed, this research confirms that the principal objective of Hong Kong government constructing the transport infrastructure is to provide better public facilities for improvement of the mobility of goods and people. In achieving this objective the government adopts a perennial policy of constructing new transport infrastructure and improving the old ones. In the 1980s and 1990s, the planning process was rational, matching anticipated demand by the additional planned capacity. The implementation process of the transport infrastructure construction programmes, however, was not immutable. In the three decades from the 1970s to the 1990s, the government had shown its prowess in making use of the characteristics of major transport infrastructure projects by manipulating the construction programmes for the purpose of meeting other imminent social, economic and political prerequisites. All the time, the decisions were made without regard to the effect to the intrinsic economic “growth-initiating” role of the transport infrastructure construction activity.

Such policy had altered the role of the transport infrastructure construction activity in the short term. As a consequence, transport infrastructure construction activity was made to play different roles at different periods of time, such as providing public facilities, contributing to the economy, stabilizing social/political confidence and invigorating the depressed economy. The evidence that construction activities can be made to play different important social and economic roles supports the proposition that the government should pay special attention to the planning and implementation processes of the construction programmes so as to reap the most benefit from the construction activities.

7.2 Construction Industry Development Policy

The research on the planning and implementation processes of Hong Kong transport infrastructure construction programmes confirms the implementation process had resulted in significant fluctuations of construction activity and a consequence of many deleterious effects in the construction industry. As a result, the economic contribution of transport infrastructure construction activity was negated. Similar effects would be inflicted by other public works construction activities, such as public housings. A coherent development policy is, therefore, needed for the construction industry.

7.2.1 Consequential Deleterious Effects of the Planning and Implementation Processes

The significantly fluctuating construction activities had led to serious deleterious effects in the construction industry. Such fluctuations had imposed immense pressure on the construction industry and consequentially also on the economy.

The two most frequent deleterious effects that had happened in the three decades from the 1970s to the 1990s were labour shortage and wage escalation. When the government was pushing to complete a major transport infrastructure construction programme for the purpose of meeting some imminent social objectives the construction industry had invariably lacking sufficient skilled workers, which led to programme slippage and escalation of local workers' wages. The problem had also led to a large number of illegal workers, unsafe site practices and poor workmanship in the construction industry.

In response to the cyclical market Hong Kong construction contractors tried reducing their overheads and commitments by subcontracting most of the production activities to subcontractors. Due to a conflict of interests of the main and sub contractors construction site safety and quality of works are always sacrificed for progress. Many subcontractors under-bidding for works during market depression periods also drove down contract prices, as a result some of them were unable to pay their workers for work done. The dire situation resulted in insolvency, wage arrears and labour dispute cases, causing great disruption to the progress of work.

When the deleterious effects were not managed properly they have nullified the economic contribution of the transport infrastructure construction activity. In the worse case, it could cause great damages to the society. The construction scandal of the public housing projects leading to the formation of CIRC is an example of the extent of damage that the deleterious effects can cause to the society. Hong Kong would be better served if the government could implement a coherent industry that mitigates the deleterious effects of the construction activities.

7.2.2 A Coherent Policy for Hong Kong's Construction Industry

In promoting reform of the construction industry, Hong Kong government has to make a trade-off between giving direct support to the industry and its allegiance to the free market principle of industry development policy. The formation of CIC to coordinate the change programmes is the balance it strikes. By forming CIC, the government takes a step to strengthen the institution capacity of the industry, hence allowing the stakeholders to thrash out the strategic issues for themselves.

The five key issues addressed by CIRC, namely technology and management, labour skill and training, industry structure, government as a client, and government as a regulator, are the crux of a coherent construction industry development policy. It is the duty of CIC to engage all stakeholders of the industry to map out the coherent development policy for the industry, which includes:

a. A co-ordinated research and development policy;

b. A labour skill, training and retention policy;

c. An industry structure for equitable risks sharing amongst the project stakeholder and improving the contractor - subcontractor relationships;

d. A policy to publicize the best construction practices of the public sector projects to the private sector projects;

e. The limits of the free market policy that the government should relent and the equilibrium point of its facilitating regulator role.

If it could successfully do so, it will become Hong Kong's important institutional capacity and a surrogate for the government's development policy for the construction industry.

7.3 Principles of Policy Approach for Implementing Transport Infrastructure Construction Programmes

This research confirms that Hong Kong's transport infrastructure construction activity is intrinsically economic "growth-initiating". But, it also confirms that Hong Kong's long-term economic growth is not a direct result of unrelenting construction of the transport infrastructure. It is the ability of the government in managing the construction programmes for satisfying the social needs and in mitigating the deleterious effects of the construction activities that are the pivotal factors to make the transport infrastructure construction activities playing an ensuring productive economic role in the long term.

This conclusion leads to the following principles of preferred policy approach for implementing the transport infrastructure construction programmes.

Principle 1: A perennial policy of continuously improving the transport infrastructures serving the needs of the society should be the basis of the transport infrastructure construction programme.

Principle 2: The transport infrastructure construction programmes should be rationally planned.

Principle 3: In implementing the construction programmes the transport infrastructure should be constructed just in time to meeting the needs of the society.

Principle 4: The transport infrastructure projects should be financially viable and affordable by the society.

Principle 5: A coherent development policy for the construction industry should be implemented to reduce the deleterious effects induced by the implementation process of the construction programmes.

Inevitably, the government has to frequently adjust the transport infrastructure construction programme in response to the imminent needs of the society. Despite the disruption to the construction programme, which may cause significant fluctuations of the construction activities, the long-term economic "growth-initiating" role of the transport infrastructure construction activities would still be assured if these principles are followed by the government.

A coherent development policy for the construction industry would strengthen the ability of the industry in handling the fluctuating workload and in managing the deleterious effects. The newfound strength of the construction industry would assure the level of contribution of the transport infrastructure construction activities to the economy during the capricious periods.

7.4 Limitations of the Conclusions and Further Researches

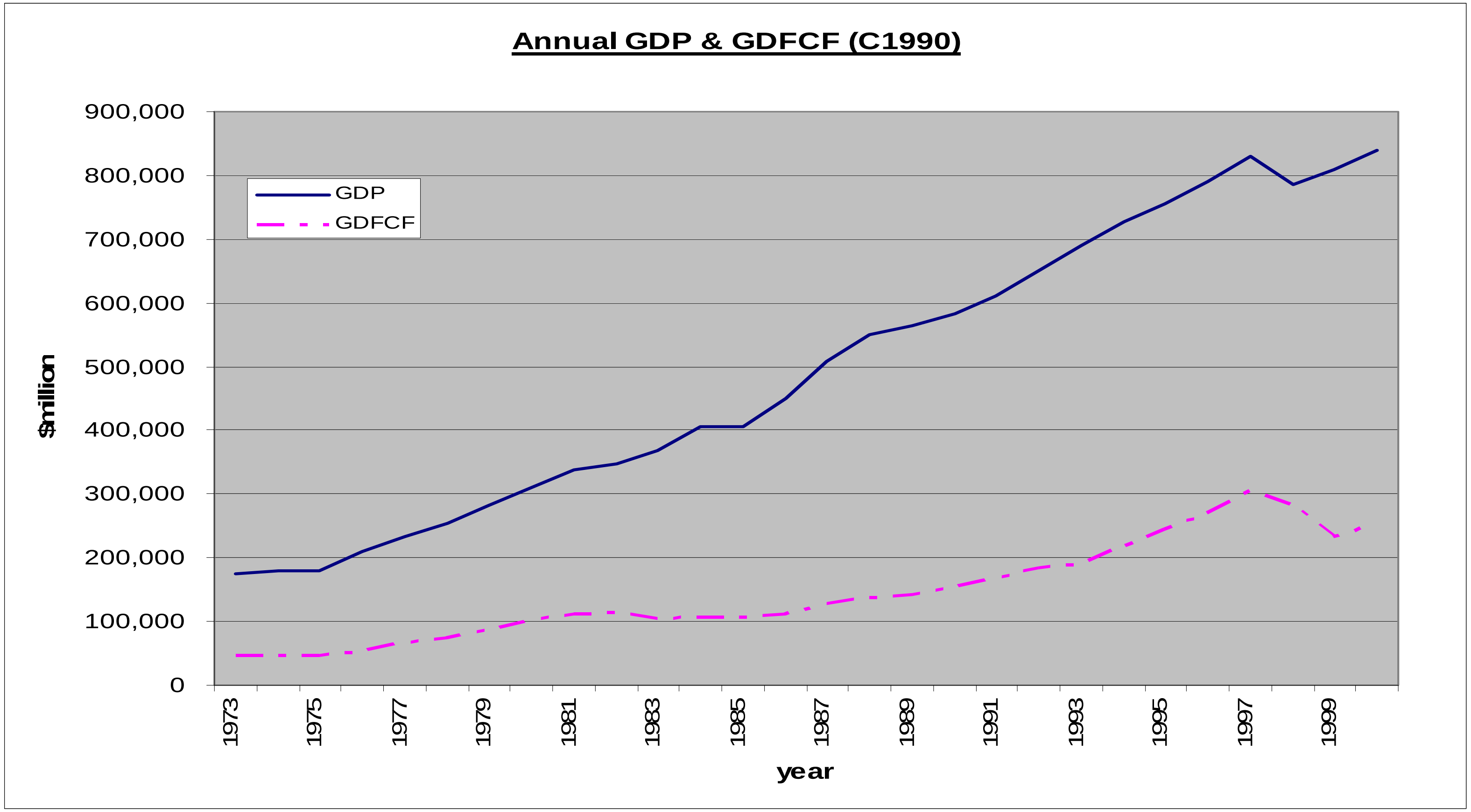
The conclusion of the intrinsic economic roles of Hong Kong's construction activities are drawn from the econometric analyses of their time series data in the two decades from the 1980s to 1990s. Ball & Wood (1996) suggested time series longer than 30 years are needed to encompass several peaks and troughs of the building cycles. Therefore, the time frame of this research may not be long enough to draw a reliable conclusion. However, longer time series data was not available when the research was carried out. It will be another decade later that the conclusion of their intrinsic economic roles can be confirmed.

The econometric analyses of this research also conclude that the short term economic roles of transport infrastructure construction activity are influenced by the implementation process of its construction programme. It is believed that this is also the case for other types of construction activity. This assumption has to be confirmed by similar econometric analyses for the other types of construction activity. These further econometric analyses, coupled with study of the planning and implementation processes of each type of the construction activity, can show whether the 5 principles of preferred policy approach for implementing the transport infrastructure construction programme are also appropriate for them or not. It is possible that different policy approaches are required for different types of construction activity, which have different social and economic roles.

It is not certain about the effectiveness of the balance that Hong Kong government strikes by forming CIC in order it can avoid meddling in the industry's affairs. As the construction industry's issues become more complicated it may not be possible for the government to distance itself from the industry's reform process. A further research to carry out a critical analysis on the two roles of the government, viz. government as a client and government as a regulator, in the industry's development process will cast a new light on the roles that it can take in a changing environment. Also, the change programmes proposed by the CIRC to address the five key issues consist of a multitudinous of actions. A detail analysis is required to confirm that they are relevant and coherent for the development of a holistic development policy for the construction industry of Hong Kong.

Annexes

Annex 1



Annual GDP & GDFCF (C1990)
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
$million
GDP
GDFCF
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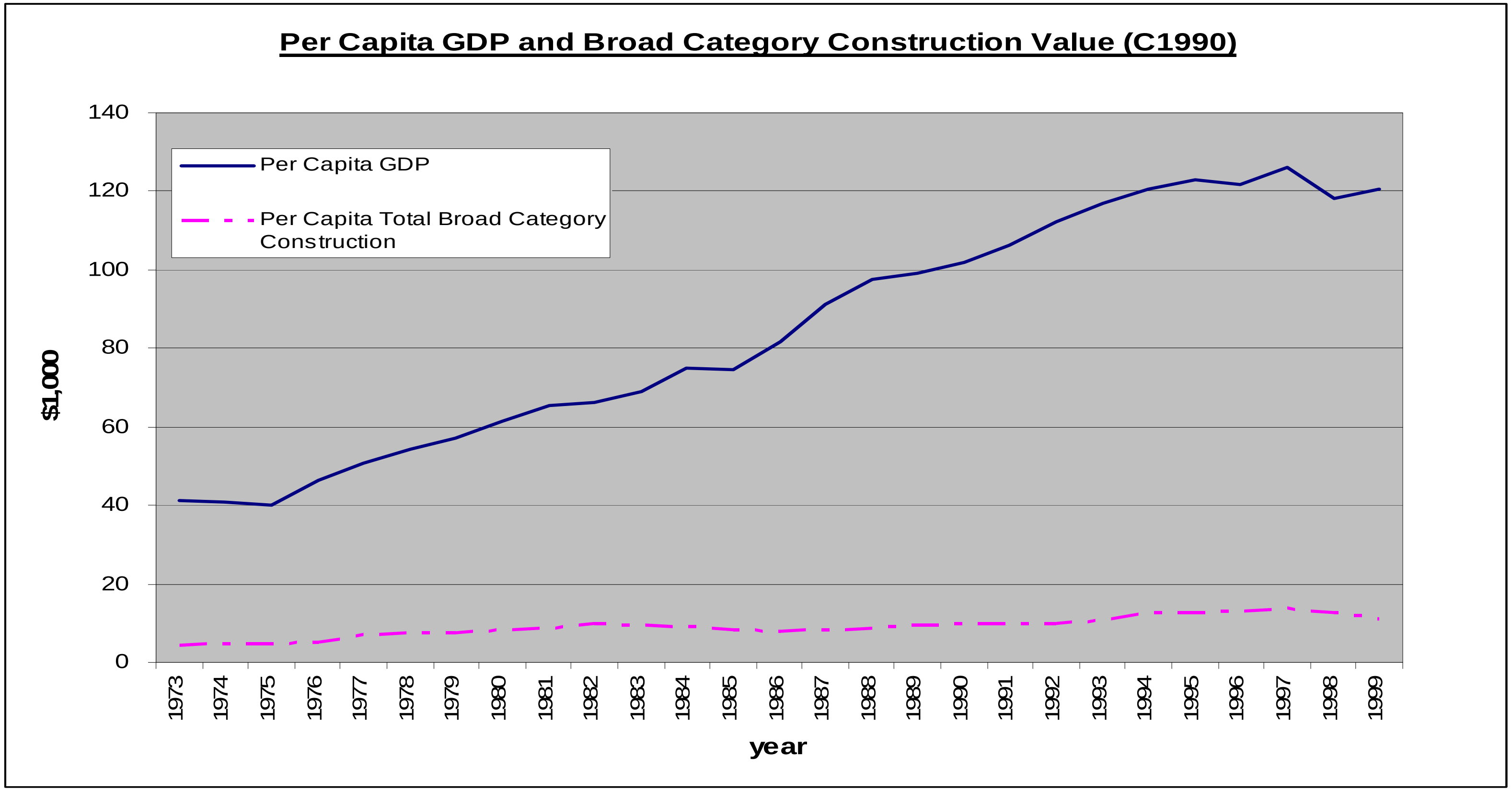
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
year

Annex 2


Per Capita GDP and Broad Category Construction Value (C1990)
Per Capita GDP
Per Capita Total Broad Category Construction
$1,000
year
140
120
100
80
60
40
20
0
1973
1974
1975
1976
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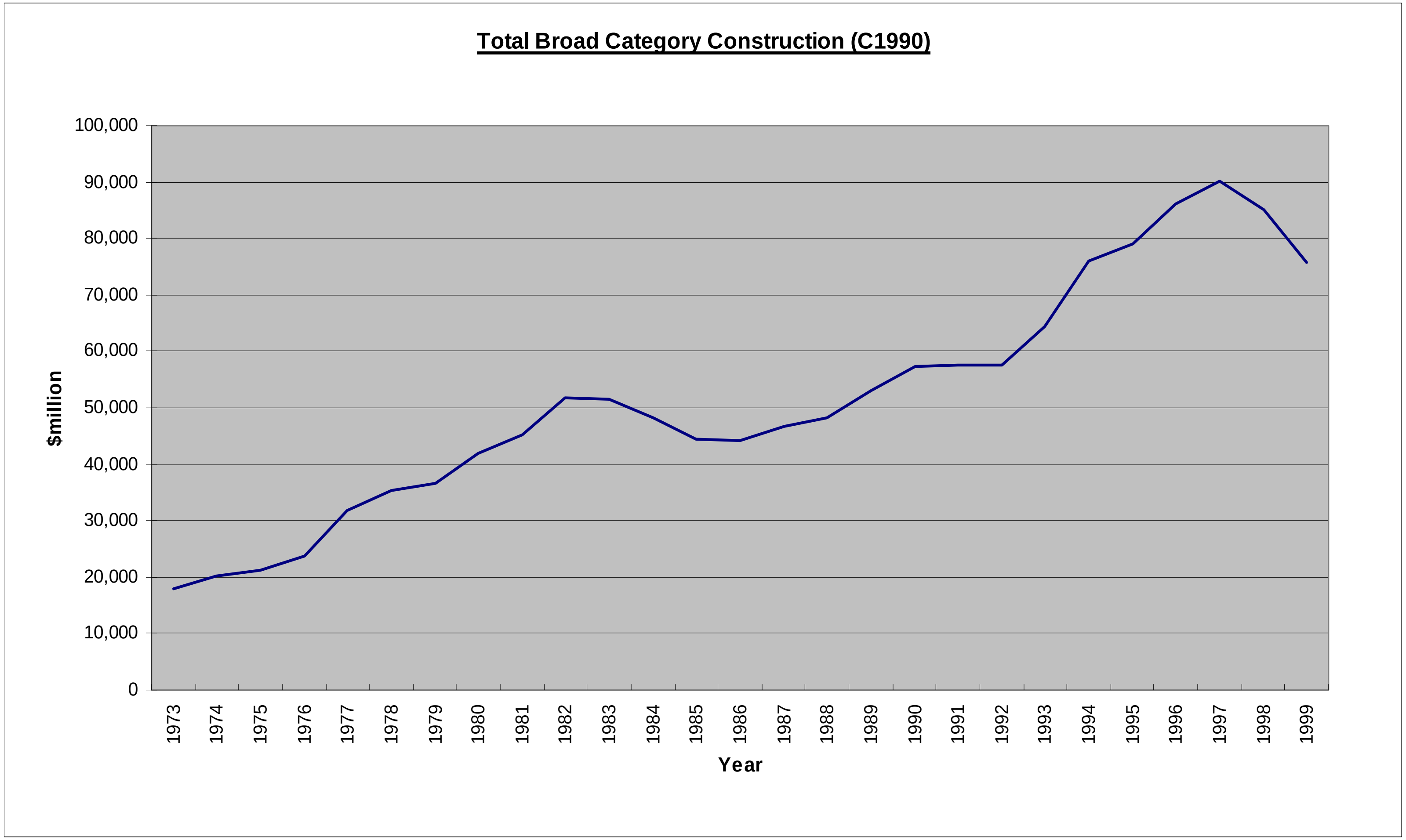
Annex 3


Total Broad Category Construction (C1990)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
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1973
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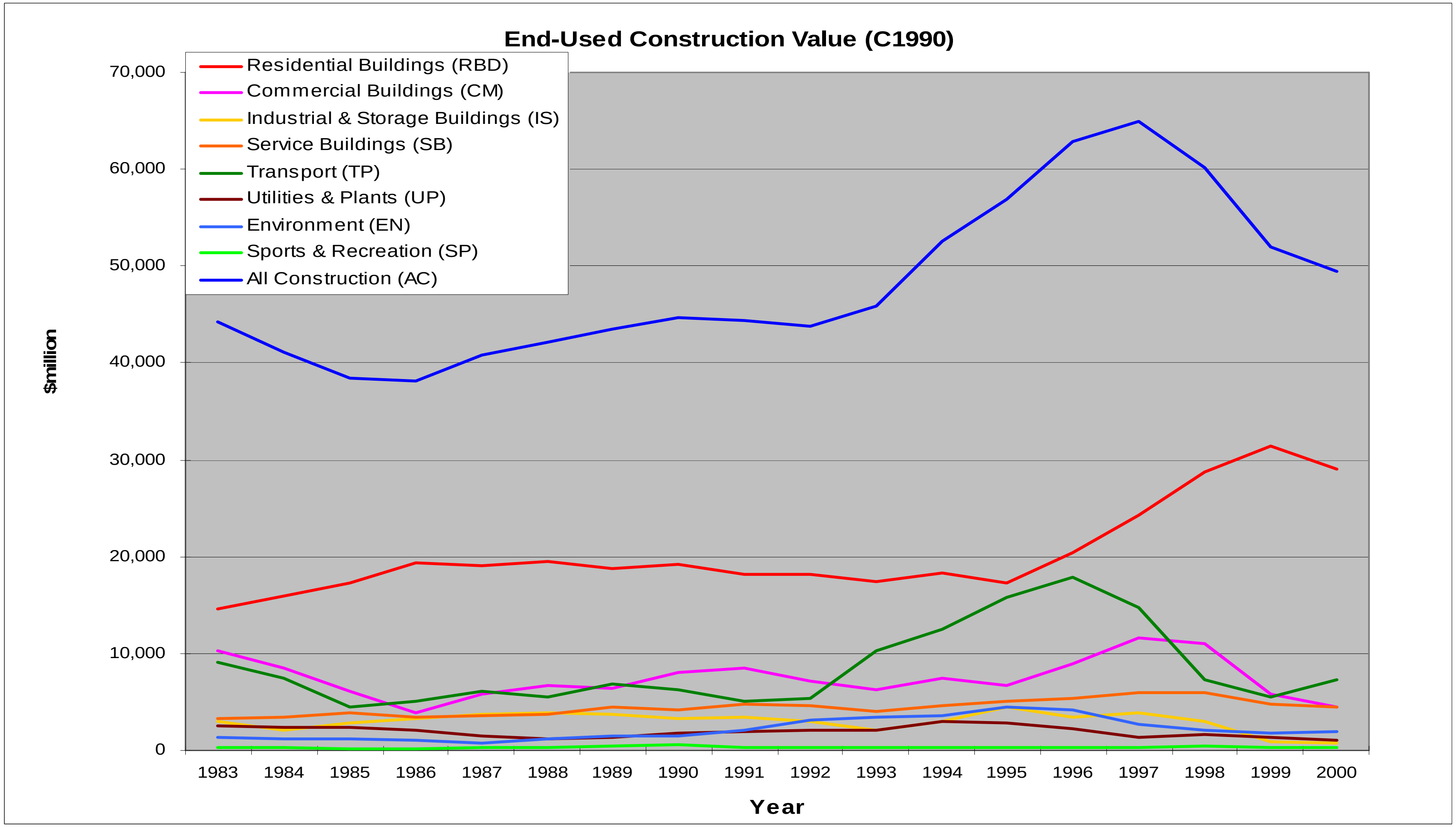
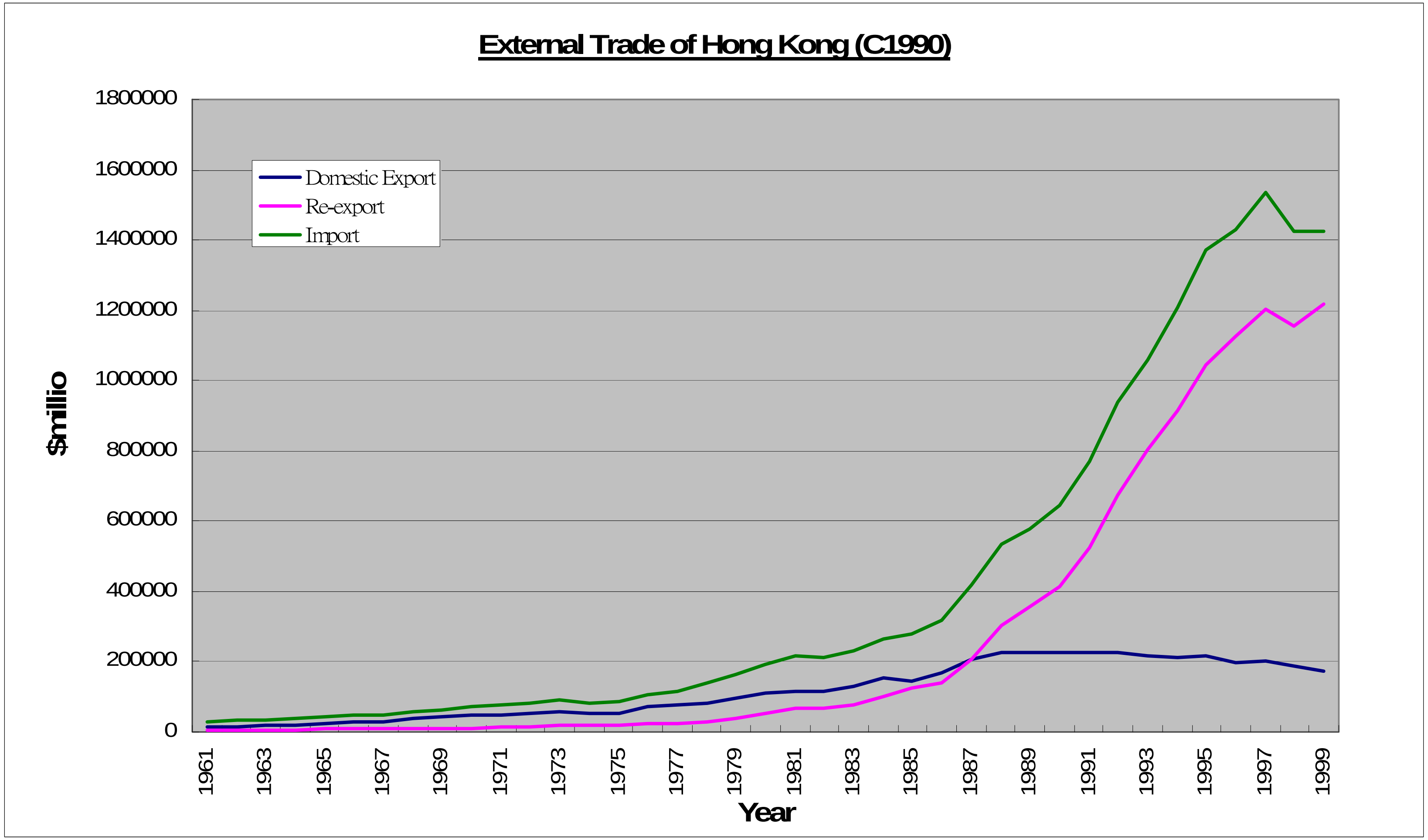
1999
Year

Annex 4

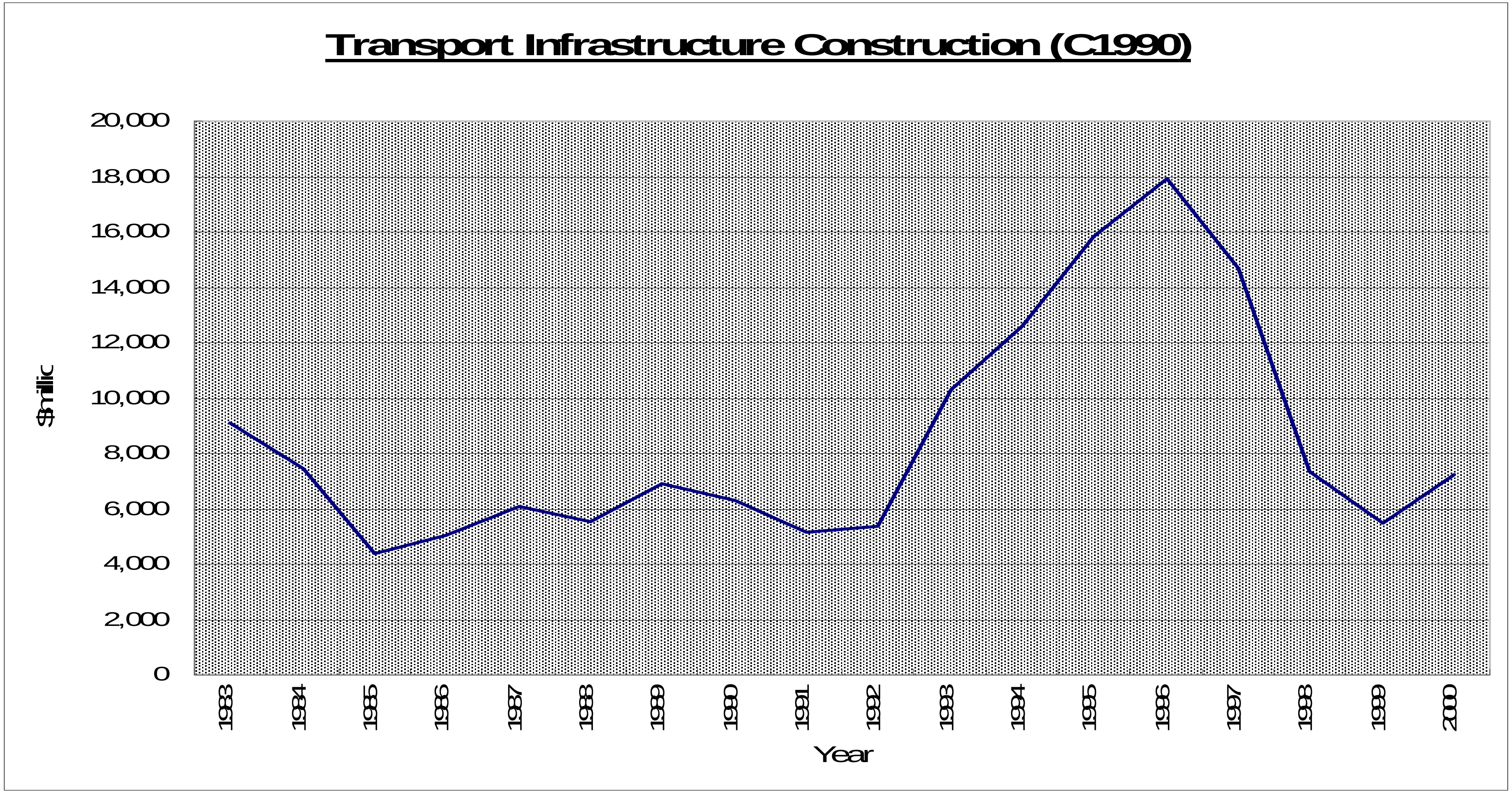


End-Used Construction Value (C1990)
Residential Buildings (RBD)
Commercial Buildings (CM)
Industrial & Storage Buildings (IS)
Service Buildings (SB)
Transport (TP)
Utilities & Plants (UP)
Environment (EN)
Sports & Recreation (SP)
All Construction (AC)
$million
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
Year

Annex 5

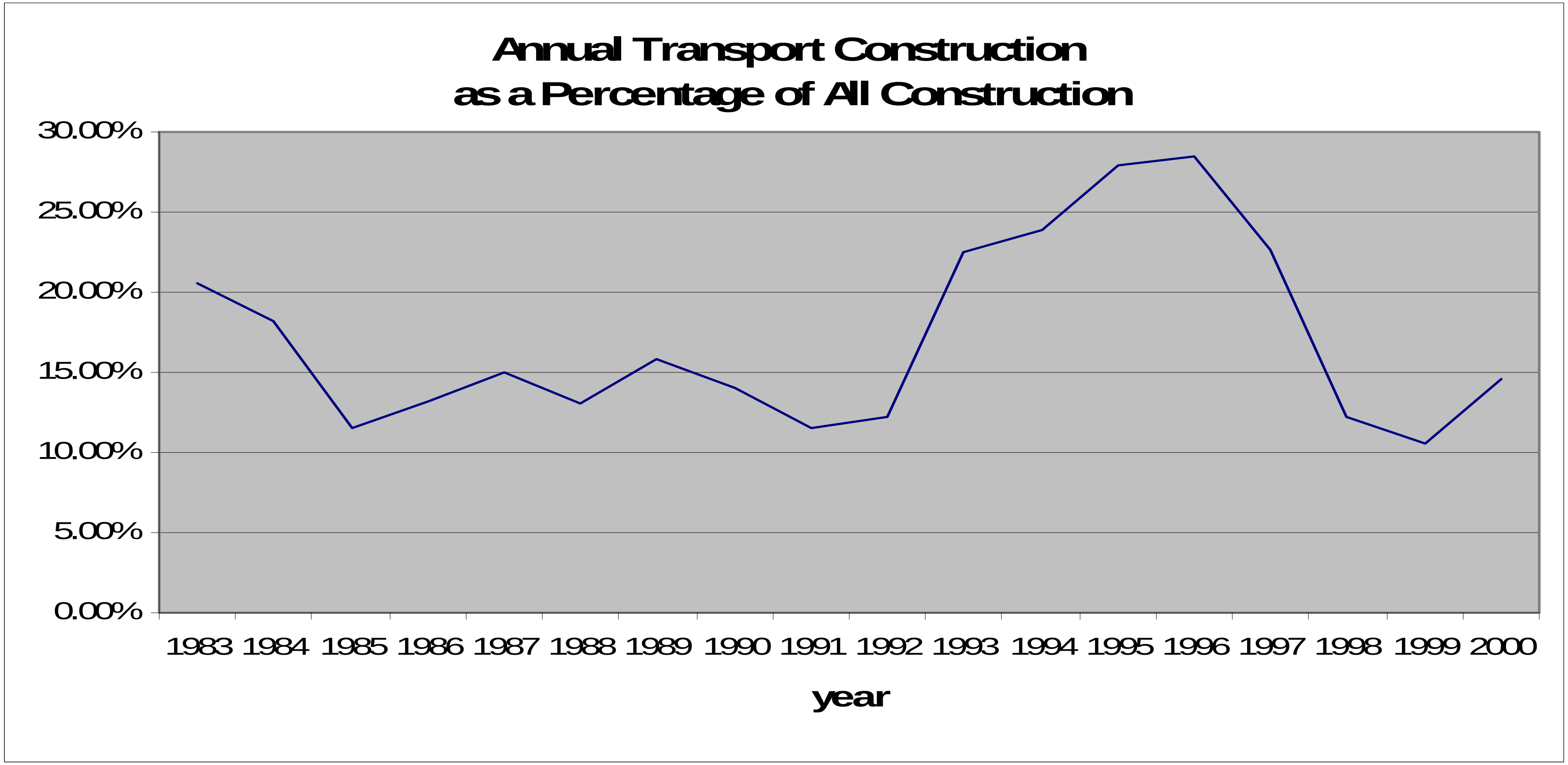

External Trade of Hong Kong (C1990)
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
$millio
Domestic Export
Re-export
Import
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
Year

Annex 6



Transport Infrastructure Construction (C1990)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
$million
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
Year

Annex 7


Annual Transport Construction
as a Percentage of All Construction
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
year

Annex 8 (Page 1)

Quarterly Detailed End-Use Construction Values

(Constant 1990 Value in HK$million)

Year / Quarter	GDP	Residential Buildings	Commercial Buildings	Industrial & Storage	Service Buildings	Transport	Utilities & Plants	Environment	Sports & Recreation	All Construction
		RBD	CM	IS	SB	TP	UP	EN	SP	AC
1983Q1	86,642	3,736	2,690	708	765	2,073	471	319	56	10,819
1983Q2	88,673	3,492	2,480	872	815	2,338	640	340	49	11,026
1983Q3	93,808	3,498	2,432	682	848	2,147	702	368	64	10,741
1983Q4	99,048	3,841	2,646	651	907	2,533	655	349	66	11,649
1984Q1	97,417	3,752	2,053	578	740	2,348	590	354	75	10,491
1984Q2	101,340	3,819	2,453	434	840	1,743	627	279	58	10,253
1984Q3	104,005	4,157	1,990	513	846	1,791	587	273	51	10,208
1984Q4	102,252	4,188	2,047	566	936	1,582	540	298	53	10,209
1985Q1	103,096	4,105	1,436	563	1,016	1,519	625	295	51	9,611
1985Q2	98,428	4,178	1,726	595	1,043	1,168	553	277	47	9,588
1985Q3	100,946	4,115	1,553	774	908	853	532	253	49	9,038
1985Q4	104,291	4,950	1,461	916	927	866	618	397	60	10,194
1986Q1	103,303	4,215	817	751	804	1,368	560	305	54	8,874
1986Q2	106,474	4,667	896	911	877	765	435	251	40	8,844

Annex 8 (Page 2)

<u>Quarterly Detailed End-Use Construction Values</u>

(Constant 1990 Value in HK$million)

Year / Quarter	GDP	Residential Buildings	Commercial Buildings	Industrial & Storage	Service Buildings	Transport	Utilities & Plants	Environment	Sports & Recreation	All Construction
		RBD	CM	IS	SB	TP	UP	EN	SP	AC
1986Q3	117,853	4,851	997	726	868	1,198	527	236	40	9,442
1986Q4	122,781	5,575	1,205	842	826	1,701	508	194	54	10,905
1987Q1	116,422	4,377	1,295	831	878	1,435	363	195	73	9,447
1987Q2	120,391	4,453	1,169	844	765	1,350	323	166	56	9,125
1987Q3	135,295	4,797	1,420	914	961	1,499	417	174	51	10,233
1987Q4	136,655	5,497	1,862	1,090	1,029	1,800	343	245	68	11,934
1988Q1	126,201	4,392	1,817	888	824	1,427	244	261	64	9,917
1988Q2	130,476	4,891	1,545	1,019	857	1,524	265	280	58	10,439
1988Q3	144,901	4,619	1,501	942	923	1,134	318	296	79	9,813
1988Q4	147,724	5,648	1,885	1,061	1,124	1,446	407	347	114	12,032
1989Q1	134,025	4,279	1,800	879	983	1,479	442	359	89	10,309
1989Q2	134,536	4,579	1,628	936	1,041	1,651	372	241	85	10,533
1989Q3	146,640	4,716	1,514	1,024	1,235	1,889	283	429	89	11,179
1989Q4	148,167	5,185	1,423	899	1,232	1,885	305	444	118	11,492

Annex 8 (Page 3)

<u>Quarterly Detailed End-Use Construction Values</u>

(Constant 1990 Value in HK$million)

Year / Quarter	GDP	Residential Buildings	Commercial Buildings	Industrial & Storage	Service Buildings	Transport	Utilities & Plants	Environment	Sports & Recreation	All Construction
		RBD	CM	IS	SB	TP	UP	EN	SP	AC
1990Q1	134,695	4,136	1,843	790	983	1,675	330	379	117	10,253
1990Q2	139,634	4,829	1,909	759	987	1,483	381	344	139	10,831
1990Q3	153,385	4,907	2,118	763	1,106	1,570	532	350	131	11,477
1990Q4	154,835	5,304	2,175	895	1,138	1,554	555	398	137	12,156
1991Q1	141,357	4,381	1,986	828	1,128	1,304	501	449	90	10,668
1991Q2	146,105	4,489	2,028	850	1,261	1,355	407	448	85	10,922
1991Q3	160,886	4,568	1,972	873	1,126	1,272	451	505	104	10,873
1991Q4	163,668	4,795	2,527	887	1,215	1,193	561	682	80	11,942
1992Q1	149,908	4,497	2,115	781	1,161	1,116	318	740	68	10,797
1992Q2	155,430	4,252	1,848	713	1,051	1,133	486	858	48	10,390
1992Q3	171,883	4,664	1,441	766	1,123	1,295	606	846	66	10,807
1992Q4	173,126	4,826	1,735	684	1,248	1,833	613	733	86	11,758
1993Q1	159,239	4,428	1,573	522	1,013	1,785	498	652	79	10,550

Annex 8 (Page 4)

<u>Quarterly Detailed End-Use Construction Values</u>

(Constant 1990 Value in HK$million)

Year / Quarter	GDP	Residential Buildings RBD	Commercial Buildings CM	Industrial & Storage IS	Service Buildings SB	Transport TP	Utilities & Plants UP	Environment EN	Sports & Recreation SP	All Construction AC
1993Q2	164,982	4,255	1,546	538	845	2,574	469	743	51	11,021
1993Q3	182,784	4,276	1,517	474	1,101	2,693	585	801	62	11,510
1993Q4	183,218	4,476	1,575	578	1,060	3,269	502	1,248	76	12,784
1994Q1	169,621	4,493	1,703	532	1,172	3,404	574	917	60	12,855
1994Q2	174,073	4,397	1,960	803	1,102	3,184	761	667	59	12,932
1994Q3	190,727	4,716	1,847	711	1,104	2,766	782	962	64	12,952
1994Q4	193,085	4,666	1,905	915	1,190	3,225	840	1,029	100	13,871
1995Q1	179,460	4,068	1,968	1,012	1,071	3,090	807	884	67	12,967
1995Q2	181,828	4,211	1,651	1,116	1,277	3,898	737	1,270	44	14,203
1995Q3	196,269	4,024	1,363	1,068	1,310	4,294	593	1,083	46	13,781
1995Q4	198,276	4,948	1,784	1,200	1,338	4,578	679	1,290	82	15,899
1996Q1	184,400	4,506	1,937	812	1,159	4,392	675	1,005	49	14,535
1996Q2	188,930	4,754	2,199	912	1,345	4,274	510	1,076	79	15,150

Annex 8 (Page 5)

Quarterly Detailed End-Use Construction Values

(Constant 1990 Value in HK$million)

Year / Quarter	GDP	Residential Buildings	Commercial Buildings	Industrial & Storage	Service Buildings	Transport	Utilities & Plants	Environment	Sports & Recreation	All Construction
		RBD	CM	IS	SB	TP	UP	EN	SP	AC
1996Q3	207,149	5,039	2,167	772	1,449	4,338	445	1,105	75	15,389
1996Q4	209,273	6,118	2,706	950	1,422	4,890	540	1,000	109	17,734
1997Q1	194,337	5,308	2,536	797	1,405	4,254	387	868	75	15,631
1997Q2	201,073	5,429	2,812	1,002	1,541	3,985	345	755	87	15,957
1997Q3	219,069	6,089	2,948	896	1,593	3,319	285	486	69	15,686
1997Q4	214,539	7,481	3,351	1,163	1,451	3,115	369	609	79	17,617
1998Q1	188,803	6,759	2,944	960	1,179	2,471	387	592	82	15,372
1998Q2	190,360	7,625	2,845	721	1,544	2,382	375	443	98	16,036
1998Q3	203,621	7,155	2,642	695	1,601	1,304	361	529	90	14,375
1998Q4	202,289	7,271	2,633	558	1,686	1,172	532	481	103	14,436
1999Q1	183,283	7,707	1,874	302	1,267	1,231	357	433	105	13,276
1999Q2	192,519	7,825	1,309	226	1,338	1,249	311	472	82	12,811
1999Q3	212,438	8,036	1,395	250	1,108	1,250	339	424	69	12,872

Annex 8 (Page 6)

<u>Quarterly Detailed End-Use Construction Values</u>

(Constant 1990 Value in HK$million)

Year / Quarter	GDP	Residential Buildings	Commercial Buildings	Industrial & Storage	Service Buildings	Transport	Utilities & Plants	Environment	Sports & Recreation	All Construction
		RBD	CM	IS	SB	TP	UP	EN	SP	AC
1999Q4	220,858	7,926	1,221	146	1,021	1,723	348	528	89	13,000
2000Q1	209,092	7,764	1,173	212	1,033	1,596	290	504	74	12,648
2000Q2	213,362	7,016	1,012	167	1,100	1,746	263	405	60	11,771
2000Q3	235,326	7,182	1,178	123	1,343	1,794	241	430	67	12,359
2000Q4	235,870	7,153	1,166	201	1,054	2,082	293	595	86	12,633
2001Q1	216,238	6,327	1,033	110	1,313	1,984	252	604	68	11,691
2001Q2	218,918	6,291	977	57	1,194	1,864	279	616	72	11,350
2001Q3	230,534	5,853	892	88	1,156	1,847	290	697	98	10,920
2001Q4	233,662	6,434	1,374	216	1,145	2,370	378	846	48	12,811
2002Q1	215,121	5,794	1,323	210	1,042	1,895	287	785	50	11,384
2002Q2	220,705	6,459	1,439	222	1,098	1,684	275	711	41	11,929
2002Q3	238,129	5,868	1,530	277	853	1,564	274	559	21	10,945
2002Q4	245,278	5,592	1,536	352	839	1,587	246	673	37	10,862

Annex 9 (Page 1)

All Construction Growth vs Economic Growth, 1983-2002

<u>Autocorrelation Analyses - Runs Tests</u>

AC > GDP $GDP_t = \Sigma_{i=1}^{n} \alpha_i AC_{t-i} + \Sigma_{j=1}^{n} \beta_j GDP_{t-j} + u_{1t}$

<u>2Q Lags</u>

k	n1	n2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
19	63	14	77	23.91	6.60	28.95	18.87

<u>4Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
27	54	21	75	31.24	11.95	38.02	24.46

<u>6Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
24	60	13	73	22.37	6.05	27.19	17.55

<u>8Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
16	61	10	71	18.18	3.97	22.09	14.28

<u>12Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
25	51	16	67	25.36	8.62	31.11	19.60

<u>Conclusion:</u>

k values of all data series lie between E(k)+1.96 σ_k **and** E(k)-1.96 σ_k

Cannot reject the null hypothesis of randomness

Notes: k = Numbers of Runs
n_1 = Number of positive residuals
n_2 = Number of negative residuals
n = $n_1 + n_2$

Annex 9 (Page 2)

All Construction Growth vs Economic Growth, 1983-2002
<u>Autocorrelation Analyses - Runs Tests</u>

GDP > AC $AC_t = \Sigma_{i=1}^{m} \lambda_i AC_{t-i} + \Sigma_{j=1}^{m} \delta_j GDP_{t-j} + u_{2t}$

<u>2Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
38	33	44	77	38.71	18.22	47.08	30.35

<u>4Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
37	28	47	75	36.09	16.17	43.97	28.21

<u>6Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
29	25	48	73	33.88	14.56	41.35	26.40

<u>8Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
25	14	57	71	23.48	6.90	28.63	18.33

<u>12Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
11	5	62	67	10.25	1.16	12.36	8.15

<u>Conclusion:</u>

k values of all data series lie between E(k)+1.96σ_k **and** E(k)-1.96σ_k

Cannot reject the null hypothesis of randomness

Notes:
k = Numbers of Runs
n_1 = Number of positive residuals
n_2 = Number of negative residuals
n = $n_1 + n_2$

Annex 9 (Page 3)

Residential Building Construction Growth vs Economic Growth, 1983-2002
Autocorrelation Analyses - Runs Tests

RBD > GDP $GDP_t = \Sigma_{i=1}^{n} \alpha_i RBD_{t-i} + \Sigma_{j=1}^{n} \beta_j GDP_{t-j} + u_{1t}$

2Q Lags

k	n1	n2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
19	64	13	77	22.61	5.86	27.36	17.87

4Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
25	53	22	75	32.09	12.64	39.06	25.12

6Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
12	67	6	73	12.01	1.53	14.44	9.59

8Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
12	65	6	71	11.99	1.57	14.44	9.53

12Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
11	60	7	67	13.54	2.19	16.44	10.64

Conclusion:

k values of all data series, except 4Q Lags, lie between E(k)+1.96 σ_k **and** E(k)-1.96 σ_k

k values of 4Q Lags is very close to the lower limit

Assume the null hypothesis of randomness cannot be rejected

Notes:
- k = Numbers of Runs
- n_1 = Number of positive residuals
- n_2 = Number of negative residuals
- n = $n_1 + n_2$

Annex 9 (Page 4)

Residential Building Construction Growth vs Economic Growth, 1983-2002
<u>Autocorrelation Analyses - Runs Tests</u>

GDP > RBD $RBD_t = \Sigma_{i=1}{}^m \lambda_i RBD_{t-i} + \Sigma_{j=1}{}^m \delta_j GDP_{t-j} + u_{2t}$

<u>2Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
34	40	37	77	39.44	18.94	47.97	30.91

<u>4Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
42	46	29	75	36.57	16.62	44.56	28.58

<u>6Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
42	40	33	73	37.16	17.66	45.40	28.93

<u>8Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
35	29	42	71	35.31	16.33	43.23	27.39

<u>12Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
11	5	62	67	10.25	1.16	12.36	8.15

<u>Conclusion:</u>

k values of all data series lie between E(k)+1.96 σ_k **and** E(k)-1.96 σ_k

Cannot reject the null hypothesis of randomness

Notes:
k = Numbers of Runs
n_1 = Number of positive residuals
n_2 = Number of negative residuals
n = $n_1 + n_2$

Annex 9 (Page 5)

Commercial Building Construction Growth vs Economic Growth, 1983-2002
<u>Autocorrelation Analyses - Runs Tests</u>

CM > GDP $GDP_t = \Sigma_{i=1}^{n} \alpha_i CM_{t-i} + \Sigma_{j=1}^{n} \beta_j GDP_{t-j} + u_{1t}$

<u>2Q Lags</u>

k	n1	n2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
23	62	15	77	25.16	7.36	30.47	19.84

<u>4Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
27	50	25	75	34.33	14.56	41.81	26.85

<u>6Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
20	62	11	73	19.68	4.59	23.88	15.49

<u>8Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
16	62	9	71	16.72	3.30	20.28	13.16

<u>12Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
23	54	13	67	21.96	6.34	26.89	17.02

<u>Conclusion:</u>
k values of all data series lie between E(k)+1.96 σ_k **and** E(k)-1.96 σ_k
Cannot reject the null hypothesis of randomness

Notes:
k = Numbers of Runs
n_1 = Number of positive residuals
n_2 = Number of negative residuals
n = $n_1 + n_2$

Annex 9(Page 6)

Commercial Building Construction Growth vs Economic Growth, 1983-2002
<u>Autocorrelation Analyses - Runs Tests</u>

GDP > CM $CM_t = \Sigma_{i=1}^{m} \lambda_i CM_{t-i} + \Sigma_{j=1}^{m} \delta_j GDP_{t-j} + u_{2t}$

<u>2Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
42	36	41	77	39.34	18.83	47.84	30.83

<u>4Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
34	29	46	75	36.57	16.62	44.56	28.58

<u>6Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
35	30	43	73	36.34	16.86	44.39	28.30

<u>8Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
44	34	37	71	36.44	17.43	44.62	28.25

<u>12Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
15	8	59	67	15.09	2.79	18.37	11.81

<u>Conclusion:</u>
k values of all data series lie between E(k)+1.96 σ_k **and** E(k)-1.96 σ_k
Cannot reject the null hypothesis of randomness

Notes:
k = Numbers of Runs
n_1 = Number of positive residuals
n_2 = Number of negative residuals
n = $n_1 + n_2$

Annex 9 (Page 7)

Industrial & Storage Construction Growth vs Economic Growth, 1983-2002
<u>Autocorrelation Analyses - Runs Tests</u>

IS > GDP $GDP_t = \Sigma_{i=1}^{n} \alpha_i IS_{t-i} + \Sigma_{j=1}^{n} \beta_j GDP_{t-j} + u_{1t}$

<u>2Q Lags</u>

k	n1	n2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
19	63	14	77	23.91	6.60	28.95	18.87

<u>4Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
29	48	27	75	35.56	15.67	43.32	27.80

<u>6Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
24	58	15	73	24.84	7.56	30.22	19.45

<u>8Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
14	60	11	71	19.59	4.67	23.83	15.35

<u>12Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
15	54	13	67	21.96	6.34	26.89	17.02

<u>Conclusion:</u>

k values of 2Q, 4Q & 6Q data series lie between E(k)+1.96 σ_k **and** E(k)-1.96 σ_k

k values of 8Q & 12Q data series lie outside the lower limit. Therefore, the disturbances for IS construction growth `Granger` causing GDP growth may be autocorrelated.

Notes:
- k = Numbers of Runs
- n_1 = Number of positive residuals
- n_2 = Number of negative residuals
- n = $n_1 + n_2$

Annex 9 (Page 8)

Industrial & Storage Construction Growth vs Economic Growth, 1983-2002
<u>Autocorrelation Analyses - Runs Tests</u>

GDP > IS $IS_t = \Sigma_{i=1}^{m} \lambda_i IS_{t-i} + \Sigma_{j=1}^{m} \delta_j GDP_{t-j} + u_{2t}$

<u>2Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
48	39	38	77	39.49	18.99	48.03	30.95

<u>4Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
37	28	47	75	36.09	16.17	43.97	28.21

<u>6Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
39	28	45	73	35.52	16.07	43.38	27.66

<u>8Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
17	11	60	71	19.59	4.67	23.83	15.35

<u>12Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
5	65	2	67	4.88	0.17	5.69	4.07

<u>Conclusion:</u>

k values of all data series lie between E(k)+1.96 σ_k **and** E(k)-1.96 σ_k

Cannot reject the null hypothesis of randomness

Notes:
- k = Numbers of Runs
- n_1 = Number of positive residuals
- n_2 = Number of negative residuals
- n = $n_1 + n_2$

Annex 9 (Page 9)

Service Building Construction Growth vs Economic Growth, 1983-2002
<u>Autocorrelation Analyses - Runs Tests</u>

SB > GDP $GDP_t = \Sigma_{i=1}^{n} \alpha_i SB_{t-i} + \Sigma_{j=1}^{n} \beta_j GDP_{t-j} + u_{1t}$

<u>2Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	$E(k)+1.96\sigma_k$	$E(k)-1.96\sigma_k$
19	64	13	77	22.61	5.86	27.36	17.87

<u>4Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	$E(k)+1.96\sigma_k$	$E(k)-1.96\sigma_k$
27	57	18	75	28.36	9.75	34.48	22.24

<u>6Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	$E(k)+1.96\sigma_k$	$E(k)-1.96\sigma_k$
20	60	13	73	22.37	6.05	27.19	17.55

<u>8Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	$E(k)+1.96\sigma_k$	$E(k)-1.96\sigma_k$
14	61	10	71	18.18	3.97	22.09	14.28

<u>12Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	$E(k)+1.96\sigma_k$	$E(k)-1.96\sigma_k$
17	56	11	67	19.39	4.84	23.70	15.07

<u>Conclusion:</u>

k values of all data series, except 8Q Lags, lie between $E(k)+1.96\sigma_k$ **and** $E(k)-1.96\sigma_k$
k values of 8Q Lag data series very close to the lower limit of E(k)-1.96σk
Assume cannot reject the null hypothesis of randomness

Notes:
k = Numbers of Runs
n_1 = Number of positive residuals
n_2 = Number of negative residuals
n = $n_1 + n_2$

Annex 9 (Page 10)

Service Building Construction Growth vs Economic Growth, 1983-2002
<u>Autocorrelation Analyses - Runs Tests</u>

GDP > SB $SB_t = \Sigma_{i=1}{}^m \lambda_i SB_{t-i} + \Sigma_{j=1}{}^m \delta_j GDP_{t-j} + u_{2t}$

<u>2Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
36	44	33	77	38.71	18.22	47.08	30.35

<u>4Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
40	39	36	75	38.44	18.44	46.86	30.02

<u>6Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
40	39	34	73	37.33	17.83	45.60	29.05

<u>8Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
41	25	46	71	33.39	14.53	40.87	25.92

<u>12Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
11	5	62	67	10.25	1.16	12.36	8.15

<u>Conclusion:</u>

k values of all data series, except 8Q Lags, lie between E(k)+1.96σ_k **and** E(k)-1.96σ_k
k values of 8Q Lags data series very close to the upper limit of E(k)+1.96σk
Assume cannot reject the null hypothesis of randomness

Notes:
- k = Numbers of Runs
- n_1 = Number of positive residuals
- n_2 = Number of negative residuals
- n = $n_1 + n_2$

Annex 9 (Page 11)

Transport Construction Growth vs Economic Growth, 1983-2002
Autocorrelation Analyses - Runs Tests

TP > GDP $GDP_t = \Sigma_{i=1}^{n} \alpha_i TP_{t-i} + \Sigma_{j=1}^{n} \beta_j GDP_{t-j} + u_{1t}$

2Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
41	25	52	77	34.77	14.56	42.24	27.29

4Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
27	52	23	75	32.89	13.31	40.05	25.74

6Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
10	67	6	73	12.01	1.53	14.44	9.59

8Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
10	65	6	71	11.99	1.57	14.44	9.53

12Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
11	62	5	67	10.25	1.16	12.36	8.15

Conclusion:
k values of all data series lie between E(k)+1.96 σ_k **and** E(k)-1.96 σ_k
Cannot reject the null hypothesis of randomness

Notes:
k = Numbers of Runs
n_1 = Number of positive residuals
n_2 = Number of negative residuals
n = $n_1 + n_2$

Annex 9 (Page 12)

Transport Construction Growth vs Economic Growth, 1983-2002
Autocorrelation Analyses - Runs Tests

GDP > TP $TP_t = \Sigma_{i=1}^{m} \lambda_i TP_{t-i} + \Sigma_{j=1}^{m} \delta_j GDP_{t-j} + u_{2t}$

2Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
36	37	40	77	39.44	18.94	47.97	30.91

4Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
35	33	42	75	37.96	17.96	46.27	29.65

6Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
37	32	41	73	36.95	17.45	45.13	28.76

8Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
29	23	48	71	32.10	13.37	39.27	24.93

12Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
19	12	55	67	20.70	5.58	25.33	16.07

Conclusion:

k values of all data series lie between E(k)+1.96σ_k **and** E(k)-1.96σ_k

Cannot reject the null hypothesis of randomness

Notes:
k = Numbers of Runs
n_1 = Number of positive residuals
n_2 = Number of negative residuals
n = $n_1 + n_2$

Annex 9 (Page 13)

Utilities & Plants Construction Growth vs Economic Growth, 1983-2002
<u>Autocorrelation Analyses - Runs Tests</u>

UP > GDP $GDP_t = \Sigma_{i=1}^{n} \alpha_i TP_{t-i} + \Sigma_{j=1}^{n} \beta_j GDP_{t-j} + u_{1t}$

2Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	$E(k)+1.96\sigma_k$	$E(k)-1.96\sigma_k$
21	62	15	77	25.16	7.36	30.47	19.84

4Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	$E(k)+1.96\sigma_k$	$E(k)-1.96\sigma_k$
29	52	23	75	32.89	13.31	40.05	25.74

6Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	$E(k)+1.96\sigma_k$	$E(k)-1.96\sigma_k$
22	61	12	73	21.05	5.31	25.57	16.54

8Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	$E(k)+1.96\sigma_k$	$E(k)-1.96\sigma_k$
16	62	9	71	16.72	3.30	20.28	13.16

12Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	$E(k)+1.96\sigma_k$	$E(k)-1.96\sigma_k$
13	60	7	67	13.54	2.19	16.44	10.64

<u>Conclusion:</u>
k values of all data series lie between $E(k)+1.96\sigma_k$ **and** $E(k)-1.96\sigma_k$
Cannot reject the null hypothesis of randomness

Notes:
k = Numbers of Runs
n_1 = Number of positive residuals
n_2 = Number of negative residuals
n = $n_1 + n_2$

Annex 9 (Page 14)

Utilities & Plants Construction Growth vs Economic Growth, 1983-2002
<u>Autocorrelation Analyses - Runs Tests</u>

GDP > UP $UP_t = \Sigma_{i=1}^{m} \lambda_i UP_{t-i} + \Sigma_{j=1}^{m} \delta_j GDP_{t-j} + u_{2t}$

<u>2Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
39	32	45	77	38.40	17.92	46.70	30.11

<u>4Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
40	36	39	75	38.44	18.44	46.86	30.02

<u>6Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
39	31	42	73	36.67	17.18	44.79	28.55

<u>8Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
37	31	40	71	35.93	16.93	43.99	27.86

<u>12Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
31	28	39	67	33.60	15.61	41.34	25.85

<u>Conclusion:</u>
k values of all data series lie between E(k)+1.96 σ_k **and** E(k)-1.96 σ_k
Cannot reject the null hypothesis of randomness

Notes: k = Numbers of Runs
n_1 = Number of positive residuals
n_2 = Number of negative residuals
n = $n_1 + n_2$

Annex 9 (Page 15)

Environment Construction Growth vs Economic Growth, 1983-2002
Autocorrelation Analyses - Runs Tests

EN > GDP $GDP_t = \Sigma_{i=1}^{n} \alpha_i EN_{t-i} + \Sigma_{j=1}^{n} \beta_j GDP_{t-j} + u_{1t}$

2Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
23	63	14	77	23.91	6.60	28.95	18.87

4Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
29	49	26	75	34.97	15.14	42.60	27.35

6Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
20	61	12	73	21.05	5.31	25.57	16.54

8Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
8	67	4	71	8.55	0.71	10.20	6.90

12Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
11	61	6	67	11.93	1.64	14.44	9.41

Conclusion:
k values of all data series lie between E(k)+1.96σ_k **and** E(k)-1.96σ_k
Cannot reject the null hypothesis of randomness

Notes:
k = Numbers of Runs
n_1 = Number of positive residuals
n_2 = Number of negative residuals
n = $n_1 + n_2$

Annex 9 (Page 16)

Environment Construction Growth vs Economic Growth, 1983-2002

Autocorrelation Analyses - Runs Tests

GDP > EN $EN_t = \Sigma_{i=1}^{m} \lambda_i EN_{t-i} + \Sigma_{j=1}^{m} \delta_j GDP_{t-j} + u_{2t}$

2Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
32	38	39	77	39.49	18.99	48.03	30.95

4Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
33	33	42	75	37.96	17.96	46.27	29.65

6Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
25	36	37	73	37.49	17.99	45.81	29.18

8Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
31	32	39	71	36.15	17.15	44.27	28.04

12Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
23	48	19	67	28.22	10.82	34.67	21.78

Conclusion:

k values of all data series, except 6Q Lags, lie between E(k)+1.96σ_k **and** E(k)-1.96σ_k

Therefore, the data series for the 6Q Lags analyses may be autocorrelated.

Notes:
- k = Numbers of Runs
- n_1 = Number of positive residuals
- n_2 = Number of negative residuals
- n = $n_1 + n_2$

Annex 9 (Page 17)

Sports & Other Construction Growth vs Economic Growth, 1983-2002
Autocorrelation Analyses - Runs Tests

SP > GDP $GDP_t = \Sigma_{i=1}^{n} \alpha_i SP_{t-i} + \Sigma_{j=1}^{n} \beta_j GDP_{t-j} + u_{1t}$

2Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
19	63	14	77	23.91	6.60	28.95	18.87

4Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
27	52	23	75	32.89	13.31	40.05	25.74

6Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
16	62	11	73	19.68	4.59	23.88	15.49

8Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
10	63	8	71	15.20	2.68	18.40	11.99

12Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
11	58	9	67	16.58	3.44	20.22	12.95

Conclusion:

k values of 2Q, 4Q & 6Q Lags data series lie between E(k)+1.96σ_k and E(k)-1.96σ_k

k values of 8Q & 12Q Lags data series lie outside E(k)+1.96σk and E(k)-1.96σk. Therefore, the data series for the 8Q & 12Q Lags analyses may be autocorrelated.

Notes:
- k = Numbers of Runs
- n_1 = Number of positive residuals
- n_2 = Number of negative residuals
- n = $n_1 + n_2$

Annex 9 (Page 18)

Sports & Other Construction Growth vs Economic Growth, 1983-2002
<u>Autocorrelation Analyses - Runs Tests</u>

GDP > SP $SP_t = \Sigma_{i=1}^{m} \lambda_i SP_{t-i} + \Sigma_{j=1}^{m} \delta_j GDP_{t-j} + u_{2t}$

<u>2Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
44	34	43	77	38.97	18.47	47.40	30.55

<u>4Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
39	32	43	75	37.69	17.70	45.94	29.45

<u>6Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
36	27	46	73	35.03	15.61	42.77	27.28

<u>8Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
32	23	48	71	32.10	13.37	39.27	24.93

<u>12Q Lags</u>

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
29	23	44	67	31.21	13.37	38.38	24.04

<u>Conclusion:</u>

k values of all data series lie between E(k)+1.96 σ_k **and** E(k)-1.96 σ_k

Cannot reject the null hypothesis of randomness

Notes:
- k = Numbers of Runs
- n_1 = Number of positive residuals
- n_2 = Number of negative residuals
- n = $n_1 + n_2$

Annex 10

Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

Dickey-Fuller Unit Root Tests Analysis

	τ (tau) statistic of Dt-1 (DF Tests)				τ (tau) statistic of Dt-1 (ADF Tests)			
D	Computed τ no trend	Critical Value	Computed τ with Trend	Critical Value	Computed τ no Trend	Critical Value	Computed τ with Trend	Critical Value
GDP	-8.531	-2.899	-8.474	-3.467	-24.710	-2.899	-24.581	-3.468
AC	-14.541		-14.503		---		---	
RBD	-14.014		-13.980		-7.700		-7.707	
CM	-9.855		-9.804		---		---	
IS	-12.377		-12.313		-5.315		-5.303	
SB	-11.908		-11.968		-8.239		-8.342	
TP	-8.654		-8.598		---		---	
UP	-9.994		-9.924		---		---	
EN	-11.329		-11.261		-7.980		-7.933	
SP	-11.594		-11.611		-8.654		-8.698	

MacKinnon Critical (tau) Value

				Source: MacKinnon (1991)			DF Tests		ADF Tests	
N	Variant	Size (%)	Obs.	β(infinity)	β1	β2	T	τ (tau)	T	τ (tau)
1	No Trend	1	600	-3.4335	-5.999	-29.250	78	-3.5152	77	-3.5163
		5	600	-2.8621	-2.738	-8.360	78	-2.8986	77	-2.8991
		10	600	-2.5671	-1.438	-4.480	78	-2.5863	77	-2.5865
1	With Trend	1	600	-3.9638	-8.353	-47.440	78	-4.0787	77	-4.0803
		5	600	-3.4126	-4.039	-17.830	78	-3.4673	77	-3.4681
		10	600	-3.1279	-2.418	-7.580	78	-3.1601	77	-3.1606

Note: N = Number of non-cointegrated Series tested

Annex 11 (Page 1)

Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

Granger Causality Tests Summary

Lagged Terms m =	2
No. of sample data n =	77
No. of Parameters in the un-restricted regression k =	4

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.6962	1.3339	2.67E+09	
AC > GDP	0.7631	1.0831		2.08E+09
RBD > GDP	0.7494	1.1885		2.21E+09
CM > GDP	0.7109	1.2760		2.54E+09
IS > GDP	0.7091	1.3088		2.56E+09
SB > GDP	0.7235	1.3602		2.43E+09
TP > GDP	0.7391	1.2278		2.30E+09
UP > GDP	0.7435	1.3080		2.26E+09
EN > GDP	0.7064	1.3479		2.58E+09
SP > GDP	0.7172	1.3924		2.49E+09
AC, Restricted	0.2261	2.0474	6.46E+07	
GDP>AC	0.5219	1.8173		3.99E+07
RBD, Restricted	0.1954	2.0141	1.86E+07	
GDP>RBD	0.3789	1.8696		1.44E+07
CM, Restricted	0.0392	1.9312	5.80E+06	
GDP>CM	0.1927	1.8905		4.87E+06
IS, Restricted	0.1597	2.0207	1.05E+06	
GDP>IS	0.2752	2.0586		9.02E+05
SB, Restricted	0.1214	2.0776	1.39E+06	
GDP>SB	0.1801	2.0220		1.29E+06
TP, Restricted	0.0526	1.9815	8.75E+06	
GDP>TP	0.1239	1.9877		8.09E+06
UP, Restricted	0.1216	1.9762	4.97E+05	
GDP>UP	0.1594	2.0277		4.75E+05
EN, Restricted	0.0894	1.9935	1.17E+06	
GDP>EN	0.1597	1.9967		1.08E+06
SP, Restricted	0.1226	2.1072	2.44E+04	
GDP>SP	0.2306	2.0554		2.14E+04

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Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

Granger Causality Tests Summary

Lagged Terms m =	4
No. of sample data n =	75
No. of Parameters in the un-restricted regression k =	8

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.8665	1.4436	1.17E+09	
AC > GDP	0.8997	1.4859		8.80E+08
RBD > GDP	0.8920	1.4431		9.48E+08
CM > GDP	0.8814	1.5270		1.04E+09
IS > GDP	0.8833	1.4512		1.02E+09
SB > GDP	0.8954	1.5583		9.17E+08
TP > GDP	0.8755	1.4615		1.09E+09
UP > GDP	0.8861	1.5158		9.99E+08
EN > GDP	0.8761	1.5422		1.09E+09
SP > GDP	0.8722	1.4335		1.12E+09
AC, Restricted	0.5503	2.2082	3.66E+07	
GDP>AC	0.6073	2.0647		3.19E+07
RBD, Restricted	0.4481	2.0933	1.27E+07	
GDP>RBD	0.4971	1.9991		1.16E+07
CM, Restricted	0.1898	1.8354	4.57E+06	
GDP>CM	0.2918	1.8495		3.99E+06
IS, Restricted	0.1849	1.9078	1.01E+06	
GDP>IS	0.3194	1.9492		8.43E+05
SB, Restricted	0.1663	1.9809	1.29E+06	
GDP>SB	0.3025	2.0854		1.08E+06
TP, Restricted	0.0739	1.9182	8.38E+06	
GDP>TP	0.1468	1.8844		7.72E+06
UP, Restricted	0.1326	1.9547	4.85E+05	
GDP>UP	0.2574	2.0085		4.15E+05
EN, Restricted	0.0893	1.9915	1.17E+06	
GDP>EN	0.2212	2.0309		9.98E+05
SP, Restricted	0.2163	1.9084	2.17E+04	
GDP>SP	0.3056	1.9502		1.92E+04

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Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

Granger Causality Tests Summary

Lagged Terms m =	6
No. of sample data n =	73
No. of Parameters in the un-restricted regression k =	12

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.8927	2.0119	9.38E+08	
AC > GDP	0.9278	1.9825		6.32E+08
RBD > GDP	0.9192	1.9691		7.07E+08
CM > GDP	0.8996	1.9989		8.78E+08
IS > GDP	0.9081	1.9786		8.04E+08
SB > GDP	0.9086	2.0130		8.00E+08
TP > GDP	0.9161	1.9384		7.34E+08
UP > GDP	0.9069	1.9687		8.14E+08
EN > GDP	0.9004	2.0286		8.72E+08
SP > GDP	0.9057	1.9791		8.25E+08
AC, Restricted	0.5843	1.9105	3.38E+07	
GDP>AC	0.6360	1.8829		2.96E+07
RBD, Restricted	0.4669	1.9529	1.22E+07	
GDP>RBD	0.5259	1.9849		1.09E+07
CM, Restricted	0.2364	2.0105	4.02E+06	
GDP>CM	0.3111	2.0054		3.63E+06
IS, Restricted	0.2677	2.0576	8.87E+05	
GDP>IS	0.4263	2.0196		6.95E+05
SB, Restricted	0.2398	1.9006	1.17E+06	
GDP>SB	0.3773	1.8932		9.57E+05
TP, Restricted	0.1239	1.9511	7.61E+06	
GDP>TP	0.2683	1.9319		6.35E+06
UP, Restricted	0.1677	1.9863	4.63E+05	
GDP>UP	0.3032	1.9067		3.87E+05
EN, Restricted	0.1167	1.9575	1.13E+06	
GDP>EN	0.2934	1.9621		9.02E+05
SP, Restricted	0.2368	1.9885	2.09E+04	
GDP>SP	0.3688	1.9889		1.72E+04

Annex 11 (Page 4)

Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

Granger Causality Tests Summary

Lagged Terms m =	8
No. of sample data n =	71
No. of Parameters in the un-restricted regression k =	16

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.9102	1.9554	7.85E+08	
AC > GDP	0.9542	1.8833		4.00E+08
RBD > GDP	0.9446	1.9279		4.84E+08
CM > GDP	0.9210	1.9260		6.91E+08
IS > GDP	0.9286	1.9571		6.24E+08
SB > GDP	0.9266	1.9426		6.42E+08
TP > GDP	0.9400	2.0102		5.25E+08
UP > GDP	0.9218	1.9715		6.84E+08
EN > GDP	0.9162	1.8957		7.33E+08
SP > GDP	0.9197	1.9678		7.02E+08
AC, Restricted	0.6003	1.8772	3.23E+07	
GDP>AC	0.6473	1.8604		2.85E+07
RBD, Restricted	0.4765	1.9750	1.20E+07	
GDP>RBD	0.5517	1.9555		1.03E+07
CM, Restricted	0.2254	2.0205	3.79E+06	
GDP>CM	0.3292	1.9082		3.28E+06
IS, Restricted	0.3050	2.0357	8.40E+05	
GDP>IS	0.4512	1.9263		6.63E+05
SB, Restricted	0.2696	1.9925	1.11E+06	
GDP>SB	0.4363	2.1077		8.58E+05
TP, Restricted	0.1794	1.9539	7.08E+06	
GDP>TP	0.2944	1.9104		6.09E+06
UP, Restricted	0.1783	1.9454	4.49E+05	
GDP>UP	0.3663	1.8927		3.46E+05
EN, Restricted	0.1891	1.9090	1.03E+06	
GDP>EN	0.3206	1.9095		8.66E+05
SP, Restricted	0.2490	2.0174	2.05E+04	
GDP>SP	0.3804	1.9855		1.69E+04

Annex 11 (Page 5)

Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

Granger Causality Tests Summary

Lagged Terms m =	12
No. of sample data n =	67
No. of Parameters in the un-restricted regression k =	24

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.9339	1.8684	5.75E+08	
AC > GDP	0.9723	1.9300		2.41E+08
RBD > GDP	0.9684	1.9269		2.75E+08
CM > GDP	0.9548	1.9491		3.93E+08
IS > GDP	0.9543	1.8696		3.98E+08
SB > GDP	0.9490	1.8558		4.44E+08
TP > GDP	0.9570	1.8614		3.74E+08
UP > GDP	0.9453	1.9072		4.76E+08
EN > GDP	0.9460	1.8270		4.70E+08
SP > GDP	0.9484	1.9077		4.49E+08
AC, Restricted	0.6274	1.9408	2.89E+07	
GDP>AC	0.7104	1.9191		2.24E+07
RBD, Restricted	0.5274	1.9314	1.02E+07	
GDP>RBD	0.6469	2.0129		7.65E+06
CM, Restricted	0.2362	1.9384	3.32E+06	
GDP>CM	0.4824	1.9662		2.25E+06
IS, Restricted	0.3844	1.9771	6.94E+05	
GDP>IS	0.5798	2.0311		4.74E+05
SB, Restricted	0.3138	1.9633	1.02E+06	
GDP>SB	0.5575	1.9388		6.59E+05
TP, Restricted	0.2333	1.8961	6.26E+06	
GDP>TP	0.4310	1.9248		4.64E+06
UP, Restricted	0.2885	1.9774	3.77E+05	
GDP>UP	0.4318	1.9876		3.01E+05
EN, Restricted	0.2309	2.0064	9.58E+05	
GDP>EN	0.4424	2.0095		6.94E+05
SP, Restricted	0.2767	1.9849	1.96E+04	
GDP>SP	0.4660	1.9178		1.45E+04

Annex 12 (Page 1)

Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

F Values

Construction "Causing" Economic Growth

2Q Lags

Lagged Terms (m) =	2
No. of sample data (n) =	77
No. of Parameters in the un-restricted regression (k) =	4

	RSS_R	RSS_{UR}	F Value
GDP Restricted	2.67E+09		
AC > GDP		2.08E+09	10.32
RBD > GDP		2.21E+09	7.75
CM > GDP		2.54E+09	1.85
IS > GDP		2.56E+09	1.61
SB > GDP		2.43E+09	3.61
TP > GDP		2.30E+09	6.00
UP > GDP		2.26E+09	6.73
EN > GDP		2.58E+09	1.27
SP > GDP		2.49E+09	2.71

4Q Lags

Lagged Terms (m) =	4
No. of sample data (n) =	75
No. of Parameters in the un-restricted regression (k) =	8

	RSS_R	RSS_{UR}	F Value
GDP Restricted	1.17E+09		
AC > GDP		8.80E+08	5.53
RBD > GDP		9.48E+08	3.94
CM > GDP		1.04E+09	2.10
IS > GDP		1.02E+09	2.41
SB > GDP		9.17E+08	4.63
TP > GDP		1.09E+09	1.21
UP > GDP		9.99E+08	2.88
EN > GDP		1.09E+09	1.29
SP > GDP		1.12E+09	0.74

Annex 12 (Page 2)

Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

F Values

Construction Growth "Causing" Economic Growth

6Q Lags

Lagged Terms (m) =	6
No. of sample data (n) =	73
No. of Parameters in the un-restricted regression (k) =	12

	RSS_R	RSS_{UR}	F Value
GDP Restricted	9.38E+08		
AC > GDP		6.32E+08	4.93
RBD > GDP		7.07E+08	3.33
CM > GDP		8.78E+08	0.70
IS > GDP		8.04E+08	1.70
SB > GDP		8.00E+08	1.76
TP > GDP		7.34E+08	2.83
UP > GDP		8.14E+08	1.55
EN > GDP		8.72E+08	0.78
SP > GDP		8.25E+08	1.40

8Q Lags

Lagged Terms (m) =	8
No. of sample data (n) =	71
No. of Parameters in the un-restricted regression (k) =	16

	RSS_R	RSS_{UR}	F Value
GDP Restricted	7.85E+08		
AC > GDP		4.00E+08	6.60
RBD > GDP		4.84E+08	4.26
CM > GDP		6.91E+08	0.94
IS > GDP		6.24E+08	1.77
SB > GDP		6.42E+08	1.53
TP > GDP		5.25E+08	3.40
UP > GDP		6.84E+08	1.02
EN > GDP		7.33E+08	0.49
SP > GDP		7.02E+08	0.81

Annex 12 (Page 3)

Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

F Values

Construction Growth "Causing" Economic Growth

12Q Lags

Lagged Terms (m) =	12
No. of sample data (n) =	67
No. of Parameters in the un-restricted regression (k) =	24

	RSS_R	RSS_{UR}	F Value
GDP Restricted	5.75E+08		
AC > GDP		2.41E+08	4.97
RBD > GDP		2.75E+08	3.91
CM > GDP		3.93E+08	1.66
IS > GDP		3.98E+08	1.59
SB > GDP		4.44E+08	1.06
TP > GDP		3.74E+08	1.92
UP > GDP		4.76E+08	0.74
EN > GDP		4.70E+08	0.80
SP > GDP		4.49E+08	1.00

Annex 13 (Page 1)

Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

F Values

Economic Growth "Causing" Construction Growth

2Q Lags

Lagged Terms (m) =	2
No. of sample data (n) =	77
No. of Parameters in the un-restricted regression (k) =	4

	RSS_R	RSS_{UR}	F Value
AC Restricted	6.46E+07		
GDP > AC		3.99E+07	22.58
RBD Restricted	1.86E+07		
GDP > RBD		1.44E+07	10.78
CM Restricted	5.80E+06		
GDP > CM		4.87E+06	6.94
IS Restricted	1.05E+06		
GDP > IS		9.02E+05	5.81
SB Restricted	1.39E+06		
GDP > SB		1.29E+06	2.61
TP Restricted	8.75E+06		
GDP > TP		8.09E+06	2.97
UP Restricted	4.97E+05		
GDP > UP		4.75E+05	1.64
EN Restricted	1.17E+06		
GDP > EN		1.08E+06	3.05
SP Restricted	2.44E+04		
GDP > SP		2.14E+04	5.12

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Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

F Values

Economic Growth "Causing" Construction Growth

4Q Lags

Lagged Terms (m) =	4
No. of sample data (n) =	75
No. of Parameters in the un-restricted regression (k) =	8

	RSS_R	RSS_{UR}	F Value
AC Restricted	3.66E+07		
GDP > AC		3.19E+07	2.43
RBD Restricted	1.27E+07		
GDP > RBD		1.16E+07	1.63
CM Restricted	4.57E+06		
GDP > CM		3.99E+06	2.41
IS Restricted	1.01E+06		
GDP > IS		8.43E+05	3.31
SB Restricted	1.29E+06		
GDP > SB		1.08E+06	3.27
TP Restricted	8.38E+06		
GDP > TP		7.72E+06	1.43
UP Restricted	4.85E+05		
GDP > UP		4.15E+05	2.81
EN Restricted	1.17E+06		
GDP > EN		9.98E+05	2.84
SP Restricted	2.17E+04		
GDP > SP		1.92E+04	2.15

Annex 13 (Page 3)

Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

F Values

Economic Growth "Causing" Construction Growth

6Q Lags

Lagged Terms (m) =	6
No. of sample data (n) =	73
No. of Parameters in the un-restricted regression (k) =	12

	RSS_R	RSS_{UR}	F Value
AC Restricted	3.38E+07		
GDP > AC		2.96E+07	1.44
RBD Restricted	1.22E+07		
GDP > RBD		1.09E+07	1.26
CM Restricted	4.02E+06		
GDP > CM		3.63E+06	1.10
IS Restricted	8.87E+05		
GDP > IS		6.95E+05	2.81
SB Restricted	1.17E+06		
GDP > SB		9.57E+05	2.25
TP Restricted	7.61E+06		
GDP > TP		6.35E+06	2.01
UP Restricted	4.63E+05		
GDP > UP		3.87E+05	1.98
EN Restricted	1.13E+06		
GDP > EN		9.02E+05	2.54
SP Restricted	2.09E+04		
GDP > SP		1.72E+04	2.13

Annex 13 (Page 4)

Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

F Values

Economic Growth "Causing" Construction Growth

8Q Lags

Lagged Terms (m) =	8
No. of sample data (n) =	71
No. of Parameters in the un-restricted regression (k) =	16

	RSS_R	RSS_{UR}	F Value
AC Restricted	3.23E+07		
GDP > AC		2.85E+07	0.92
RBD Restricted	1.20E+07		
GDP > RBD		1.03E+07	1.15
CM Restricted	3.79E+06		
GDP > CM		3.28E+06	1.06
IS Restricted	8.40E+05		
GDP > IS		6.63E+05	1.83
SB Restricted	1.11E+06		
GDP > SB		8.58E+05	2.03
TP Restricted	7.08E+06		
GDP > TP		6.09E+06	1.12
UP Restricted	4.49E+05		
GDP > UP		3.46E+05	2.04
EN Restricted	1.03E+06		
GDP > EN		8.66E+05	1.33
SP Restricted	2.05E+04		
GDP > SP		1.69E+04	1.46

Annex 13 (Page 5)

Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

F Values

Economic Growth "Causing" Construction Growth

12Q Lags

Lagged Terms (m) =	12
No. of sample data (n) =	67
No. of Parameters in the un-restricted regression (k) =	24

	RSS_R	RSS_{UR}	F Value
AC Restricted	2.89E+07		
GDP > AC		2.24E+07	1.03
RBD Restricted	1.02E+07		
GDP > RBD		7.65E+06	1.21
CM Restricted	3.32E+06		
GDP > CM		2.25E+06	1.70
IS Restricted	6.94E+05		
GDP > IS		4.74E+05	1.67
SB Restricted	1.02E+06		
GDP > SB		6.59E+05	1.97
TP Restricted	6.26E+06		
GDP > TP		4.64E+06	1.25
UP Restricted	3.77E+05		
GDP > UP		3.01E+05	0.90
EN Restricted	9.58E+05		
GDP > EN		6.94E+05	1.36
SP Restricted	1.96E+04		
GDP > SP		1.45E+04	1.27

Annex 14

Detailed End-Use Construction Growth vs Economic Growth, 1983-2002

Granger Causality Tests

F Value Summary

Construction Growth Causing Economic Growth

	2Q Lags	4Q Lags	6Q Lags	8Q Lags	12Q Lags
AC > GDP	10.32	5.53	4.93	6.60	4.97
RBD > GDP	7.75	3.94	3.33	4.26	3.91
CM > GDP	1.85	2.10	0.70	0.94	1.66
IS > GDP	1.61	2.41	1.70	1.77	1.59
SB > GDP	3.61	4.63	1.76	1.53	1.06
TP > GDP	6.00	1.21	2.83	3.40	1.92
UP > GDP	6.73	2.88	1.55	1.02	0.74
EN > GDP	1.27	1.29	0.78	0.49	0.80
SP > GDP	2.71	0.74	1.40	0.81	1.00

Economic Growth Causing Construction Growth

	2Q Lags	4Q Lags	6Q Lags	8Q Lags	12Q Lags
GDP > AC	22.58	2.43	1.44	0.92	1.03
GDP > RBD	10.78	1.63	1.26	1.15	1.21
GDP > CM	6.94	2.41	1.10	1.06	1.70
GDP > IS	5.81	3.31	2.81	1.83	1.67
GDP > SB	2.61	3.27	2.25	2.03	1.97
GDP > TP	2.97	1.43	2.01	1.12	1.25
GDP > UP	1.64	2.81	1.98	2.04	0.90
GDP > EN	3.05	2.84	2.54	1.33	1.36
GDP > SP	5.12	2.15	2.13	1.46	1.27

Critical Values:	**1%**	**5%**	**10%**	
2Q Lags	4.94	3.13	2.38	(for N_1 = 2, N_2 =73)
4Q Lags	3.63	2.52	2.03	(for N1 = 4, N2 =67)
6Q Lags	3.12	2.25	1.87	(for N1 = 6, N2 = 61)
8Q Lags	2.86	2.12	1.79	(for N1 = 8, N2 = 55)
12Q Lags	2.64	1.99	1.70	(for N1 = 12, N2 = 43)

Source: Gujarati (1995)

Annex 15 (Page 1)

Transport Construction Growth vs Economic Growth, 1983-1992
Autocorrelation Analyses - Runs Tests

TP > GDP $GDP_t = \Sigma_{i=1}^{n} \alpha_i TP_{t-i} + \Sigma_{j=1}^{n} \beta_j GDP_{t-j} + u_{1t}$

2Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
11	27	10	37	15.59	5.51	20.20	10.99

4Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
14	19	16	35	18.37	8.36	24.04	12.70

6Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
15	19	14	33	17.12	7.62	22.53	11.71

8Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
13	16	15	31	16.48	7.48	21.84	11.12

12Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
7	9	18	27	13.00	5.08	17.42	8.58

Conclusion:

k values of all Runs Tests, except the 12Q Lagged, lie between E(k)+1.96 σ_k and E(k)-1.96 σ_k
k value of the Runs Test for the 12Q Lagged data series is outside the lower limit, suggesting the disturbances are correlated.
The Granger Causality Test results of the 12Q Lagged data have to be viewed with care.

Notes:
k = Numbers of Runs
n_1 = Number of positive residuals
n_2 = Number of negative residuals
n = $n_1 + n_2$

Annex 15 (Page 2)

Transport Construction Growth vs Economic Growth, 1983-1992
Autocorrelation Analyses - Runs Tests

GDP > TP $TP_t = \Sigma_{i=1}^{m} \lambda_i TP_{t-i} + \Sigma_{j=1}^{m} \delta_j GDP_{t-j} + u_{2t}$

2Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
18	19	18	37	19.49	8.98	25.36	13.61

4Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
17	16	19	35	18.37	8.36	24.04	12.70

6Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
12	13	20	33	16.76	7.27	22.04	11.47

8Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
12	9	22	31	13.77	5.01	18.16	9.39

12Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96σ_k	E(k)-1.96σ_k
16	14	13	27	14.48	6.47	19.47	9.50

Conclusion:

k values of all Runs Tests lie between E(k)+1.96σ_k and E(k)-1.96σ_k

Cannot reject the null hypothesis of randomness

Notes:
- k = Numbers of Runs
- n_1 = Number of positive residuals
- n_2 = Number of negative residuals
- n = $n_1 + n_2$

Annex 16(Page 1)

Transport Construction Growth vs Economic Growth, 1993-2002

Autocorrelation Analyses - Runs Tests

TP > GDP $GDP_t = \Sigma_{i=1}^{n} \alpha_i TP_{t-i} + \Sigma_{j=1}^{n} \beta_j GDP_{t-j} + u_{1t}$

2Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
14	27	10	37	15.59	5.51	20.20	10.99

4Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
16	21	14	35	17.80	7.81	23.28	12.32

6Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
14	25	8	33	13.12	4.21	17.14	9.10

8Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
17	21	10	31	14.55	5.67	19.21	9.88

12Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
13	12	15	27	14.33	6.32	19.26	9.40

Conclusion:

k values of all Runs Tests lie between E(k)+1.96 σ_k and E(k)-1.96 σ_k

Cannot reject the null hypothesis of randomness

Notes:
k = Numbers of Runs
n_1 = Number of positive residuals
n_2 = Number of negative residuals
n = $n_1 + n_2$

Annex 16(Page 2)

Transport Construction Growth vs Economic Growth, 1993-2002

Autocorrelation Analyses - Runs Tests

GDP > TP $TP_t = \Sigma_{i=1}^{m} \lambda_i TP_{t-i} + \Sigma_{j=1}^{m} \delta_j GDP_{t-j} + u_{2t}$

2Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
20	17	20	37	19.38	8.87	25.22	13.54

4Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
15	18	17	35	18.49	8.48	24.19	12.78

6Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
14	18	15	33	17.36	7.86	22.86	11.87

8Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
14	12	19	31	15.71	6.72	20.79	10.63

12Q Lags

k	n_1	n_2	n	E(k)	σ_k^2	E(k)+1.96 σ_k	E(k)-1.96 σ_k
11	11	16	27	14.04	6.04	18.85	9.22

Conclusion:

k values of all data series lie between E(k)+1.96 σ_k and E(k)-1.96 σ_k

Cannot reject the null hypothesis of randomness

Notes:
- k = Numbers of Runs
- n_1 = Number of positive residuals
- n_2 = Number of negative residuals
- n = $n_1 + n_2$

Annex 17

Transport Construction Growth vs Economic Growth, 1983-1992 & 1993-2002

<u>Dickey-Fuller Unit Root Tests Analysis</u>

		τ (tau) statistic of Dt-1 (DF Tests)				τ (tau) statistic of Dt-1 (ADF Tests)			
Period	D	Computed τ no trend	Critical Value	Computed τ with Trend	Critical Value	Computed τ no Trend	Critical Value	Computed τ with Trend	Critical Value
1983-1992	GDP	-6.033	-2.940	-5.953	-3.531	-17.316	-2.942	-17.058	-3.535
	TP	-7.015		-7.116		-4.776		-4.896	
1993-2002	GDP	-5.764	-2.940	-5.681	-3.531	---		---	
	TP	-5.654		-5.631					

MacKinnon Critical (tau) Value Source: MacKinnon (1991)

N	Variant	Size (%)	Obs.	β(infinity)	β1	β2	DF Tests T	DF Tests τ (tau)	ADF Tests T	ADF Tests τ (tau)
1	No Trend	1	600	-3.4335	-5.999	-29.25	38	-3.61	37	-3.62
		5	600	-2.8621	-2.738	-8.36	38	-2.94	37	-2.94
		10	600	-2.5671	-1.438	-4.48	38	-2.61	37	-2.61
1	With Trend	1	600	-3.9638	-8.353	-47.44	38	-4.22	37	-4.22
		5	600	-3.4126	-4.039	-17.83	38	-3.53	37	-3.53
		10	600	-3.1279	-2.418	-7.58	38	-3.20	37	-3.20

Note: N = Number of non-cointegrated Series tested

Annex 18 (Page 1)

Transport Construction Growth vs Economic Growth, 1983-1992

Granger Causality Tests Summary

2Q Lags

Lagged Terms m =	2
No. of sample data n =	37
No. of Parameters in the un-restricted regression k =	4

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.6162	1.1889	9.75E+08	
TP > GDP	0.6468	1.1849		8.97E+08
TP, Restricted	0.0430	1.7809	2.91E+06	
GDP>TP	0.1678	1.8626		2.53E+06

4Q Lags

Lagged Terms m =	4
No. of sample data n =	35
No. of Parameters in the un-restricted regression k =	8

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.8516	1.8765	3.73E+08	
TP > GDP	0.8707	1.8165		3.25E+08
TP, Restricted	0.0587	1.8131	2.69E+06	
GDP>TP	0.1719	1.8374		2.37E+06

6Q Lags

Lagged Terms m =	6
No. of sample data n =	33
No. of Parameters in the un-restricted regression k =	12

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.8607	2.0437	3.47E+08	
TP > GDP	0.9045	2.2222		2.38E+08
TP, Restricted	0.1040	1.9104	2.23E+06	
GDP>TP	0.4108	1.9380		1.47E+06

Annex 18 (Page 2)

Transport Construction Growth vs Economic Growth, 1983-1992

Granger Causality Tests Summary

8Q Lags

Lagged Terms m =	8
No. of sample data n =	31
No. of Parameters in the un-restricted regression k =	16

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.8798	1.6313	2.99E+08	
TP > GDP	0.9436	1.5226		1.40E+08
TP, Restricted	0.1722	1.7820	2.02E+06	
GDP>TP	0.4716	1.4237		1.29E+06

12Q Lags

Lagged Terms m =	12
No. of sample data n =	27
No. of Parameters in the un-restricted regression k =	24

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.9296	1.6136	1.72E+08	
TP > GDP	0.9926	2.7239		1.80E+07
TP, Restricted	0.4739	1.4415	1.04E+06	
GDP>TP	0.8163	2.4721		3.62E+05

Annex 19 (Page 1)

Transport Construction Growth vs Economic Growth, 1993-2002

Granger Causality Tests Summary

2Q Lags

Lagged Terms m =	2
No. of sample data n =	37
No. of Parameters in the un-restricted regression k =	4

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.7201	1.4941	1.60E+09	
TP > GDP	0.7787	1.2595		1.27E+09
TP, Restricted	0.1162	1.9041	4.91E+06	
GDP>TP	0.2027	1.8813		4.43E+06

4Q Lags

Lagged Terms m =	4
No. of sample data n =	35
No. of Parameters in the un-restricted regression k =	8

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.8608	1.2122	7.70E+08	
TP > GDP	0.8691	1.3123		7.24E+08
TP, Restricted	0.1293	1.8467	4.53E+06	
GDP>TP	0.2291	1.8715		4.01E+06

6Q Lags

Lagged Terms m =	6
No. of sample data n =	33
No. of Parameters in the un-restricted regression k =	12

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.9096	1.9533	4.73E+08	
TP > GDP	0.9388	1.7326		3.20E+08
TP, Restricted	0.2468	1.7523	3.75E+06	
GDP>TP	0.4083	1.6860		2.95E+06

Annex 19 (Page 2)

Transport Construction Growth vs Economic Growth, 1993-2002

Granger Causality Tests Summary

8Q Lags

Lagged Terms m =	8
No. of sample data n =	31
No. of Parameters in the un-restricted regression k =	16

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.9294	2.0726	3.56E+08	
TP > GDP	0.9615	2.2938		1.94E+08
TP, Restricted	0.3470	1.8138	3.10E+06	
GDP>TP	0.4788	1.9064		2.48E+06

12Q Lags

Lagged Terms m =	12
No. of sample data n =	27
No. of Parameters in the un-restricted regression k =	24

	R^2	d	RSS_R	RSS_{UR}
GDP, Restricted	0.9407	1.7574	2.75E+08	
TP > GDP	0.9848	1.8158		7.04E+07
TP, Restricted	0.5063	1.9853	1.89E+06	
GDP>TP	0.9899	1.1972		3.87E+04

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Transport Construction Growth vs Economic Growth, 1983-1992

<u>F Values</u>

2Q Lags

Lagged Terms (m) =	2
No. of sample data (n) =	37
No. of Parameters in the un-restricted regression (k) =	4

	RSS_R	RSS_{UR}	F Value
GDP Restricetd Residual Sum of Squares	9.75E+08		
TP (Granger) causing GDP		8.97E+08	1.43
TP Restricetd Residual Sum of Squares	2.91E+06		
GDP (Granger) causing TP		2.53E+06	2.47

4Q Lags

Lagged Terms (m) =	4
No. of sample data (n) =	35
No. of Parameters in the un-restricted regression (k) =	8

	RSS_R	RSS_{UR}	F Value
GDP Restricetd Residual Sum of Squares	3.73E+08		
TP (Granger) causing GDP		3.25E+08	1.00
TP Restricetd Residual Sum of Squares	2.69E+06		
GDP (Granger) causing TP		2.37E+06	0.92

6Q Lags

Lagged Terms (m) =	6
No. of sample data (n) =	33
No. of Parameters in the un-restricted regression (k) =	12

	RSS_R	RSS_{UR}	F Value
GDP Restricetd Residual Sum of Squares	3.47E+08		
TP (Granger) causing GDP		2.38E+08	1.60
TP Restricetd Residual Sum of Squares	2.23E+06		
GDP (Granger) causing TP		1.47E+06	1.82

Annex 20 (Page 2)

Transport Construction Growth vs Economic Growth, 1983-1992

F Values

8Q Lags

Lagged Terms (m) =	8
No. of sample data (n) =	31
No. of Parameters in the un-restricted regression (k) =	16

	RSS_R	RSS_{UR}	F Value
GDP Restricetd Residual Sum of Squares	2.99E+08		
TP (Granger) causing GDP		1.40E+08	2.12
TP Restricetd Residual Sum of Squares	2.02E+06		
GDP (Granger) causing TP		1.29E+06	1.06

12Q Lags

Lagged Terms (m) =	12
No. of sample data (n) =	27
No. of Parameters in the un-restricted regression (k) =	24

	RSS_R	RSS_{UR}	F Value
GDP Restricetd Residual Sum of Squares	1.72E+08		
TP (Granger) causing GDP		1.80E+07	2.13
TP Restricetd Residual Sum of Squares	1.04E+06		
GDP (Granger) causing TP		3.62E+05	0.47

Annex 21 (Page 1)

Transport Construction Growth vs Economic Growth, 1993-2002

F Values

2Q Lags

Lagged Terms (m) =	2
No. of sample data (n) =	37
No. of Parameters in the un-restricted regression (k) =	4

	RSS_R	RSS_{UR}	F Value
GDP Restricetd Residual Sum of Squares	1.60E+09		
TP (Granger) causing GDP		1.27E+09	4.37
TP Restricetd Residual Sum of Squares	4.91E+06		
GDP (Granger) causing TP		4.43E+06	1.79

4Q Lags

Lagged Terms (m) =	4
No. of sample data (n) =	35
No. of Parameters in the un-restricted regression (k) =	8

	RSS_R	RSS_{UR}	F Value
GDP Restricetd Residual Sum of Squares	7.70E+08		
TP (Granger) causing GDP		7.24E+08	0.43
TP Restricetd Residual Sum of Squares	4.53E+06		
GDP (Granger) causing TP		4.01E+06	0.87

6Q Lags

Lagged Terms (m) =	6
No. of sample data (n) =	33
No. of Parameters in the un-restricted regression (k) =	12

	RSS_R	RSS_{UR}	F Value
GDP Restricetd Residual Sum of Squares	4.73E+08		
TP (Granger) causing GDP		3.20E+08	1.67
TP Restricetd Residual Sum of Squares	3.75E+06		
GDP (Granger) causing TP		2.95E+06	0.96

Annex 21 (Page 2)

Transport Construction Growth vs Economic Growth, 1993-2002

F Values

8Q Lags

Lagged Terms (m) =	8
No. of sample data (n) =	31
No. of Parameters in the un-restricted regression (k) =	16

	RSS_R	RSS_{UR}	F Value
GDP Restricetd Residual Sum of Squares	3.56E+08		
TP (Granger) causing GDP		1.94E+08	1.56
TP Restricetd Residual Sum of Squares	3.10E+06		
GDP (Granger) causing TP		2.48E+06	0.47

12Q Lags

Lagged Terms (m) =	12
No. of sample data (n) =	27
No. of Parameters in the un-restricted regression (k) =	24

	RSS_R	RSS_{UR}	F Value
GDP Restricetd Residual Sum of Squares	2.75E+08		
TP (Granger) causing GDP		7.04E+07	0.73
TP Restricetd Residual Sum of Squares	1.89E+06		
GDP (Granger) causing TP		3.87E+04	11.94

Annex 22

Transport Construction Growth vs GDP Growth, 1983-1992 & 1993-2002

Granger Causality Tests

F Value Summary

Transport Construction Growth Causing GDP Growth

	2 Lags	4 Lags	6 Lags	8 Lags	12 Lags
1983-1992	1.43	1.00	1.60	2.12	2.77
1993-2002	4.37	0.43	1.67	1.56	0.73

GDP Growth Causing Transport Construction Growth

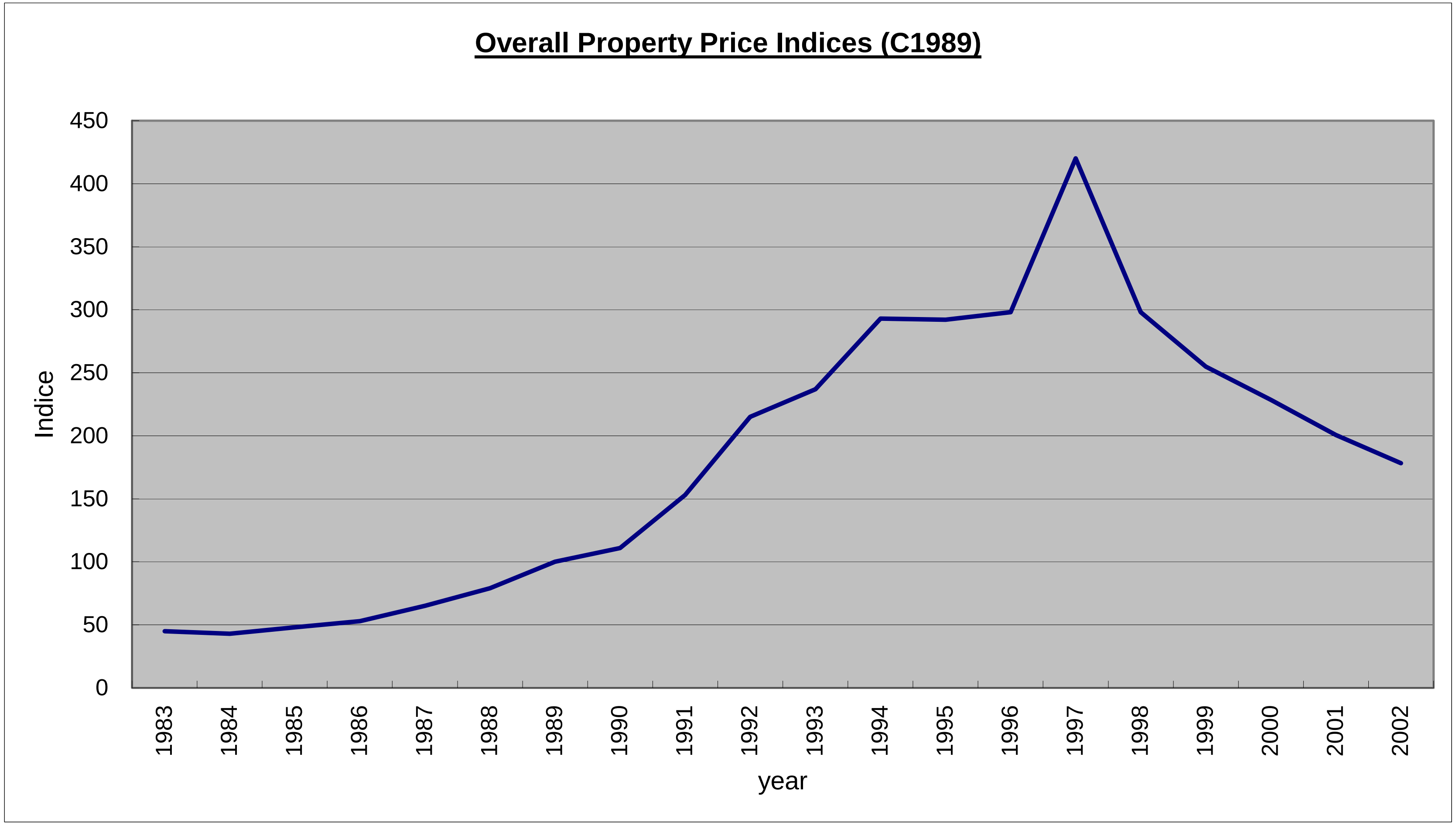
	2 Lags	4 Lags	6 Lags	8 Lags	12 Lags
1983-1992	2.47	0.92	1.82	1.06	0.77
1993-2002	1.79	0.87	0.96	0.47	11.94

Critical Values:

	1%	5%	10%	
2 Lags	5.33	3.29	2.48	(for N1 = 2, N2 =33)
4 Lags	4.11	2.73	2.17	(for N1 = 4, N2 =27)
6 Lags	3.82	2.58	2.08	(for N1 = 6, N2 = 21)
8 Lags	5.52	3.22	2.46	(for N1 = 8, N2 = 15)
10 Lags	5.26	3.14	2.42	(for N1 = 10, N2 = 9)
12 Lags	27.1	8.74	5.22	(for N1 = 12, N2 = 3)

Source: Gujarati (1995)

Annex 23



Source: Hong Kong Annual Digest

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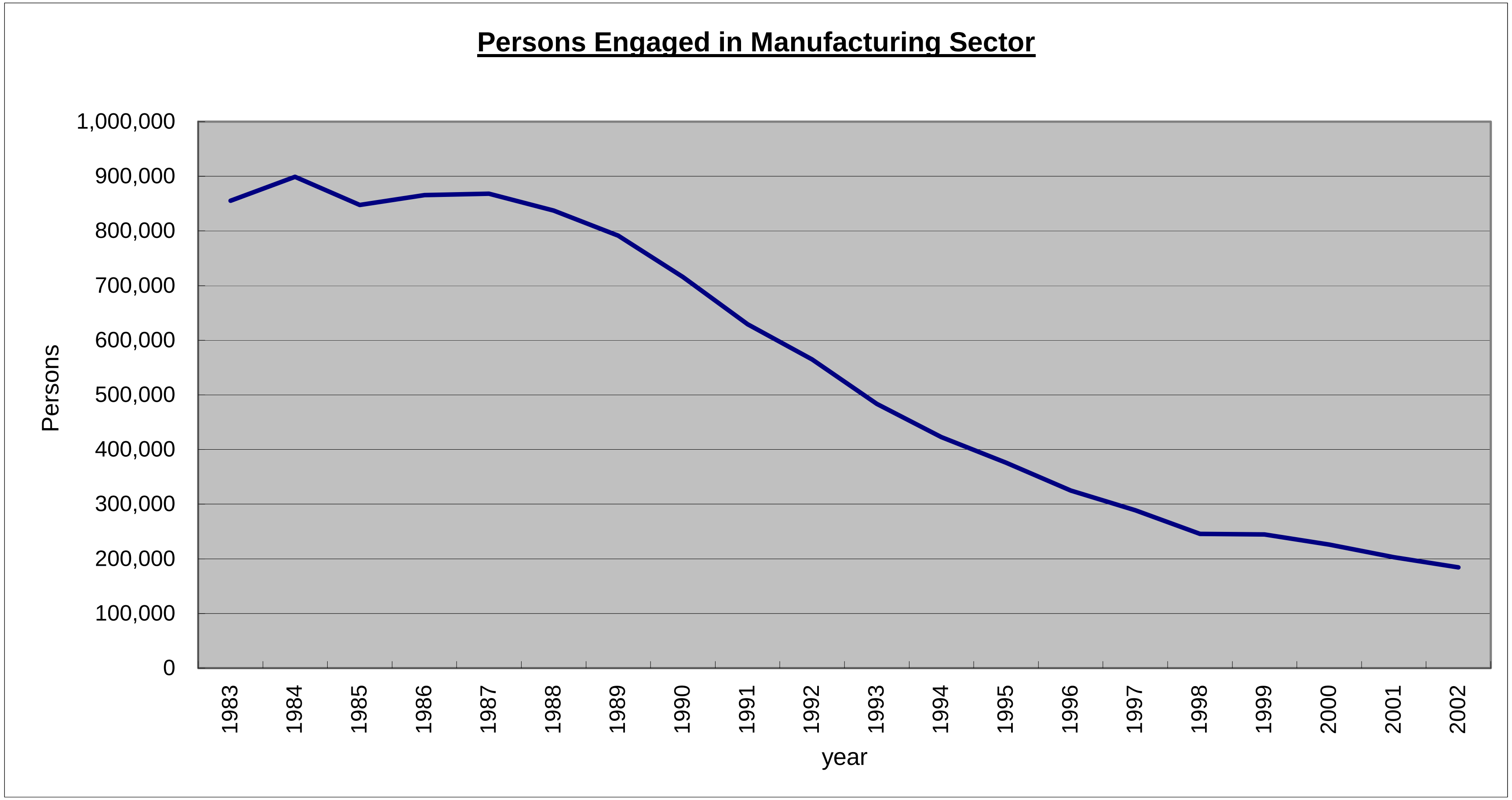

Source: Hong Kong Annual Digest

Appendices

Appendix 1

An Abridged History of Hong Kong's Transport Infrastructure Planning and Construction Programme implementation processes, 1970s – 1990s

A1.1 Planning and Implementation Processes Before 1980s

The 1970s was the decade when Hong Kong began its massive transport construction programme, which continued unabated for three decades. Social commentator T L Tsim had said, "The seventies will be remembered for the quite spectacular building programme..." [64]. This section discusses the major transport infrastructure construction programmes in the 1970s, which include the road building programme and the mass transit system. These two types of transport infrastructure construction had dominated the building programmes in the 1970s, especially in its later part.

Road Building Programme

In the 1960s and 1970s, there was yet a comprehensive transport policy for Hong Kong and the planning process was ad hoc and thematic. Transport infrastructure projects at that time were to meet the pressing social and economical needs. These needs included easing traffic congestions, serving the newly developed new town in Tuen Mun, and facilitating the growing import & export activities through the newly developed Kwai Chung container ports.

The road-building programme was started in the late 1960s when rapid economic growth led by the booming manufacturing industry had made it necessary to improve the road system. Initially, improvements were made to roads connecting the manufacturing districts, such as Kwun Tong and Tsuen Wan, and to ease traffic congestions in the urban areas. The corridor between Kwun Tong and Mongkok was enhanced in the early 1960s as a result of the rapid development of air travel and manufacturing industry.

In the early 1970s the road construction programme was further expanded. Lung Cheung Road and Ching Cheung Road were constructed to provide a more direct link to speed up the delivery of the goods manufactured in Kwun Tong to the newly developing container port at Kwai Chung for exporting to other countries.

In the urban areas, further improvements were made to the road system in Kowloon City adjacent to Kai Tak Airport. Traffic flow in this corridor was further improved with the completion of the Princess Margaret Road Flyover, which was the first pre-cast pre-stressed concrete flyover constructed in Hong Kong. In 1972, the first Cross Harbour Tunnel was opened, providing the first road linkage between the Kowloon Peninsula and Hong Kong Island. The Cross Harbour Tunnel is one of the most significant road projects in the history of Hong Kong. Its completion changed the traffic patterns in both Hong Kong Island and the Kowloon Peninsula.

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[64] 8 Aril 1979, SCMP, "'Governed' put on a bold new face"

In the New Territories, the construction of major roads progressed at a much slower pace until the early 1970s when Hong Kong began to build the new towns. The Tsing Yi Bridge, connecting Tsing Yi Island with Tsuen Wan, was completed in 1974, which marked the beginning of major development on the island. The first road cum water pipes tunnel connecting Sha Tin with Kowloon was built in 1967. It was not until 1978 that a second two-lane tunnel adjacent to the first one was opened to traffic.

One major road project in the 1970s was the Tuen Mun Road, which was built to link the newly developed Tuen Mun New Town to the urban areas. Its construction was started in 1974 and had taken nearly 10 years to fully complete in May 1983. With a length of 17 kilometers, it was Hong Kong's first limited-access dual 3-lane expressway.

The decision of the government to start constructing the Tuen Mun Road was made at a time when the economy of Hong Kong was in severe recession. Economically, this was a less than suitable time to launch major capital works projects. The world was in recession and Hong Kong was faced with a record budget deficit estimated at $410 million[65] and the unemployment rate was high. It was also forecast that the deficit would deteriorate to $429 million in the following year.[66] Whilst public expenditure was on the rise and the Government had already planned to borrow $427 million from overseas to finance the public service, conventional wisdom would suggest that capital works project programmes should be curtailed because it is the easiest way to control the expenditure budget. Instead, the government had chosen to make such an audacious decision.

It was a bold decision to start constructing such a major project during the prevailing adverse economic situation at that time, for the purpose of meeting the transportation needs of the residents in the northern New Territories. The government's assertion on the social need of Tuen Mun Road was proven correct three years after the opening to traffic of its first phase in 1978. In 1981, traffic between Tsun Wan and Tuen Mun had become heavily congested.[67] The road has since been upgraded twice In order to cope with the ever-increasing traffic. The first upgrading was commenced in mid-1994 and completed in August 1996. The second upgrade was done to the Siu Lam Section of Tuen Mun Road in the Kowloon-bound direction, which was widened from a 3-lane to a 4-lane highway. The work was completed in May 2001.

Mass Transit Railways (MTR)

Although without yet an overall transport policy at that time, the growth of Hong Kong in the 1960s and the demand for better public transport by the society prompted the government into commissioning a study of a mass transit system for Hong Kong. A consultant was engaged to undertake a detailed study of public transport needs and to formulate a functional plan for mass transportation to meet the anticipated demand in 1986. The result is a report entitled "Hong Kong Mass Transit Study" published in 1965. The report recommends Hong Kong to build an extensive rail rapid transit system supported by feeder bus services covering all urban areas and connecting them with major population centres in the New Territories. By February 1969, a further study was

[65] 7 Mar 1975, Far Eastern Economic Review, "Radical implications for Hongkong"
[66] 7 Mar 1975, Far Eastern Economic Review, "Radical implications for Hongkong"
[67] 19 February 1981, SCMP, "NT road links 'on the mend'"

undertaken and the "Hong Kong Mass Transit Further Studies Report" was published in 1970. It recommends the construction of the first stage of a mass transit system, called the Initial System, to cope with an estimated 2,700,000 daily commuters in 1986.

The government acted on the recommendation of the report two years later. In 1972, it invited submission of proposals from interested parties to construct the Initial System of the MTR. After negotiations with four consortia, it awarded the construction of the whole Initial System, a route 20 kilometres long, in a single contract to a Japanese consortium. In December 1974, the development of Hong Kong's first mass transit railway system met with a set back, when the Japanese consortium withdrew its offer. As a result, the government had to reorganise its plan. It acted very quickly, and within weeks it decided to scale down the project and let it out in multi-contracts. The reduced system is the 16-km long Modified Initial System (MIS), which runs from Central on Hong Kong Island to Kwun Tong in Kowloon, which is designed to provide transport for 1,000,000 people in 1986, costing an estimated $5,800 million.

The decision to construct the Modified Initial System of the mass transit railway was met with a mixed response of the society. Apart from some people cautioning about the poor economic environment some had argued that Hong Kong could not afford to have a mass transit railway because it was not economically prosperous enough. Others questioned its viability, as the trains were designed to carry up to 600,000 passengers an hour during peak periods whilst the estimated traffic along the route at that time was about 600,000 journeys a day and the proposed fare was also much more than the public transport commuters were paying. Some also argued that the decision to build one of the world's most ambitious underground railway systems, which was also the most expensive civil engineering venture ever undertaken in Hong Kong, would be the biggest financial gamble in its 136-year history[68].

The public generally welcomed the decision because they had hoped the project would solve the traffic problem and restore their confidence to the economy. When the project was debated at the Urban Council's meeting there was even a suggestion that the government should use the money for the Cultural Complex project to construct the underground railway instead. They considered that the proposed MTR line would be more useful to the economy of Hong Kong[69].

The government was also determined to move ahead with building the MTR to serve as the backbone of the public transport network. It believed that an underground railway system would be a long-term solution affording maximum relief from congestion on the roads and the MIS project would be financially viable [70]. It also argued that the MTR should be the most efficient means of meeting the public transport demand in the following decade and beyond, and if the proposed MIS were not built, severely congested traffic conditions would be experienced in the 1980s, which would have serious social and economic consequences for the future of Hong Kong.[71]

This decision was made long before the government commissioned the first comprehensive transport study for the preparation of Hong Kong's first Transport White Paper, although it was later included as a policy in the White Paper. It

[68] 18 Mar 1977, Far Eastern Economic Review, "Keeping commuter cool behind the air curtains"
[69] 16 Jan 1975, SCMP, "Kaifong leaders support the tube"
[70] 8 May 1975, SCMP, "Tube: the last legal hurdle is removed"
[71] 10 Sep 1975, SCMP, "It's 'Yes' to the tube - $5,800m"

was envisaged that the mass transit railway, as an off-street public passenger mode of transport, would be a key part of an integrated, multi-modal public transport system. This was why the government was so determine to keep the project going by letting the project out in multiple contracts when the Japanese Consortium revoked the development contract of the Initial System. Before the first Transport White Paper was published, construction of both the Modified Initial System of the mass transit railway and its Tsuen Wan extension had already begun.

On 7 May 1975, the Legislative Council passed a Legislation setting up the Mass Transit Railway Corporation (MTRC). Four months later, on 9 September 1975, the Executive Council approved the construction of the $5,800 million MIS. Eight weeks later, the Legislative Council authorised the government to guarantee loans and export credits obtained by the MTRC. This cleared the way for construction work of the MIS to begin.

The first section of the MIS from Kwun Tong Station to Shek Kip Mei Station was opened to serve the public on 1 October 1979. The remaining stations of the line were opened in February 1980. The public's response to this new mode of transport was overwhelming. In its first six weeks of operation, it carried more than five million passengers, 1.75 million above the projected figure.[72] Despite the comparatively high fare MTR commuters seems to appreciate the service.[73] One year after the opening of the first section, a total of 130 million people had travelled on the MTR[74]. The operation of the MTR had also had a quite marked effect on road conditions throughout Kowloon. This was particularly noticeable in the Kwun Tong area. Surveys had shown that the majority of users were young people and that commuters were saving on average 17 minutes on their normal journey times for an additional cost of 58 cents.[75]

In December 1976, the MTRC began to study the feasibility of extending the underground railway to Tsuen Wan at the request of the government. They both believed that the next extension of the MTR should be towards Tsuen Wan.[76] By June 1977, senior government officials concluded that the extension should be able to repay itself quickly because it would go through the heavily congested West Kowloon Corridor. The 10.75-km extension would be from Prince Edward Station to Tsuen Wan.[77]

On 19 July 1977, the Executive Council approved the Tsuen Wan extension proposal. The project was estimated to be $4.1 billion. The Financial Secretary, Mr Philip Haddon-Cave, later explained that the decision was based on the CTS report, which concluded that an extension to Tsuen Wan would significantly improve the public transport in the West Kowloon corridor and should also help to meet the growing needs of the new towns in Tsuen Wan, Kwai Chung, Tsing Yi and Tuen Mun. He said the extension would cut travelling time from Tsuen Wan to Central by as much as 50 percent.[78]

He further gave five reasons for going ahead with the extension:

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[72] 12 Feb 1980, SCMP, "Passenger turnover exceeds expectations"
[73] The minimum fare is $1 and the fare for the full journey from Kun Tong to Shek Kip Mei, $2. This compares with a bus fare for the same journey of 30 cents. 12 Feb 1980, SCMP, "Passenger turnover exceeds expectations"
[74] 1 Oct 1980, SCMP, "It's 130 million up for the MTR"
[75] 1 Oct 1980, SCMP, "It's 130 million up for the MTR"
[76] 9 Dec 1976, SCMP, "Proposed extension of MTR"
[77] 7 Jun 1977, SCMP, "MTR line to Tsun Wan wins favour"
[78] 28 Jul 1977, SCMP, "Five reasons to put Tsun Wan on the rail"

1. The West Kowloon corridor would be congested by the end of 1982, therefore the MTR extension should be started as soon as possible;
2. It would be highly likely to receive very competitive bids from contractors around that time because the necessary heavy equipments were already in Hong Kong;
3. A cadre of experienced technical and engineering staff was already available to supervise the construction of the extension;
4. The overall cost of the system would be increased by inflation if the extension were delayed;
5. It was a favourable time to negotiate loans to finance the cost of the extension.

On 10 August 1977, the Legislative Council passed a motion to extend the MTR to Tsuen Wan.

Construction work on the Tsuen Wan extension began on 17 October 1978 and was completed in late 1982, which was only three years after the MIS began partial operation.

A1.2 Planning and Implementation Processes in 1980s

The spate of transport infrastructure building in Hong Kong continued into the 1980s unabated. Before the mid-1970s, policy decision in transport had been either reactive to immediate social needs, such as traffic congestions, or thematic, such as the mass transit system studies. This sporadic and reactive approach was changed when the Government appointed a consultant to carry out the first ever "Comprehensive Transport Study" (CTS-1) and the transport infrastructure construction programme was much more thoroughly planned and systematically implemented in the 1980s.

The consultant of CTS-1 did a sample survey of 25,000 households of their travelling needs and habits. By making use of these data and assuming certain relationships among them, demand for transport facilities up to 1991 was predicted. Then, the consultant analysed the combined effect of increasing the transport capacity by constructing new transport infrastructures and facilities and the implementation of transport restraining measures to contain the transport demand for the best results in ensuring improved traffic mobility. The key assumptions used in this rational and analytical model include population growth, household size prediction, real GDP growth and road construction expenditure.

In the report of CTS-1 published in December 1976, the consultant proposed that their analytical model could be used as an aid to transport policy formulation. It was intended that the results of the model, which reckoned all the related factors should forecast reasonably accurate scenarios to allow the formulation of a coherent transport policy.

First White Paper on Transport Policy

After the release of CTS-1 report, a high-level working group was set up by the government to review the recommendations in the report with an aim to formulate a set of a longer-term transport policy. The working group accepted that the approach adopted in CTS-1 report was a good basis for transport policy formulation and recommended a set of transport policy in a White Paper. This

White Paper, entitled "Keeping Hong Kong Moving", which was published in May 1979 and became Hong Kong first White Paper on transport policy.

The government's central transport policy, as explained in the White Paper, was to "maintain and improve the mobility of people and goods". In the White Paper, the government recognised that there was "a threat of serious road congestion from an increasing demand for private, public and freight transport" and if nothing were done it would get worse. In the White Paper it proposed to develop an integrated, multi-modal transport system, based on the tripod of principles proposed in the report of CTS-1:

1. Improvement of the road system;
2. Expansion and improvement of public transport; and
3. More economic use of the road system.

The first two of these principles had significantly affected the construction industry in the following decade. They led to a massive road building programme, the continued expansion of the dawning MTR system and the modernisation of the antiquated Kowloon-Canton Railway (KCR).

A road-building programme of about $7,000 million (1979 price) for the following five years was proposed in the White Paper.

Roads serving New Towns

Demographic redistribution was an important policy started in the 1970s and continued into the 1980s[79]. The policy was to solve congestion problem in the urban areas and to prepare for future population increases. It involved moving people out of the urban areas and housing them in the new towns. Emphasis was placed to develop three new towns at Tuen Mun, Tsun Wan and Sha Tin in the beginning[80]. Eventually, the numbers of new towns in the New Territories grow to seven in early 1980[81].

Development of these new towns involves several major construction programmes:

1. Housing – to provide housing for residents;
2. Industrial estates – to provide employment;
3. Service and community buildings – to provide social services, leisure, entertainment and sports activities;
4. Transport – to move people between the new towns and urban areas and within the new towns.

Amongst them, both the housing and transport programmes consumed the largest share of public money. Considerably expansion of the transport infrastructures was necessary because the building of New Towns and the expansion of other areas in the New Territories had distributed large concentrations of population and industries far more widely, making the existing transport system considerably inadequate to cope with the new demand. This demand for more transport facilities for the new towns was a major focus in

[79] Governor Sir Murray MacLehose's Policy Speech, 1981
[80] 13 Mar 1976, SCMP, "$600m for new towns' development"
[81] The seven new towns are Sha Tin and Ma On Shan, Tsun Wan, Tuen Mun, Tai Po, Yuen Long, Fanling, and Junk Bay - 2 Jul 1982, SCMP, "A $51b foundation for the future"

CTS-1[82] and considerable investment in road construction in the New Territories was recommended in the first White Paper on transport policy.

A number of high capacity trunk road projects serving six of the new towns were on the five-year road construction programme proposed in the White Paper. Collectively, it is called the New Territories Circular Road (NTCR). The NTCR consists of Tuen Mun Road, Route Five, Tolo Highway, existing road between Fanling and Yuen Long, and new roads linking Yuen Long and Tuen Mun. This is the largest road system in Hong Kong, totalling about 80 kilometres linking Sha Tin, Tai Po, Fanling and Sheung Shui, Yuen Long, Tuen Mun and Tsun Wan. It also serves the increasing cross-boundary traffics with Shenzhen.

Construction of the trunk road linking Sha Tin to Yuen Long was commenced in 1980. By September 1985, the section from Sha Tin to Fanling was completed. Subsequent sections from Fanling to Pak Shek Au and from Pak Shek Au to Fairview Park were opened to traffic in April 1987 and August 1991 respectively. The final section from Fairview Park to Au Tau was opened to traffic in January 1993.

Roads serving Other Districts

On Kowloon peninsular, many major road projects were completed in the 1980s. Roads connecting to the Cross-Harbour Tunnel and its Hong Kong Interchange, which were opened to traffic in 1972, were improved in 1980s as the traffic using the tunnel increased. The Princess Margaret Road Flyover, which is a key road section connecting the Cross-Harbour Tunnel to the Lion Rock Tunnel, was reconstructed in the 1980s, hence further increase the north-south direction traffic capacity to cope with the substantial increase in traffic from the New Territories. The elevated East Kowloon Way was completed in 1981 and the Airport Tunnel (Route 2) in 1982. Together, these two projects improved the access to Kai Tak Airport and Kwun Tong area. In west Kowloon, the West Kowloon Corridor was completed in stages between 1987 and early 1997, hence the journey times between Yau Ma Tei and Lai Chi Kok was shortened. The Kwun Tong Bypass was completed in 1991, providing a link between the Tate's Cairn Tunnel and both the Tseung Kwan O Tunnel and the Eastern Harbour Crossing at Cha Kwo Ling, which was opened in 1989. The second Tsing Yi Bridge was constructed and opened to traffic in late 1987.

On Hong Kong Island, the road construction activities were equally intense. To cater for the growing development on the southern Ap Lei Chau Island, two bridges were completed in 1980 and 1994 respectively to provide direct access to the island. The section of Route 1 comprising the Aberdeen Tunnel and grade-separated road networks, running in north-south direction through the centre of the Island, was completed in early 1982, linking Aberdeen with Happy Valley and the Cross-Harbour Tunnel. From Causeway Bay construction of the Island Eastern Corridor, a 9-kilometre long dual 3-lane expressway extending eastwards to Chai Wan, began in early 1981 and was completed in October 1989.

All these major road projects, and many others not mentioned here, were implemented smoothly as planned in the White Paper.

Railway Development

[82] 20 Nov 1976, SCMP, "$10 billion in 5 years to boost transport"

Construction of the MIS of the MTR linking Kwun Tong to Central had already begun while the White Paper was written. By the time that the White Paper was published in 1979, the first section of the MIS running from Kwun Tong to Shek Kip Mei was about to be completed and construction of the Tsun Wan Extension had also begun. After that, it had taken the government a little longer to make a decision on the building of the Island Line extension.

In 1977, traffic congestion in Eastern District had worsened. Although the government would like to deal with it urgently, it was facing with a complex situation. Firstly, it did not want to build MTR Island Line before construction of the whole Eastern Island Corridor was completed. It had worried that the construction of the underground railway would worsen the traffic congestion in the Eastern District. Secondly, the modernization plan of the existing Hong Kong Tramway could not be decided until the finalisation of the MTR Island Line plan.

Because the passenger demand at that time did not justify a full MTR line on Hong Kong Island, the government had planned to build a light rail system first, which would be upgraded later to a full MTR line when passenger volume had increased. The government had intended that the light rail system would replace the existing Hong Kong Tramways[83].

The debate on how the underground railway on Hong Kong Island should be built had dragged on for a long time. By January 1980, negotiation with the Hong Kong Tramways had failed and it was decided that the MTRC would develop and run the new light rail system[84]. By December 1980, the private sector won an upper hand in the argument for a full MTR line on Hong Kong Island, which was also endorsed by the Transport Advisory Committee. On 23 December 1980, the Executive Council gave its approval for the $7 billion underground extension from Chai Wan to Sheung Wan.

At this time, the financial market situation was very different from the time when the MIS and Tsun Wan Extension were built. The MTRC had accumulated a sizable debt and low interest loan was no longer available. The Island Line was primary financed by the government to reduce the borrowings from the commercial market[85].

Construction of the Island Line was started in October 1981 and finished in May 1986.

A1.3 Planning and Implementation Processes in 1990s

In the 1990s, construction of the Airport Core Programme (ACP) projects dominated Hong Kong's infrastructure construction agenda. The ACP projects were part of the Ports and Airport Development Scheme (PADS), which was launched by Governor David Wilson in 1989 to bring back public confidence and revive the economy after the June 4 incident in Beijing that unnerved the people of Hong Kong[86]. Governor Wilson's vision was that these major investments would contribute to China's accession to world market economy by advancing technology and expertise required for the modernization of the Chinese economy thereby strengthening Hong Kong's future political status as a Special

[83] 8 Jul 1978, SCMP, "Light rail system picks up speed"
[84] 3 Jan 1980, SCMP, "All systems go for rail"
[85] 20 May 1981, HK Standard, "Island line work starts in October, MTR man says"
[86] 22 Jun 1998, SCMP, "Taking off in turbulent times"

Administration Region of China[87]. However, the very grand scale of PADS had caused major concerns of Mainland China. It was afraid that the Scheme might deplete the financial reserve of Hong Kong. The press viewed the Scheme as a gamble to rebuild confidence, but was in general lending countenance to the plan[88].

Yielding to the pressure from the Mainland, the government of Hong Kong eventually separated the ports development projects from the airport and its related projects. The projects related to the new airport were grouped under ACP. Negotiations with Mainland China to allow the ACP projects to be constructed were protracted and politicised. By 1993, it was clear that the political influence of China would affect the completion programme of the new airport at Chek Lap Kok. Although the government of Hong Kong had continued constructing the projects that were financed by public revenue it became clear that without China's endorsement on the programme no financing institute was willing to lend money for construction of the cargo, catering, fuel, maintenance and other vital facilities at the new airport[89]. In the end, China and Britain settled their differences, allowing construction of the new airport at Chek Lap Kok to start.

Second White Paper on Transport Policy

The transport infrastructure projects of PADS were originally considered and recommended in a separate Port and Airport Development Strategy Study independent from CTS-2. When the government decided to go ahead with PADS projects they were included in the second White Paper on Transport Policy published in January 1990.

The title of the Second White Paper on Transport, entitled "Moving into the Twenty-first Century", was written primary based on the work of CTS-2, which was commissioned in 1986-89. By assuming that the transport policy[90] remained the same as in the first White Paper on Transport and the already committed transport projects were built CTS-2 forecasted the transport demand and traffic conditions up to 2001. It projected that there would be significant increase in traffic demand due to economic growth, increasing of population and demographic redistribution. It forecasted that there would be serious traffic congestion and significantly slower traffic speed.

The White Paper identified, as one of the four challenges[91], the need to maintaining a reasonable level of mobility of people and goods necessary to

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[87] Policy Speech, Governor David Wilson, 1989

[88] 12 Oct 1989, South China Morning Post "A gamble on a grand vision of the future"

[89] 16 Dec 1993, SCMP, "Political delays kill '97 takeoff"

[90] The Government's transport policy has not been changed since the first White Paper on Transport. It is founded on the following three main principles:

a. improving the transport infrastructure;
b. expanding and improving public transport; and
c. managing road use.

[91] The other three challenges identified were:

a. improving public transport services for meeting the rapid growth in travel demand and the rising expectations of an increasingly affluent society;
b. developing new traffic management techniques to make more effective use of the transport infrastructure; and
c. developing transport policies to manage road use so that the community gets the maximum benefits from using the limited road space.

support economic growth and to meet the social, commercial and recreational needs of the people. It recommended a massive construction programme of transport infrastructure projects for meeting the transport needs of the passengers and freight up to and beyond 2001[92]. They were planned primary to serve PADS, the cross-border traffic and the development of the new towns and metropolitan area.

The White Paper also emphasised the consideration for environmental awareness, which was not considered in the first White Paper. It asserted that the electrically operated trains should be more energy efficient and would not contribute directly to air pollution. It concluded that the completion of the three MTR lines and the modernisation of the KCR in late 1970s and the 1980s had significantly improved the public transport system. They carried 24% of all the passengers using the public transport in 1988 and had significantly reduced the pressure on the road network. The transport infrastructure programme includes, in addition to the highways, four railway projects[93]. The road and rail projects were estimated to cost $37 billion and $18 billion respectively at 1989 prices.

The other major difference of the second White Paper from the first one was that it has not included a definitive list of transport infrastructure construction projects. The explanation given in the White Paper was that it was not appropriate for the government to commit to a detailed construction programme because the transport infrastructure plan was subject to complex and changing dynamics, such as future land use patterns. It said that the proposed broad transport strategy for the next decade was just a framework and the proposed construction programmes would be regularly updated in the light of subsequent changes.

<u>Chek Lap Kok Airport and Airport Core Programme</u>

The search for a suitable site to develop a new airport was started in the 1970s. Significant sums of money had been spent on various studies and engineering works on the potential sites[94]. But the decision to construct it was deferred many times due to various reasons. The last time was in 1983 by the Financial Secretary, Sir John Bembridge, based on the reason of a poor economy[95]. In 1987, when the economy had turned buoyant, the Acting Governor, Sir David Akers-Jones still insisted that there was no great urgency to build the new airport, although he said it was "a practical possibility" to build the new airport at Chek

[92] The objectives of the transport infrastructure development programme were:
- to provide high capacity strategic links to support future airport and port facilities;
- to provide efficient transport links to support the growth in goods vehicle traffic between Hong Kong and China;
- to provide high capacity expressways to connect the new towns and the urban areas, and to separate through traffic from local traffic;
- to extend the rail system to major population centres, and to relieve congestion in the existing network; and
- to provide new roads and upgrading existing roads to relieve congestion, and to improve road safety by incorporating the latest safety design features.

[93] The four railway projects are the Airport Railway, the third rail harbour crossing, the North-west New Territories Urban Link and the Mass Transit Railway Extension to Tseung Kwan O.

[94] 9 Sept 1988, HK Standard, "Fresh findings back Chek Lap Kok for airport"

[95] 22 Jun 1998, South China Morning Post, "Taking off in turbulent times"

Lap Kok. He said, however, developing the harbour was more important[96]. When he made that comment, the PADS study had already begun since 1986[97].

In August 1989, the government finally said that it would spend $90 billion constructing a new airport, together with additional port facilities, a fixed crossing from Tsing Yi to Lantau and a super highway linking to Mainland China. The Secretary for Lands and Works, Mr. Graham Barnes, said it was necessary to renew the infrastructure so that Hong Kong would be able to play the role useful to the economic expansion of China[98]. The decision of the government was viewed by the media as a measure to shore up the shattered public confidence on the future of Hong Kong after the June 4 incident in Beijing and to boost the depressed economy[99].

On October 11, 1989 Governor David Wilson formally announced the PADS development programme in his policy speech. He said the new airport would be located at the Chek Lap Kok off Lantau Island and the plan was to have the first runway operational in early 1997. He also said the government would build Container Terminal 8 on the reclaimed land at Stonecutter Island and the first berth of the terminal would be operational by mid-1993.

Shortly after Governor Wilson announced the PADS programme, Mainland China expressed its worry about the timing and scale of the PADS projects. China was afraid that the ambitious PADS projects might deplete the financial reserve of Hong Kong and they demanded the pre-1997 Hong Kong government to consult them on matters straddling the hand-over date in 1997[100]. This started four years of negotiation between China and Britain over the financing arrangements for several of the PADS projects and the altercation lasted until June 1995. In the end, there was a Memorandum of Understanding, which pledges the support from both sides to the airport-related projects, and the supporting financial agreements signed between the two sovereignties[101].

Preparation works for the new airport construction then moved quickly shortly after the government's announcement to develop PADS projects. A Provisional Airport Authority was then formed and the Legislative Council also approved $760 million for the Airport Master Plan consultancy and the advance reclamation works at the northern tips of Chek Lap Kok[102], which was started almost immediately.

On November 30, 1990 the Legislative Council approved the first significant fund of $3.34 billion for first phase work of the extensive West Kowloon reclamation project[103]. The whole West Kowloon reclamation work was estimated to cost $9.63 billion, on which the Western Harbour Crossing, the West Kowloon Expressway, the airport railway and the town airport terminal would be located[104].

The government continued to push ahead with the PADS projects whilst the negotiation between China and Britain was going on. Strong objections of

[96] 12 Jan 1987, South China Morning Post, "New look at plans for Chek Lap Kok airport"
[97] 13 Mar 1989, South China Morning Post, "Lantau highway network certain"
[98] 22 Aug 1989, HK Standard, "$90b projects not in danger"
[99] 25 Sept 1989, South China Morning Post, "Governor's speech looks to the future"
[100] 1 Jul 1991, HK Standard, Legco members hints at solution to airport crisis
[101] The Memorandum of Understanding was signed in July 1991 and the supporting financial agreements for Chek Lap Kok airport and its rail link were signed in June 1995.
[102] 13 July 1990, HK Standard, "Airport body seeks $760m to start work"
[103] 1 Dec 1990, South China Morning Post, "Legco agree to $3.34b for reclamation"
[104] 1 Dec 1990, South China Morning Post, "Legco agree to $3.34b for reclamation"

China could not stop the government letting out projects that had their target completion dates before the hand-over date on 1 July 1997.

In December 1992, the Legislative Council approved $6.69 billion for the Chek Lap Kok airport site formation contract, allowing the contract to begin, despite Mainland China had strongly expressed its concern regarding the airport finance. A week later, the government asked the Legislative Council again to grant $603 million for Phase 2 work of the West Kowloon Reclamation. The project includes hinterland drainage works and sewage networks[105].

On 5 February 1993, the Legislative Council was asked again by the government to grant an approval for $1.4 billion to cover work related to the North Lantau Expressway. The money was to pay for the remaining of the North Lantau Expressway road works, a fresh water reservoir at Tung Chung, plus a fresh water supply system and treatment facilities for the new town and airport[106].

Even though the construction of the Chek Lap Kok airport proper, all its associated facilities, its rail link and the Route 3 had been delayed by protracted Sino-British negotiation construction activities of other related transport infrastructure projects in ACP were proceeding at full speed. These projects include Container Terminal 8 and seven of the ten ACP projects[107]. By end 1993, seven of the ten ACP projects had been started and was achieving good progress[108]. All Highways Department contracts in the ACP were progressing on time[109].

Construction of the $9 billion Tsing-Ma Bridge was slightly delayed, but the government immediately proceeded with the project after Mainland China and Britain signed the Memorandum of Understanding[110].

The remaining three projects, which include Chek Lap Kok airport, the airport railway and Route 3 highway, were delayed after potential investors demanded Britain to get China's unequivocal support to these projects before they would agree to finance the projects[111].

In early 1994, signs of conclusion of the Sino-British negotiation began to appear. In a deviating response, Mainland China did not criticise the government's attempt to seek approval of $1.67 billion from the Legislative Council for Chek Lap Kok airport's foundation contract and other key contracts[112]. Eventually construction works of these three ACP projects were started after the two countries settled the financial arrangements for these projects in mid-1994[113]. From then, progress of the ACP further accelerated. In May 1994 the foundation contract of the 1.2 kilometre long passenger terminal was awarded[114].

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[105] 7 Dec 1992, South China Morning Post, "Funding request for Kowloon project"
[106] 4 Feb 1993, South China Morning Post, "Support sought for core project"
[107] The ten Airport Core Projects are:
(1) CLK Airport (first runway & associated facilities); (2) North Lantau Expressway; (3) Western Kowloon Reclamation; (4) Western Kowloon Expressway; (5) Western Harbour Crossing; (6) Route 3 (part); (7) Airport Railway; (8) Central Reclamation; (9) Lantau Fixed Crossing; (10) Tung Chung Development Phase 1
[108] 16 Dec 1993, SCMP, "PAA chief remains optimistic"
[109] 16 Dec 1993, South China Morning Post, "Highway projects 'satisfactory and all on schedule'
[110] 7 Jul 1991, South China Morning Post, "Top-level letters led to Chek Lap Kok accord"
[111] 28 Jun 1992, South China Morning Post, "China asked to sign new airport deal"
[112] 24 May 1994, South China Morning Post, "China nod of approval on airport funds"
[113] 15 Jun 1994, South China Morning Post, "Political row over, says Qian"
[114] 31 May 1994, South China Morning Post, "$ 465m airport job awarded"

On June 30, 1995, Britain and China signed financial support agreements for Hong Kong's new airport at Chek Lap Kok and its rail link[115]. On January 30, 1995, construction of the $10.1 billion passenger terminal for the airport began[116].

The Airport Authority also began to award concessions to run the facilities for the new airport. The total value of these facilities was estimated to be $20 billion, about 33 percent of the total airport development cost. They include the 400,000 tonnes capacity a year operated by Asia Airfreight Terminals, 2.6 million tonnes capacity a year cargo complex operated by Hong Kong Air Cargo Terminals, in-flight catering facility operated by Cathay Pacific Catering Services, in-flight kitchens operated by LSG-Lufthansa Sky Chefs and Gate Gourmet International, Cathay Pacific Airways headquarters office and hotel development, and aircraft maintenance facilities[117].

Chek Lap Kok airport was officially opened on 8 July 1998.

Roads Construction

The road construction programme in the 1990s was dominated by the road projects of ACP. From Chek Lap Kok airport, the 12.5 kilometer North Lantau Highway runs along the northern coastline of Lantau Island and joins the 5 kilometer long Lantau Link at the northern tip of Lantau Island. The Lantau Link comprises the cable-stayed Kap Shui Mun Bridge and the Tsing Ma Suspension Bridge, which links to the northwestern part of Tsing Yi Island. From there it is connected with the Cheung Tsing Highway, through the 1.6 kilometer long Cheung Tsing Tunnel and emerges again at the 4.2 kilometer long dual 3 to 4-lane Tsing Kwai Highway. At Lai Chi Kok the airport access continues along the 4.2 kilometer long West Kowloon Highway that runs along the western coastline of the Kowloon Peninsula. Then, the route finally enters the Western Harbour Crossing and ends at Sai Ying Pun on Hong Kong Island. The total length of the route is 34 kilometers and costs about $37 billion to build. The whole route was opened to traffic in phases, with the Western Harbour Crossing being the last to open on 30 April 1997.

In the 1990s, other new roads not directly related to Chek Lap Kok airport were also constructed and some existing roads were improved[118]. On Hong Kong Island, the section of Route 7 on the northern shore of Hong Kong island was completed in 1990, allowing free-flow traffic in an east-west direction along Connaught Road through Central via the Rumsey Street Flyover, Pedder Street Underpass and the Harcourt Road Flyover. Extension of Route 7 to Kennedy Town was subsequently completed in February 1997. A covered walkway system with escalators and travelators between the central business district on Hong Kong Island and the mid-levels residential district was completed and opened to the public in October 1993, providing a direct access for pedestrians. A two-way link between Smithfield and Pok Fu Lam Road was completed in January 1998. It improves traffic flow and copes with the increase in traffic from the Western Harbour Crossing.

In the New Territories, Route 5, a 7-kilometer long dual 2-lane carriageway linking Shatin directly with Tsuen Wan via the Shing Mun Tunnels, was

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[115] 30 Jun 1995, SCMP, “D-day for airport finance accords”
[116] 29 Jan 1995, South China Morning Post, “PAA awards $ 10b contract for terminal”
[117] 14 Jan 1996, SCMP, “Chek Lap Kok set for second boom”
[118] HK Highways & Railways, Highways Department

completed and opened to the public in 1990. Yuen Long Highway was completed in July 1993, providing a continuation of Route 2 from Tuen Mun to Yuen Long leading to the Shap Pat Heung Interchange and Pok Oi Interchange. Construction of the latter two interchanges started in early 1992 and was completed in late 1994. The third Tsing Yi Bridge was constructed and opened to traffic in late 1997. The 10 kilometer long Tsing Long Highway consists of 6.2 kilometer long Yuen Long Approach Road and 3.8 kilometer long Tai Lam Tunnel was opened to traffic in May 1998, providing a direct, high speed link to the northwestern New Territories with Tuen Mun Road and Ting Kau Bridge at Ting Kau. Ting Kau Bridge, a 1,177 meter long cable-stayed bridge, was completed in May 1998 connecting the Country Park Section of Route 3 and Tuen Mun Road at Ting Kau with a major transport interchange at the Tsing Yi end of the Lantau Link.

On Kowloon peninsular, Hung Hom Bypass, an elevated highway system linking Hung Hom with Tsim Sha Tsui East, Princess Margaret Road and Chatham Road, was completed in August 1999.

Other than building new roads, the government had also completed a number of major improvements to the existing road system. An improvement to Tuen Mun Road commenced in mid-1994, providing a climbing lane in three critical uphill sections of Tuen Mun Road in the Kowloon-bound direction, namely Sam Shing Hui, So Kwun Wat and Ting Kau, and was completed in August 1996. The Siu Lam Section of Tuen Mun Road in the Kowloon-bound direction was further widened from a 3-lane to a 4-lane highway. The construction was completed in May 2001. Hiram's Highway, the main road linking Sai Kung town to Kowloon, was improved in phases. A climbing lane between Nam Wai and Clear Water Bay Road in the Kowloon-bound direction was constructed in July 1992 and a substantial improvement to the junction of Hiram's Highway and Clear Water Bay Road was completed in May 2000. The section of Hiram's Highway between Nam Wai and Ho Chung had been re-aligned and widened to a dual 2-lane road. The improvement was completed in August 2001. Other road improvement projects included Lung Cheung Road and Ching Cheung Road in October 1998, Sha Tau Kok Road in February 1999, Castle Peak Road from Siu Lam to So Kwun Tan in December 2000, and Tuen Mun Road in May 2001.

Railway Development

In addition to constructing the Chek Lap Kok airport rail link the West Rail and the MTR extension to Tseung Kwan O projects were also begun in the 1990s. These two railway projects were originally included in the Second White Paper on Transport Policy, the details of which were further elaborated by the Railway Development Strategy published in December 1994.

The Railway Development Strategy had identified three priority rail projects and proposed to have them completed by 2001. It suggested that the projects are economically viable and they were needed to relief critical transport corridors or to serve committed developments. The projects are:

a. The Western Corridor comprising the Port Rail Line, the Cross Border Passenger Service and the Sub-regional Passenger Service, which was later known as the West Rail;
b. The MTR Tseung Kwan O Extension; and
c. The East Kowloon Route – KCR extension from Hung Hom to Tsim Sha Tsui and a railway from Ma On Shan to Tai Wai.

Discussions of the construction of these three rail projects continued up to the re-unification of Hong Kong with China in July 1997. As a strategy to reinforce confidence at the time of the handing over, the Hong Kong Special Administrative Region (SAR) government decided to implement the West Rail and MTR Tseung Kwan O Extension projects soon after it took office[119]. At that time, the Asian economic crisis had taken its toll, dissipating the liquidity in the financial market. KCRC had found it difficult to raise all the finance commercially and the SAR government had to inject $29 billion of equity into KCRC to allow the project to start[120]. The financing position of MTRC was much stronger and it was able to finance the 10 kilometre long railway partly from its own resources and partly from borrowing[121].

Eventually the KCR extension from Hung Hom to Tsim Sha Tsui and the rail from Ma On Shan to Tai Wai were also started in April and February 2001 respectively. Although they were not completed in 2001 as planned, the four rail projects were completed in October and December 2004 respectively.

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[119] 15 Jun 1997, SCMP, "West Rail set to get SAR approval; Contractors told to start preparing tenders for $ 80b construction project"

[120] 5 Jul 1998, SCMP, "KCRC seeks bidders for West Rail project"

[121] 24 Oct 1996, SCMP, "MTR: no chance of row on finances"

Appendix 2
Functions of Construction Industry Council (CIC)

The functions of CIC are:

(a) to advise and make recommendations to the Government on strategic matters, major policies and legislative proposals, that may affect or are connected with the construction industry;

(b) to reflect to the Government the construction industry's needs and aspirations;

(c) to elevate the quality and competitiveness of the construction industry by promoting the ongoing development and improvement of the industry;

(d) to uphold professionalism and integrity within the construction industry by promoting self-regulation, formulating codes of conduct and enforcing such codes;

(e) to improve the performance of stakeholders in the construction industry through establishing or administering registration schemes or rating schemes;

(f) to advance the skills of personnel in the construction industry through planning, promotion, supervision, provision or coordination of training courses or programmes;

(g) to encourage research activities and the use of innovative techniques and to establish or promote the establishment of standards for the construction industry;

(h) to promote good practices in the construction industry in relation to procurement methods, site safety, environmental protection, sustainable construction and other areas conducive to improving construction quality;

(i) to serve as a resource centre for the sharing of knowledge and experience within the construction industry;

(j) to monitor improvements made by the construction industry through the compilation of performance indicators;

(k) to make recommendations with respect to the rate of the levy imposed under this Ordinance; and

(l) to perform any other functions relevant to the construction industry, including those functions imposed on it by or under this Ordinance or any other enactment.

The CIC has also the following supplementary functions:

(a) to provide training courses for the construction industry;

(b) to establish and maintain industrial training centres for the construction industry;

(c) to assist, including by the provision of financial assistance, in the placement of persons who have completed training courses provided for the construction industry;

(d) to assess the standards of skills achieved by any person in any kind of work involving or in connection with the construction industry, to conduct examinations and tests, to issue or award certificates of attendance or competence, and to establish the standards to be achieved in respect of any such work.

Source: Construction Industry Council (No. 2) Bill

Appendix 3
Common Issues of "Construct for Excellence" Report and Turin's Recommended Lines of Actions for Development of Construction Industry

Issues	"Construct for Excellence" Report's Recommendations	Turin's Recommendations
Technology and Management	<u>Fostering a Quality Culture</u> 4.11 Use of value management 4.38 Independent technical audits carried out on a regular basis <u>An Efficient, Innovative and Productive Industry</u> 7.11 Facilitate better integration in delivery of construction projects through wider adoption of alternative procurement 7.15 Public sector clients promote use of standardised and modular components 7.17 Clients improve construction efficiency by judicious standardisation and rationalisation of construction processes and practices 7.19 Support establishment of central construction standardization body 7.24 Enhance private sector capability in prefabrication and other buildability measures through training, promulgation of guidelines and codes and R&D 7.28a Raise IT literacy through training for management and the construction workforce at all levels 7.28b Major clients lead in adoption of IT and commit resources for implementation of IT initiative 7.29a Buildings Department monitor development of artificial intelligence technology to testing the feasibility of electronic checking of building plans 7.29b Government expedite development of common platform for electronic communications 7.31a Industry co-ordinating body identify priority areas for software development and communicate industry's requirements to software developers 7.31b Works Bureau work with industry on electronic service delivery initiatives 7.37 Public sector clients commit resources for carrying out research activities 7.38 Encourage the industry to make use of the Innovation and Technology Fund to finance construction research activities 7.39 Establish collaboration between industry and local research bodies on construction-related R&D	2. To recognise the variety of possible technologies and to relate them to the availability of national materials, and human and financial resources

	7.43 Planning and Lands Bureau and Buildings Department review Buildings Ordinance and its subsidiary regulations to facilitate more imaginative land use and innovative building designs 7.51 Highways Department streamline procedures for processing road excavation permits <u>A Safer Workplace and an Environmentally Responsible Industry</u> 8.13 Government review introducing legislation similar to UK's Construction (Design and Management) Regulations 8.14a Works Bureau and the Housing Authority incorporating practicable features of the UK's Construction (Design and Management) Regulations into the safety planning and management systems for public works projects and public housing projects 8.14b Industry bodies, professional institutions and the local research community draw up code of practice or designers' guide to assist design professionals in evaluating safety risks and hazards and provide guidelines on known hazardous activities and procedures on site, safe work sequences, precautionary measures and determination of the reasonable time-frame for the safe conduct of construction activities 8.15 Promote integrated site management systems with site safety 8.29 Government develop coherent policy framework for sustainable development 8.33 Works Bureau develop costing models and tools for calculating life-cycle costs, database on the life-cycle costs and performance of materials and components, and common set of accepted performance-based specifications for materials and components 8.36 Housing Authority take lead in wider use of green designs in its housing Estates 8.37 Stakeholders and local research community jointly develop design tools and databases to promote development of environmentally friendly designs 8.38a Electrical and Mechanical Services Department work with Buildings Department in promoting public awareness of energy efficiency and adoption of energy efficient designs 8.38b Develop and disseminate guidelines and design tools for analyzing energy consequences of design options 8.38c Develop guidelines to help clients and occupiers to assess life-cycle energy cost of construction and to carry out self-audits of energy consumption 8.41 Public sector clients to take a lead in abating environmental nuisance during construction by: (a) Giving appropriate weight to environmental performance of contractors in tender assessment and ongoing performance assessment (b) Considering allowing separate account in construction contracts for measures taken to address pollution prevention and control during construction stage	

	(c) Encouraging contractors to employ dedicated personnel on-site to assist line managers in managing environmental aspects of construction activities, adopt environmental management systems to systematically identify environmental impacts arising from construction, and take appropriate steps to mitigate any adverse impact 8.45 Public sector clients take lead in wider use of recycled materials in their projects by suitably revising the general specifications for public works projects and public housing projects and carrying out trial projects 8.48 Buildings Department and other industry participants to work on common, comprehensive environmental assessment scheme with appropriate incentives for local use, capitalising on the work that has gone into the formulation of HK-BEAM, the Hong Kong Energy Efficiency Registration Scheme for Buildings and similar assessment Schemes	
Labour Skills and Training	<u>Fostering a Quality Culture</u> 4.27 Enhance skills and competence of subcontractors 4.31 Contractors assist raising subcontractors performance 4.34 Clients ensure adequate supervisory provision 4.36 Clients enforce acceptance standards and designate site supervision proposals a critical criterion for tender evaluation <u>Nurturing a Professional Workforce</u> 6.5 Tertiary institutions review and enhance curricula of construction-related undergraduates and postgraduate courses 6.7a Local tertiary institutions teaching staff to acquire practical experience in the industry 6.7b Experienced construction professionals involved in part-time teaching of undergraduate and postgraduate courses 6.9 Mandatory participation in Continuing Professional Development (CPD) activities as a pre-requisite for renewal of membership of professional institutions 6.11 Industry co-ordinating body draw up a structured training framework site supervisors, training institutions improve on the curricula of diploma courses for site supervisors 6.13 Professional institutions introduce new membership class for site supervisors 6.14 Review need for mandatory supervisor registration 6.15 Professional institutions consider introducing new class of membership for technicians 6.20 CITA enhance scope, content and duration of basic craft courses 6.24 Revamp apprenticeship scheme 6.26 Encourage construction workers multi-skill development	3. To appreciate the relative labour intensity of construction, even in modern sector, and therefore its potential for useful and sustained employment generation (It should be stressed that nothing could be more damaging to a healthy development of construction than its misuse by government as a cheap way of absorbing unskilled unemployment in sporadic and mostly disastrous ventures of "public works" employment programmes.

	6.27 Develop craft skill qualification framework to provide a career path for tradesmen 6.28 Review the composition of the CITA Board 6.30 Foster ethical culture by: • ICAC rigorous enforcement and corruption prevention education • Professional institutions and other industry bodies maintain effective sanction mechanism against breaching the rules of conduct • Tertiary institutions and other construction training institutions make professional ethics a compulsory subject in construction-related courses • Enhance training on professional ethics 6.34 Client organisations promote use of direct labour <u>A Safer Workplace and an Environmentally Responsible Industry</u> 8.16 Strengthen safety training and promotional efforts by: (a) Training to construction professionals (b) Training to line managers and site supervisors (c) Requiring safety officers in the construction industry to receive construction specific safety training (d) Promoting site-specific safety briefings and training (e) Enhance green card safety training for construction workers	
Industry Structure	<u>Fostering a Quality Culture</u> 4.7 Clients develop understanding of construction process, set clear project requirements and maintain close involvement 4.10 Clients ensure integrated input 4.18 Clients ensure appropriate responsibilities allocation and enforce a clear accountability structure 4.21 Professional institutions instil greater sense of accountability 4.24 Set up voluntary subcontractor registration scheme 4.25 Government review need for mandatory subcontractor registration scheme 4.28 Clients prohibit total subletting and exercise tighter control of subcontractors. 4.29 Works Bureau and the works departments exercise control over subcontracting 4.30 Housing Authority tighten control over subcontracting 4.44 Establish voluntary registration scheme for renovation contractors and decorators <u>Achieving Value in Construction Procurement</u> 5.59a Industry co-ordinating body review Standard Form of Building Contract, Private Edition with a	4. To accept the fragmentation of the construction industry, a direct consequence of the variety and feature of its products, which are fixed in space, and of the bulk of its inputs, which reduce the effective radius of transport of basic materials. Instead of attempting to standardize and to centralize for the sake of the elusive “economic of scale”, construction programmes should be used to foster local variety and initiatives, to encourage the use of local skills, materials and techniques, and to generate the

	view to achieving equitable allocation of risks 5.69b Public sector clients taking lead in wider adoption of partnering approach in implementing construction projects 5.70 Government considers new form of contract which integrates a partnering approach into contractual relationship. 5.71 Clients secure teamwork, good practice and commitment from all parties at a project level 5.85 Major clients consider wider adoption of alternative procurement approaches <u>Nurturing a Professional Workforce</u> 6.18a Public sector clients support construction worker registration scheme 6.18b Public sector clients contractually require contractors employ a specified percentage of trade-tested workers <u>Institutional Framework for Implementing the Change Programme</u> 9.8 Government appoint lead agency to co-ordinate with relevant bureaux and departments on construction-related matters 9.9 Establish industry co-ordinating body for the construction industry 9.15 Government consider need and timeframe for comprehensive review of entire development process	finest possible mesh of social capital goods.
Government as a Client	<u>Fostering a Quality Culture</u> 4.29 Works Bureau and the works departments exercise control over subcontracting 4.30 Housing Authority tighten control over subcontracting 4.35 Housing Authority and works departments develop structured site supervision system 4.38 Works Bureau review audit findings under the Independent Audit Scheme and identify common improvement areas <u>Achieving Value in Construction Procurement</u> 5.13 Housing Authority to review new consultant selection arrangements 5.15 AACSB review listing criteria and shortlisting arrangements 5.17 Public works marking schemes for consultancies adequately reflect all quality aspects critical to a project 5.28 Housing Authority implement contractor listing and tendering practices and contractor performance appraisal system 5.33 Improve contractor selection system for public works projects	7. To use the public client, which often dominates the modern sector of demand, for introducing and encouraging the use of adequate technology, for setting up and, where they exist, strengthening small and medium-sized local contractors, for establishing and guaranteeing suitable training schemes and finally, for encouraging innovation. (Unfortunately, in many countries the role played by the public works department tends to the opposite.

	5.37 Works Bureau allow only those with consistently good performance to take part in pre-qualification exercise for major public works projects 5.39 Housing Authority review and refine Performance Assessment Scoring System 2000 5.41a Enhance transparency of performance assessment arrangements for consultants and contractors for public works projects 5.41b Works Bureau provide the industry regularly with benchmark scores from the Public Works Contractors' Performance Index System and other quantitative performance indicators 5.42 Works Bureau improve objectivity of performance assessment system for consultants and contractors for public works projects 5.46 Public sector clients offer debriefing to unsuccessful bidders 5.46 Public sector clients conduct post-completion reviews with consultants and contractors. 5.47 Public sector clients sharing information among themselves on the performance of consultants and contractors 5.51a Public sector clients promoting adoption of systematic risk management 5.51b Public sector clients developing guidance notes on integrated and systematic risk identification and management. 5.59 Works Bureau reconsider recommendations of the consultancy study on General Conditions of Contract for Public Works Projects with the objective of achieving a more equitable allocation of risks between the contracting parties 5.69 Public sector clients taking lead in wider adoption of partnering approach in implementing construction projects 5.70 Government considers new form of contract which integrates a partnering approach into contractual relationship. 5.76 Government considers wider adoption of milestone payments approach. 5.80 Works Bureau considers enacting security of payment legislation <u>Nurturing a Professional Workforce</u> 6.18a Support construction worker registration scheme 6.18b Public sector clients contractually require contractors employ a specified percentage of trade-tested workers 6.30 Foster ethical culture by: • Employers issue guidelines against acceptance of advantages • Public sector clients requiring consultants and contractors to pledge for probity, promulgate a code of conduct and provide probity training for their staff	For the sake of an ill-conceived criterion of public accountability, the public sector is often the most conservative and technologically reactionary of the lot.

	6.31 EMB improve methodology for collating and compiling construction manpower statistics to facilitate manpower planning <u>An Efficient, Innovative and Productive Industry</u> 7.15 Public sector clients promote use of standardised and modular components 7.19 Support establishment of central construction standardization body 7.24 Public sector clients, in particular Housing Authority, promote use of prefabrication and other buildability measures 7.29 Government expedite development of common platform for electronic communications 7.31 Works Bureau work with industry on electronic service delivery initiatives 7.37 Public sector clients commit resources for carrying out research activities 7.51 Highways Department streamline procedures for processing road excavation permits <u>A Safer Workplace and an Environmentally Responsible Industry</u> 8.14 Works Bureau and the Housing Authority incorporating practicable features of the UK's Construction (Design and Management) Regulations into the safety planning and management systems for public works projects and public housing projects 8.33 Major clients, in particular public sector clients, take a lead in practising the concept of life-cycle costing 8.36 Housing Authority take lead in wider use of green designs in its housing Estates 8.41 Public sector clients to take a lead in abating environmental nuisance during construction by: (a) Giving appropriate weight to environmental performance of contractors in tender assessment and ongoing performance assessment (b) Considering allowing separate account in construction contracts for measures taken to address pollution prevention and control during construction stage (c) Encouraging contractors to employ dedicated personnel on-site to assist line managers in managing environmental aspects of construction activities, adopt environmental management systems to systematically identify environmental impacts arising from construction, and take appropriate steps to mitigate any adverse impact 8.45 Public sector clients take lead in wider use of recycled materials in their projects by suitably revising the general specifications for public works projects and public housing projects and carrying out trial projects	
Government as a Regulator	<u>Fostering a Quality Culture</u> 4.16 Regulators ensure legislation allocates responsibilities clearly and fairly, and explore ways for	10. To abandon meaningless statutory instruments and

	self-regulation 4.25 Government review need for mandatory subcontractor registration scheme 4.35 Buildings Department consider merits of quality supervision requirements 4.39 Government and the Housing Authority consider bringing public housing projects within Buildings Ordinance ambit and put in place independent auditing arrangements <u>Achieving Value in Construction Procurement</u> 5.47 Buildings Department taking disciplinary action against Registered General Building Contractors and Registered Specialist Contractors <u>An Efficient, Innovative and Productive Industry</u> 7.46a Government designate Buildings Department to assume lead role in resolving conflicting requirements among public authorities arise during building plan approval process, and develop condensed and integrated processing system 7.46b Government departments pledge a time limit for tendering their advice in building plan approval process, and adopt forthcoming and proactive approach to help clients address difficulties in meeting regulatory requirements 7.47a Government regulators respond promptly and constructively to industry's requests for assistance and draw up codes and guidelines to help the industry 7.47b Legislative requirements to be kept under regular review 7.51 Highways Department develop efficient system to facilitate access of existing and proposed underground utilities to information 7.51 Highways Department require utility undertakings to improve the accuracy of as-built records <u>A Safer Workplace and an Environmentally Responsible Industry</u> 8.21-8.23 Labour Department enhance enforcement by: (a) Vigilant in taking enforcement action against sites with unacceptably high accident records and blatant offenders of statutory safety requirements (b) Prosecution against subcontractors for non-compliance with safety requirements in operations under their direct control (c) Enforcement action against workers 8.24a Buildings Department initiates disciplinary action against Registered General Building Contractors and Registered Specialist Contractors for blatant negligence leading to serious site accidents or for poor site safety performance below a certain benchmark. 8.24b Buildings Department and Labour Department co-ordinate requirements for Site Supervision	regulations, mostly obsolete in the industrialized countries where they originated and totally inappropriate to the less developed countries.

	Plan System mandated under the Buildings Ordinance and the Safety Management System under the Factories and Industrial Undertakings (Safety Management) Regulation. 8.33 Buildings Department strengthen defects liability warranty for new buildings 8.35 Government to encourage green designs by: (a) Exempting extra floor areas required for installation of green features and facilities from the calculation of gross floor area (GFA) (b) Providing additional GFA to offset extra cost incurred in use of green construction methods and materials as well as provision of building services, devices and systems which would improve the environmental performance of a building (c) Government charge no premium for modifying existing restricted leases for the provision of green and keep processing time for such lease modification to minimum 8.41a Environment and Food Bureau and Environmental Protection Department conduct regulatory impact assessment on cumulative impact of environmental legislation on construction industry vis-à-vis the community 8.41b Environmental Protection Department develop service culture and work in partnership with construction industry to improve the latter's environmental performance 8.44a Introduce charges for waste disposal facilities (such as landfills) to motivate contractors to separate and sort C&D material or to seek alternative disposal outlets 8.44b Government identify and provide suitable sites for: (a) temporary and permanent off-site sorting facilities (b) temporary and permanent barging points for public fill (c) setting up of "fill banks" for stockpiling surplus fill materials; and (d) establishing recycling and prefabrication facilities 8.45a Government encourage durable buildings to minimise generation of demolition materials 8.45b Government implement proposals to educate and encourage building owners to take better care of their properties 8.45 Government extending incentive scheme to promote construction of new environmentally friendly buildings, also to cover existing buildings so as to encourage upgrading of existing buildings and urban renewal process by private initiatives	
Others	<u>Fostering a Quality Culture</u> 4.14a Clients allow sufficient time 4.14b Government to address the high land cost 4.37 Clients, consultants and contractors examine site supervision systems to streamline bureaucratic	

	procedures 4.41 Employers improve quality control tests arrangements <u>Achieving Value in Construction Procurement</u> 5.54 Clients reject exceptionally low bids 5.52 Clients exercise robust change control, with particular emphasis on comprehensive project planning and risk assessment at project outset 5.64a Employers, consultants and contractors adopt a proactive approach in resolving claims and disputes 5.64b Encourage proactive and collaborative ways of dispute resolution 5.80 Client improve the security of project payments <u>An Efficient, Innovative and Productive Industry</u> 7.54 Works Bureau and the Housing Authority to promote competition in the prices of ready-mixed concrete 7.57 Works Bureau, the Hong Kong Trade Development Council (TDC), the industry and other related professional sectors examine the strategy and action plan for promotion of Hong Kong's construction services in other markets <u>A Safer Workplace and an Environmentally Responsible Industry</u> 8.8 Labour Department review methodology for collating construction safety statistics 8.17 Drive improvements in safety performance through procurement and contractual arrangements 8.18 Labour Department explore feasibility of developing construction insurance incentive schemes	

Source: Construct for Excellence – Report of the Construction Industry Review Committee, January 2001

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