School of Construction Management and Engineering

The relationship of the construction sector to economic growth: analysis of South African and UK construction sectors

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Declaration

I confirm that this thesis is my own work and the use of material from other sources has been properly and fully acknowledged.

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Sitsabo Dlamini

Dedication

To my late spiritual father Peter Dlamini who led me to Christ. In my youth, I always believed that all Christians were hypocrites. Peter was the first believer I had ever met who walked the talk. He was truly filled with grace and humility. Although I was living a sinful life when I came to know him, he never criticized me. Instead, he embraced me with love. Consequently, he became a deciding factor in my decision to accept Jesus Christ as my Saviour. My whole world changed. He inculcated deep within me an inner longing to live a life of greatness and contribution. This conviction has influenced me to make a decisive determination in my life to work hard, making every sacrifice necessary, studying, learning, putting in every effort to make this a concentrated focus of my life. Achieving the PhD will enable me to live up to the legacy that Peter left in my life.

And

To the late President Nelson Mandela who survived 27 years of incarceration designed by the apartheid regime to break his spirit of determination to achieve a democratic South Africa. He dedicated himself to the liberation struggle of the African people. He fought against white domination, and fought against black domination. He cherished the ideal of a democratic and free society in which all persons would live together in harmony and with equal opportunities. From his youth, this was an ideal which he hoped to live for and to achieve. He declared in the trial in 1964 before his incarceration that if needs be, it was an ideal for which he was prepared to die. When he came out of prison in 1990, he preached reconciliation. He charged that all the youth of South Africa must go back to school. I consider that nowhere has the significance of education been brought into sharper focus than in President Mandela's life, to which I owe a huge debt of gratitude.

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To my wife Londiwe, and my endeared sons, Nzuzo, Zwelo and Sizo; you were my source of strength, love and joy. Thank you so much for your patience and support. To the Office Administrator, Cebsile Hlophe in my business, Sitsabo Project Managers; thank you so much for keeping the business going while I was away. You contributed immensely to the completion of this work. Without your sacrifices, dedication and commitment, Sitsabo Project Managers would not have survived to continue funding me on my studies.

I thank you.

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Acronyms

GDP	Gross domestic product
GNI	Gross national income
GNP	Gross national product
LDC	Less developed countries
NIC	Newly industrialised country
AIC	Advanced industrial country
ICOR	Incremental capital output ratio
SARB	South African Reserve Bank
ONS	Office for National Statistics
BERR	Department for Business Enterprise and Regulatory Reform
SOE	State owned enterprise
RDP	Reconstruction and development programme
GEAR	Growth, employment and redistribution
Stats SA	Statistics South Africa
TCO	Total construction output
MA	Moving average
PPI	Producer price index
CPI	Consumer price index
CPIX	Consumer price index excluding interest rates on mortgage bonds
NSDP	National spatial and development perspective
FDI	Foreign direct investment
SAID	South African infrastructure department
CIDB	Construction industry development board
NDP	National development plan
PICC	Presidential infrastructure coordinating commission
DPSA	Department of public service and administration
NPF	National planning framework
MTSF	Medium term strategic framework
IDP	Integrated development plan
DCGTA	Department of cooperative governance and traditional affairs
GSCI	Public sector construction investment
PSCI	Private sector construction investment
TCI	Total construction investment

Abstract

Construction is considered a major sector of the economy throughout the world. It accounts for about 10% of most countries' gross domestic product (GDP). Its sheer size and role in economic growth is used to justify its importance. The importance of the construction sector in both national and world economies is unclear. Three growth theories are mobilized to explain the relationship of the construction sector to economic growth: Harrod–Domar, Solow and endogenous growth models. The theory of market and government failure is also used in order to explain public sector intervention in construction activity. The fundamental dynamics of the construction sector are studied in relation to economic growth, with a view to ascertaining if there is a basis for national governments to stimulate economic growth through investment in construction. This will enable policy makers to make better use of the construction sector. Time series statistical analysis of total construction output (TCO) and GDP data for South Africa and the UK reveal that a positive short run relationship between the construction sector and economic growth does exist, subject to other factors being equal. However, empirical evidence suggests that there is no obvious link between construction investment and economic growth. While the growth theories show that construction influences investment, which is a major factor in determining economic growth, the growth process *per se* is a complex phenomenon. Public sector investment in construction activity is necessary to fill the gaps of market failure left by the private sector, but the existence of government failure undermines such intervention.

Chapter 1: Introduction

There is a great deal of interest in the role of the construction sector in economic growth. It constitutes a significant part of the gross national product (GNP) or gross domestic product (GDP) of both developed and developing economies (Hillebrandt 2000). Over the years, this observation has evolved to create the notion that the construction sector plays a pivotal role in economic growth. This has inculcated the assumption that the construction sector drives economic growth.

The main indicators of the national output of a nation are the GNP and GDP. The latter measures what is produced in the economy within a country's border and according to Lopes *et al.* (2011), it is a better measure of growth in productive capacity. GNP measures how much of what is produced in the economy belongs to residents of the country, and is more closely related to changes in welfare (Hillebrandt 2000). In the UN Systems of National Accounts (SNA), GNP is derived from the GDP adjusted to the net factor incomes (labour and capital) with the rest of the world (United Nations 1992). Major writers on the relationship of the construction sector to economic growth such as Turin (1978), Bon (1992) and Choy (2011) have used both GNP and GDP in their arguments. Therefore, the two indicators will be used interchangeably throughout this thesis.

GNP per capita and GDP per capita is used in instances when the variable population is introduced. GNP per capita has been utilized by institutional bodies such as the World Bank and the OECD to compare living standards between their member countries. A common currency is used, usually the US dollar, in order to facilitate international comparisons. The World Bank publishes annually the world development indicators in which member countries are ranked and classified according to GNP per capita measured in US dollars (UNDP 1990).

Early studies in development economics focused mainly on explaining the role of the construction sector in economic development. Strassmann (1970) studied the role that the construction sector played in economic development using regression analysis. He found that the role that the construction sector played varied according to the level of developmental trajectory for each economy. Turin (1978), building on the work of Strassmann, used time series analysis to examine the place of construction in the world economy. He found that the share of construction in GDP and the value added in construction per capita grew as the economy developed. Building on the work of Turin and Strassmann, Bon (1992) used the input-output analysis to examine the changing role of the construction sector at the various stages of economic development. He suggested that the share of construction spending in GDP first grows, then peaks and declines as economies go through a growth cycle. All these studies emphasized the role that the construction sector plays in economic development.

The construction sector satisfies a wide range of physical, economic and social needs of society (Strassman 1970, Turin 1978 and Bon 1992). Ofori (1988), building on the work of Turin, added the role that the construction sector plays in sustained socioeconomic development. Building on the work of Bon, Myers (2008) as did Tan (2002), argued that construction can be regarded as an engine for economic growth. Given such significance, it is of interest to understand why developing economies are not utilizing the construction sector to transform their economies to developed economy status.

1.1 Problem statement

Most governments believe that the construction sector plays a powerful role in economic growth, in addition to producing the structures that add to productivity and quality of life (Jackman 2010). Policy makers assume that the construction sector is a driver for economic growth (Myers 2008). The construction sector is considered to be an important player in the growth process of most economies around the world (Bon 1992). This research seeks to understand why this is so by studying the relationship of the construction sector to economic growth.

The primary theme of the thesis is to establish if a relationship exists between construction activity and economic growth. Further, the research seeks to ascertain the nature of the relationship. An understanding of these dynamics is important to determine if there is a basis for the public sector to invest in construction activity. While private sector investment in construction is important in some economies, this research concentrates more on understanding the rationale for public sector investment in construction activity. It also seeks to understand whether the construction sector is enhanced or hindered by such investments.

Construction output and GDP data from SA and the UK have been used. These economies have been chosen because they are at two different growth trajectories. According to the World Bank (2013), the UK is categorised as an advanced industrial country (AIC), while SA is categorised as a less developed country (LDC). It is intended that analyses of the data from these two economies will help in making a comparison of the specific growth patterns and trends that apply to AICs and LDCs.

1.2 Thesis aim

The aim is to ascertain how the construction sector relates to economic growth so that policy might be based on more detailed considerations than the mere assumption that construction drives growth. The construction sector provides infrastructure. Developing economies face backlogs in the provision of infrastructure such as roads, schools, hospitals and sanitation. This can be considered an economic opportunity growth. However, the extent to which the construction sector affects or is affected by economic growth needs to be investigated. An understanding of the implications of investment in construction activity by government and public sector agencies would lead to better allocation of resources.

1.3 Thesis objectives

In all economies across the globe, policy makers play an important part in the drive to stimulate economic growth. Knowledge about the construction sector's relationship to economic growth could influence their decisions and investment policies. To this end, this investigation will entail fulfilling the following objectives:

- Analyse current literature on the relationship of the construction sector to economic growth with a view to ascertaining the current arguments and theories that underpin the relationship.

- Determine if there is a relationship between activity in the construction sector and economic growth. Investigate the nature of the relationship.

- Determine how the public sector of SA gets involved in construction.

While the understanding of the growth process as it relates to the construction sector is a crucial objective, even more important is where and how this increase in construction output is achieved. An explanation of the correlation of construction activity to economic growth will clear up any misconceptions about the construction sector. This will assist policy makers in the efficient allocation of resources, particularly in developing economies.

This thesis is an empirical inquiry into the fundamental dynamics of the construction sector and economic growth relationship at the different stages of the growth trajectory. Throughout the investigations, the research objectives are explored in depth to provide for the acceptance or rejection of the thesis hypothesis. It is also anticipated that answers to the objectives will reflect the contribution of this research.

1.4 Research questions

Detailed investigations on this study is pursued in two streams, using the following research questions:

- What is the relationship of the construction sector to economic growth?

- How is the public sector of South Africa involved in construction?

1.5 Thesis hypothesis

The unit of analysis for this study is the construction sector. The hypothesis for the thesis is that there is a relationship between construction activity and economic growth. The investigation will explore the nature of the relationship with a view to ascertaining if there is justification for the public sector to invest in construction activity to stimulate economic growth.

A proposed framework of the relationship is as illustrated in Figure 1.1. According to this framework, it is assumed that the public sector invests in the construction sector to stimulate economic growth. Strassman 1970, Turin 1978, Bon 1992, Ofori 1988, Myers (2008) and Tan (2002) all emphasized the importance of the construction sector to economic growth. To policy makers, this may be seen as an easy way to mobilize votes, promising the electorate that they will invest in construction activity to grow the economy and create jobs.

Figure 1.1: Proposed framework of relationship

This research questions the assumption that investment in construction activity will stimulate economic growth. Investigations set out to ascertain the nature and impact of the relationships. Both growth theory and the theory of market and government failures are used to explain the relationships.

Testing the research hypothesis is intended to make a contribution that fills the gaps in the understanding of the relationships. The proposed framework of relationships have important public sector policy dimensions. Growth theory and the theory of market and government failures are applied in understanding the relationships. It is intended that these theories will assist in identifying the existence of parameters in the construction sector that can help explain, in relation to economic growth and public sector investment, what causes what and why. Areas of public policy concern, such as investment, are investigated to ensure that policy makers base their decisions on more detailed considerations, in the light of the theory of market and government failures.

1.6 Organization of the study

The thesis follows a logical sequence. While the objectives of the research are outlined in this chapter, it is important to note that they were drawn up after undertaking a comprehensive literature review. Historical and current literature on the relationship of the construction sector to economic growth was analyzed, with a view to ascertaining the current arguments and economic theories that underpin the relationship.

The importance of the construction sector to economic growth, propagated by most authors in this area was questioned. Economic growth theory was studied to identify ways in which models of growth can be applied to explain the phenomenon of growth as it relates to the construction sector. The literature review focused on identifying a coherent account of views that can be supported by the growth theories.

Relevant literature and theory relating to state involvement in the construction sector was also surveyed to ascertain if there was any basis for the public sector to invest in construction to stimulate economic growth. A detailed account of the literature revealed how public sector investment affects the functioning of the construction sector. Past and present debates on the need for public sector investment in construction to deal with market failures were explored against the existence of government failures that overshadow such investments.

The methodology for the collection and presentation of data regarding different measures of the construction sector and national output was discussed. The adopted methods, that is, time series statistical analysis and sectoral analysis are discussed, including the reasons for their preference. The research instruments are described, both in terms of composition and rationale.

The sectoral analysis was undertaken to investigate how the public sector of SA is involved in construction. The impact of public sector investment on the functioning of the construction sector was explored. The analysis used secondary data sourced from various public sector documents and reports. The relevant features of the public sector of SA as it relates to construction were presented and discussed, focusing on the post-apartheid period.

Data from SA and the UK is used to analyze the relationship between the construction sector and economic growth. Evidence is presented on the nature of the relationship using time series statistical analyses of TCO and GDP data for both SA and the UK. Patterns and trends in the behaviour of TCO and GDP over time are discussed to ascertain what the relationship is between the two variables. Comparison is drawn between the major findings in the two economies, that is, SA and the UK.

In conclusion, the areas where contribution to existing knowledge has been made were highlighted. At the end of each section of the thesis, the important findings are summarized. The key research findings that respond to the research questions are summarized in the conclusion. This includes a discussion of how the conclusions reached fulfil the objectives of the research and address the hypothesis. Policy implications, limitations and the areas in which further work may be pursued are also outlined.

Chapter 2: Nexus of construction sector and economic growth

The previous chapter introduced the research as an empirical inquiry into the fundamental dynamics of the relationship of the construction sector to economic growth. This chapter examines the established views of the relationship. The importance of the construction sector with respect to economic growth is then discussed. Economic growth theory is studied to identify ways in which models of growth can be applied to explain the phenomenon of growth as it relates to the construction sector.

2.1 Key historical views

The relationship of the construction sector to economic growth was first brought into sharp focus by Strassmann (1970). Before this period, economic historians such as Thomas (1954), Kuznets (1960) and Chenery (1963) explained building cycles but did not observe the relationship. While these economists also undertook regression analysis of value added in major sectors of the economy using data from several countries just as Strassmann later did, their studies were not particularly concerned with the construction sector.

Strassmann (1970) sought to establish if the construction sector followed a pattern of change that reflected a country's stage of development. He applied regression analysis to a sample of 27 under-developed, 7 middle group and 14 developed countries for which construction output, employment and labour earnings data were available for the period 1955-64. He found that the construction sector had distinctive characteristics at various levels of growth.

In less developed countries (LDCs) construction activity is widely dispersed, as it takes place mainly in the informal sector. This means that construction output figures in LDCs do not give an accurate picture of the performance of the construction sector as compared to developed economies. The heterogeneity of the construction sector, allied with the immobility, complexity, durability and costliness of its products varies throughout the various stages of growth (Strassman 1970).

Subsequent to Strassmann's finding, several studies ensued on the patterns of growth of the construction sector. It became a well-entrenched view that construction activity plays a dynamic role in the process of economic growth (Wells 1986). However, the fundamental dynamics of the construction sector that informed such views were less understood.

Turin (1978), using time series analysis, examined the place of construction in the world economy, its dynamic relationships with other major development indicators, the main technological problems facing the industry in developing countries and finally a set of broad policy issues. Turin's work was based on his personal experience of construction in the developing countries and on the results of research carried out by members of the building economics research unit of the University College London. The sample was composed of 87 countries and spanned between 1960 and 1978. His findings on the relationship of construction and economic growth are shown in Figure 2.1 and Figure 2.2. The data from each country were plotted in a graph and the line drawn, represented the regression fit.

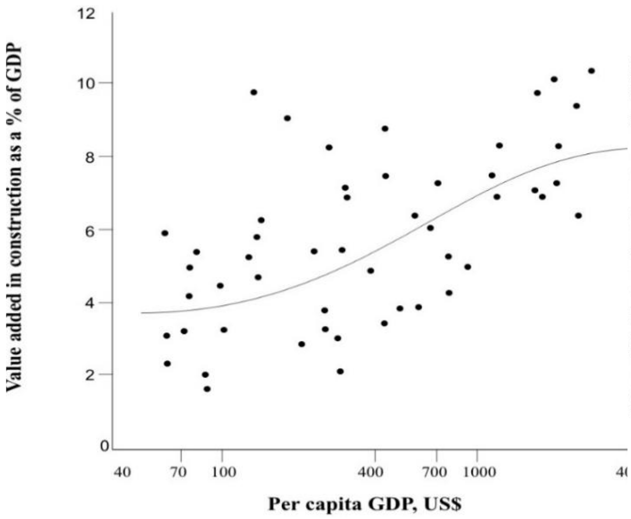


Figure 2.1: S-shaped relationship
Source: Turin 1978

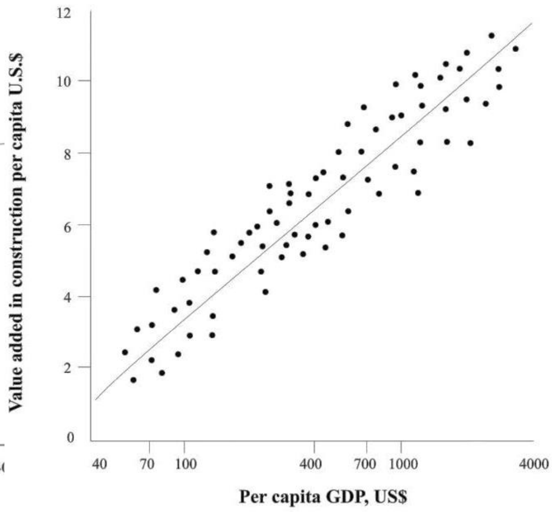


Figure 2.2: Linear positive relationship
Source: Turin 1978

Figure 2.1 shows that the share of construction grows from 4-8% between US$100-4000 per capita and that the highest rate of increase occurs in the middle range of countries (US$400-1000). Turin hypothesized the relationship to be S-shaped. Figure 2.2 shows that the value added in construction per capita grows more rapidly than GDP per capita. At both extremes of the range, the slope of the relationship is approximately one. This means that above a certain level of GDP per capita, construction accounts for an approximately fixed share of the national product.

Turin (1978) investigated the contribution of the construction sector to national income (Figure 2.1) and capital formation (Figure 2.2). The reasoning behind the use of these two diagrams was the fact that construction statistics appear twice in the national accounts of most economies (United Nations 1992). In the countries included in his analysis, there was a clear positive relationship between GDP per capita and the two separate measures of construction activity, that is, value-added by construction as a % of GDP (Figure 2.1) and capital formation in construction (gross output) per capita (Figure 2.2). The solid line in the graphs indicates the statistical relationship between the variables.

Turin observed that the difference between the relative importance of construction as measured by two separate indices was due to the fact that the value added in construction is inflated in high-income countries by high wages in the construction sector, in comparison to other sectors of the economy. Also, Turin's findings suggest that the relative importance of the construction sector in the economy in middle-income countries is a reflection of higher levels of investment in these economies. This finding was in line with Strassman's finding that the construction sector had distinctive characteristics at the various levels of growth.

Turin (1978) concluded that the share of construction in GDP and the value added in construction per capita grow with economic development. The construction sector exhibits unique features, which need to be understood for their impact in economic growth. Turin

(1978) found that an S-shaped relationship exists, however, the intrinsic nature of the relationship remains unknown.

Bon (1992) discussed the changing role of the construction sector at the various stages of economic development. He studied the construction activity since World War II in Finland, Ireland, Italy, Japan, the UK, and the USA. The data underlying his analysis spans a 50-year period and appears to place special emphasis on Europe. He argued that construction follows the bell-shaped pattern of development or an inverted U-shaped relationship as shown in Figure 2.3. This assumption was founded on the observation that the share of construction in GNP first grows and then declines with the level of economic development. The inverted U-shaped relationship is associated with less population growth, less migration and the assumption that most physical capital is already in place in later stages of economic development.

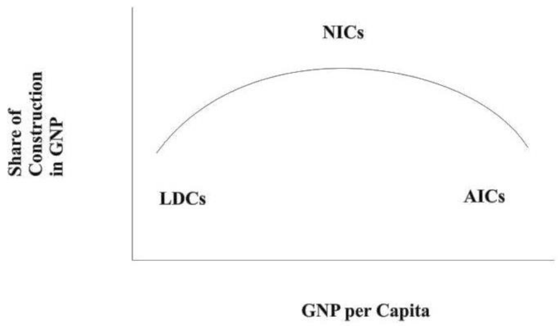


Figure 2.3: The Bon curve (Source: Bon 1992)

The inverted U-shaped relationship presented by Bon (1992) is very different from the S-shaped relationship found by Turin (1978). Bon argued that the main reason for Turin's S-shaped relationship is that his sample is dominated by less developed countries (LDCs) and newly industrialised countries (NICs), so that the trends characteristic of advanced industrial countries (AICs) were obscured. It may be argued though that Bon's study also gives emphasis on AICs. Although that was primarily due to the paucity of reliable economic data concerning NICs and LDCs, it does not give a full picture. This therefore presents the need for further holistic study of the relationship between the construction sector and economic growth.

Authors on construction economics such as Myers (2008), Hillebrandt (2000), Tan (2002), Bon (1992), Wells (1986), Turin (1978) and Strassmann (1970) all emphasized the importance of the role that the construction sector play in economic growth. However, they seemed to base their work purely on the power of their argument. It would appear that writers in this area, generally, start with the assumption that the construction sector drives economic growth. An understanding of this relationship would enable policy makers in government to make better use of the construction sector.

The synopsis of literature given above on the relationship of the construction sector to economic growth demonstrates the lack of common ground on the nature of the relationship and the theoretical reasoning applied in explaining it. The main feature drawn from these works is the common assumption that construction drives growth. Therefore, a deeper understanding of the relationship is necessary.

2.2 Role of construction activity in economic growth

The purpose of this section is to discuss to some depth, the relevant literature on the relationship of the construction sector to economic growth and to identify the gaps. The role of the construction sector is discussed in line with 2 major areas of importance as promulgated by key writers in this area. They assumed that: first, since the construction sector constitutes a significant part of national output, it was correlated with economic growth. Second, government has a major role in promoting economic growth.

2.2.1 Role of construction sector in national output

To understand how the construction sector relates to economic growth, it is important first to understand the economic process that underpins growth. What is economic growth? Economic growth refers to the growth of output over the long run (Samuelson and Nordhaus 2001). Does this mean that short run growth is not economic growth? Todaro (2009) explained that economic growth is primarily concerned with the long run, whilst the short run variation is termed a business cycle. Growth in output per capita is an important objective of most governments because it is associated with rising average real incomes and living standards.

The World Bank classifies economies of countries as low income, middle income (subdivided into lower middle and upper middle), and high income. The main criterion for these is the gross national income (GNI) or GDP per capita. Authors such as Tan (2002) use this standard. Another common standard of categorization based on growth stage of the country was used mainly by Bon (1992) and Crosthwaite (2000). This standard was based on the perceived changing role of construction as an economy goes through the different levels of development. It consisted of less developed countries (LDCs), newly industrialised countries (NICs) and advanced industrial countries (AICs). The IMF classifies countries as developed or advanced economies and developing or undeveloped countries. The United Nations human development index also uses first world and third world classifications to denote developed and developing countries respectively. Although the criteria used to arrive at all these different classifications remain a contentious issue, they will be used interchangeably throughout this research.

Turok (2008) argued that the term “third world” implied the false notion that those countries were not a part of the global economic system. It is of interest to note that different writers use different classifications to try and understand the fundamental socio-economic status of the countries they may be dealing with at any given point in time. Therefore, the use of these classifications in this research will be handled tactfully, to avert any unintended negative misinterpretation.

Growth is concerned mainly with the increase in a country's real level of national output. It is measured by the increase in a country's gross domestic product (World Bank 2003). Samuelson and Nordhaus, as did Todaro, raised some limitation on the way growth is measured. They argued that the measurement of economic growth does not take into account the size of the informal economy. Instead it is considered as the black economy which is unrecorded economic activity. This is a matter of concern, especially in the construction sector where a majority of the work is undertaken by the informal sector. Todaro (2009) also argued that economic growth does not take into account the depletion of natural resources which might lead to pollution, congestion & disease.

The accuracy of statistics in LDCs is a challenge. About 40% of construction work is undertaken by the informal sector (Ofori 2001). Such statistics are omitted from national statistics or, if included, the methods of assessment are of necessity crude. In addition, construction activity in LDCs is subject to wide fluctuations from year to year, and indeed from month to month; due to its casual nature. Employment figures fluctuate even more widely (Hillebrandt 2000).

Despite the efforts of international organisations to bring consistency in the definition and presentation of national statistics, considerable deviation from the standardized systems remains in the data of many countries. Thus all data relating to the construction sector in LDCs must be interpreted with caution. A discussion of how construction work done in the informal sector of the SA economy has been factored into the data used in this research is included in Chapter 4, page .

A significant number of countries have achieved remarkable progress economically over the years, growing from LDC stage through NIC stage to AIC stage. The role of the construction sector in the growth trajectories is not clear. What happens when an economy reaches the AIC stage of growth? Why is it difficult for most economies to achieve economic growth and move from LDC stage to AIC stage? What is the relationship of the construction sector to economic growth beyond the AIC stage?

In a study that covered 105 developing countries over the period 1968 to 1985, Wells (1986) confirmed that relationships observed between countries at different income levels at a fixed point in time, occur within any one country, over a period of time. The construction sector, like agriculture and manufacturing, follow a pattern of change that reflects a country's level of growth (Strassman 1970). Wells concluded that construction output represents an increasing share of GDP, with increasing per capita GDP, in any one country over time. This means that as overall national GDP increases construction output would grow at an even faster rate. Wells' work is important to this research in that it seeks to explore the fundamental dynamics of the role the construction sector plays in economic growth.

Wells' finding does not, however, indicate if growth in the construction sector would influence growth in the economy. The evidence presented does not show how rapid expansion of construction output may be achieved. The construction process absorbs resources such as building material and expertise from other sectors of the economy. Such resources may be scarce, especially in LDCs. There is no clear indication in Wells' findings of what economies need to do to increase construction output. The length of time required to achieve such increases is also unclear. Therefore, while Wells findings advance our understanding of the relationship, some questions remain unanswered.

LDCs may be rich in indegenous resources, but for such resources to be effectively used in construction programmes they would need to be developed. The extent to which LDCs need to create a strong indigenous construction capacity needs to be explored. Strategies of how to deal with technological constraints such as the lack of skills, which characterizes most LDCs would need to be innovated. Institutional challenges and political will are also factors that would need consideration. These considerations would need to form part of a broader strategy for the production of capital goods.

Strassman (1970), in his seminal work on the role of the construction sector in economic growth argued that there is no contradiction between the time series and cross-sectional results. He observed that the pattern of growth had not changed fundamentally in the period between 1955 and 1964. Cross sectional figures for most underdeveloped countries reflected what happened in early phases of growth, while the long-run series for developed countries mostly began after those phases are past. Construction first stayed at a low level since its output was part of the informal economy.

Low (1994) examined the role of construction and marketing in economic growth. His study was based predominantly on reviewing the literature of major authors around the world on construction between 1958 and 1994. He mentioned that several studies showed a strong correlation between the per capita value added by construction and the per capita GDP. He also argued that regression analyses showed that the share of construction in GDP tends to increase with increasing per capita GDP. Low’s study is imperative to this research as it outlined previous attempts that were made to define the place for construction in the national economies of different countries studied. His empirical work covered countries such as the UK, US, France, Italy, Hong Kong, Singapore, Malaysia and India. However, some important questions remain. What exactly is the relationship of construction activity to economic growth? Does the construction sector stimulate economic growth?

Building on the work of Wells (1986), Hillebrandt (2000) in her classic textbook dealt with the application of economic theory to the workings of the construction firm and the construction industry. Hillebrandt concluded that the construction sector is likely to have an effect on the whole economy, and similarly, it would be affected by the economy. This implies that the two interact with each other. Hillebrandt's work is vital to this research as it underpins the key concepts involved in the discipline of construction economics.

Wong *et al.* (2008) took Hillebrandt's observations further. They examined the complexities in the relationship between construction activity and stage of economic growth in Hong Kong using time series data. Their analysis covered the period 1993 to 2006. They acknowledged that the views presented by Hillebrandt (2000) on the role which construction activity plays in the economic growth of nations was made important through the realisation of the linkages between construction activity and the rest of the economy. They argued that as the construction sector provides the necessary infrastructure and productive facilities, it must grow faster than the economy as a whole.

Building on the work of Wong *et al.* (2008), Jackman (2010) empirically investigated the relationship between residential construction and economic growth for Barbados from after World War II in the 1940s up to the recent global economic crunch experienced since 2008. He employed an econometric approach to investigate the relationship. His finding was that investment in construction will have an impact in economic growth.

The approach that was taken by Jackman (2010) was a bit narrow by comparison with Wong *et al.* (2008). Infrastructure development was not included in the study, yet it is so crucial to total construction output. A broader study of the relationship would yield more valuable insights. Despite the narrow approach, Jackman's study provided some insights, upon which a broader research can be undertaken to explore the relationship in greater depth.

Strassman 1970, Turin 1978 and Bon (1992) all emphasized the importance of the role that the construction sector play in economic growth. Following the previous works, Myers (2008) outlined the principles and concepts underlying the relationship. He stated that construction can be regarded as the engine of economic growth without providing evidence. In the same vein, Tan (2002) also argued that construction was a potential agent of economic growth. As argued above, construction provides infrastructure for use by other sectors of the economy. So how does it then become the engine of economic growth? Is construction the end in itself or is it the means to the end?

Econometric analysis of Cape Verde to test whether construction activity contributes to economic growth, concluded that growth in the construction sector followed economic growth (Lopes *et al.* 2011). The results of the study reflected that in the long-run there was a uni-directional relationship between GDP and construction output. Growth in construction output was shown to have no effect on GDP growth.

The construction sector deals mainly with the provision of capital infrastructure. The delivery of such infrastructure generates further investment in other sectors of the economy through the multiplier effect. However, the construction sector *per se* cannot be regarded as the determinant of such growth.

This section of the literature review has shown that early studies of the relationship between the construction sector and economic growth suggested that construction activity played an important role in economic growth. However, the fundamental dynamics pertaining to such a relationship remain unclear. Turin (1978) postulated an S-shaped relationship, while Bon (1992) promulgated an inverted U-shaped relationship. Recently Choy (2011) refuted this and instead observed an inverted U-shaped curve with a long-tailed end on the right hand side (see Figure 2.4).

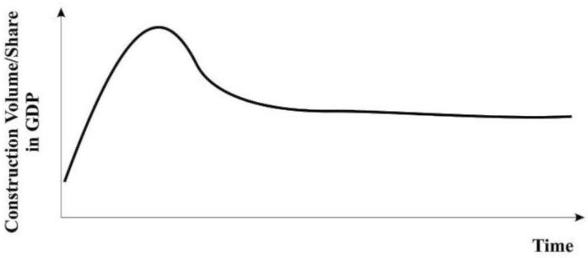


Figure 2.4: Construction share and volume over time

Source: Choy 2011

Since the pioneering work of Strassmann in 1970, much attention has been paid to the role of the construction sector in the national economy. A significant debate has ensued. The current global financial crisis has made it the preoccupation of every government to explore the minimum necessary and sufficient conditions for economic growth. Clearly, there is need to deepen current understanding of the relationship of the construction sector to economic growth. This will enable policy makers to generate informed policies that will have the potential to turn the economy around. The next sub-section explores literature on the role of government in economic growth.

2.2.2 Government role in growth

Economic growth has been the preoccupation of every government around the world since the enlightenment in the 17th and 18th century (Lucas 1988). Modern economic growth started in the early nineteenth century (Mokyr 2005). In the post World War II period authors such as Samuelson (1954) and Koopmans (1965) studied the economies of several countries using data on total government consumption expenditures and other variables from international financial statistics.

In a cross sectional study of 104 countries, Landau (1983) found a significantly negative relationship between the growth rate of real GDP per capita and the level of government consumption expenditures as a ratio to GDP. Similarly, Kormendi and Meguire (1985) investigated 47 economies using data that covered an average period of 20 years. No relationship was found to exist between average growth rates of real GDP and the share of government consumption spending in GDP.

Subsequent to these studies, Ram (1986) also undertook a similar study, which reached a different conclusion. He investigated 115 economies. His finding was that there were positive effects of the growth of government consumption spending on the growth of GDP. However, according to Barro (1991), Ram's results held constant the ratio of both public and private investment to GDP. This eliminated the channel for the negative effect of government on growth. Barro also observed that the results amounted to a positive coefficient in a regression of the growth rate of GDP on the growth rate of government consumption expenditures. He argued that such a regression would pick up the reverse effect of income on government consumption. Such reverse effect he viewed as amounting to a demand function for public services.

Building on the work of Kormendi and Meguire (1985), the analysis of 47 economies was extended to 115 economies by Grier and Tullock (1987). Like Kormendi and Meguire, Grier and Tullock also used data on total government consumption and other variables from international financial statistics. Their extension was a pooled cross section, time series analysis. It utilized data that averaged over 5-year intervals. A significantly negative relationship was found between the growth of GDP and the growth of the government share of GDP.

Subsequent to these findings, Romer (1988) studied models on endogenous economic growth where private and social returns to investment diverged so that decentralized choices led to sub-optimal rates of saving and economic growth. The models showed that while private returns to scale may be diminishing, social returns reflecting spillovers of knowledge can be constant or increasing. Barro (1991) took these arguments further and investigated the effect of government spending on growth using the endogenous theory of growth. He found that the economy's growth rate and saving rate initially rises with the ratio of government expenditure to GDP.

A number of studies have estimated regressions where the dependent variable was output within some area, and the independent variables were private capital, labour, public capital, and a constant for the level of technology. Aschauer (1990) made a significant contribution by drawing attention to the importance of public infrastructure and by adding public capital to the conventional production function. His original aggregate time series estimates suggested that the impact of aggregate public capital on private sector output and productivity was very large. He concluded that increases in GNP resulting from increased public infrastructure spending exceeded those from private investment by a factor of between two and five.

Munnell (1991) countered Aschauer's findings. He argued that the implied impact of public infrastructure investment on private sector output that emerged from Aschauer's time series studies was too large to be credilble. In his study of the relationship between public capital and measures of economic activity at the state level, Munnell observed that it did not make sense for public capital investment to have a substantially greater impact on private sector output than private capital investment. He considered that so much public investment went into improving the environment and other goals that were not captured in national output measures.

What is the impact of public infrastructure investment? The literature considered here provides little insight on this question. While several voices urge caution when considering increased public sector spending on infrastructure, some evidence seems to support the notion that profitable public investment opportunities do exist. The UK, SA and other governments around the world repeatedly make pronouncements to the effect that they are undertaking significant investment in infrastructure projects to stimulate economic recovery (World Bank 2013). This is done on the assumption that the construction sector drives growth.

Hillebrandt (2000) provided that government may encourage certain types of development in order to benefit the economy through the control of public sector expenditure, the use of the rate of interest and fiscal policies. She continued to argue that in many South East Asian economies, especially those of Hong Kong and Singapore, the property development and real estate businesses provided significant revenue for government through land sales and taxes, and its activities generated further prosperity. Does this require government intervention?

Wong *et al.* (2008) observed that government can implement a macroeconomic policy to stimulate the growth of the general economy via construction activity. But the study failed to identify how exactly, if at all, the construction sector stimulates economic growth. The study was not comprehensive enough as it only covered different metropolitan areas within Hong Kong and as such it was difficult to validate their findings. The work of Wong *et al.* is however very critical to this research as it highlights the underlying difficulties in understanding the relationship between construction and economic growth.

Tan (2002) provided some valuable insights concerning the relationship of the construction sector to economic growth. He argued that statistical correlation does not imply causation, and that there is a need to differentiate growth-initiating construction output such as factories and infrastructure from growth-dependent construction output such as social amenities and housing. How does construction initiate economic growth? How does economic growth affect the construction sector? If statistical correlation does not imply causation, how then does investment in construction serve as a stimulus for growth, if at all?

Tan’s view, tends to confirm the conclusion reached by Hillebrandt (2000) that the construction sector is likely to have an effect on the whole economy, and similarly, it would be affected by the economy. Since the two interact with each other, scarce resources should be allocated to growth-initiating projects in the initial stages of growth and subsequently to growth-dependent construction output. It is not clear though how this can be achieved without government intervention. There is some scepticism in relying on government to stimulate growth in the economy (Reidl 2010). So can the construction sector rely on market forces to create the necessary demand for its output?

In their analysis of the origins of developmental states, Doner *et al.* (2005) found that the growth experienced by the East Asian countries emerged amid political leaders' recognition that under conditions of systemic vulnerability, only coherent bureaucracies and broad public-private linkages could achieve growth. It is not just state intervention *per se* that influenced the growth. The formation of economic institutions of governance also played an important part.

According to the Panayotou (2003), what matters is the content of growth, which is the composition of inputs (including environmental resources) and outputs (including waste products). The content of growth is determined by, among other things, the economic institutions within which human activities are conducted. These institutions need to be designed so that they provide the right incentives for growth. They can ensure that government actions in the construction sector enhance productivity in the performance of other sectors of the national economy. Governments need to consider the impact of their infrastructure programmes on the construction sector and how the sector might be able to respond.

2.2.3 Summary of gaps identified

Of all issues facing policy makers today, none is so compelling as the question of economic growth. Early writers in construction economics, such as Strassman (1970), Turin (1978) and Bon (1992) focused mainly on explaining the role of the construction sector in economic development. While their observations advance our understanding of the relationship, it is important to deepen the understanding in order to explain if there is any basis to promote economic growth through investment in the construction sector. This question has not been addressed by existing literature.

Strassmann (1970) studied the role that the construction sector played in economic development using regression analysis. He found that the construction sector had distinctive characteristics at the various levels of growth. What were these characteristics?

(a) In LDCs construction activity is widely dispersed, as it takes place mainly in the informal sector. This means that construction output figures in LDCs do not give an accurate picture of the performance of the construction sector as compared to NICs and AICs. Despite such shortfalls, there is currently no explicit framework to factor in construction work that takes place in the informal sector.

(b) The heterogeneity of the construction sector, allied with the immobility, complexity, durability and costliness of its products varies throughout the various stages of development (Strassman 1970). While the SIC and the ISIC outline the boundaries of the construction sector, some significant variations exist in different economies. For example, there are some debates over the inclusion of professional services costs in construction output.

Turin (1978), building on the work of Strassmann, used time series analysis to examine the place of construction in the world economy. He found that the share of construction in GDP and the value added in construction per capita grew as the economy developed. He postulated an S-shaped relationship.

Bon (1992), building on the work of Turin and Strassmann, used the input-output analysis to examine the changing role of the construction sector at the various stages of economic growth. He suggested that the share of construction spending in GDP first grows, then peaks and declines as economies go through a growth cycle. Unlike Turin, Bon promulgated an inverted U-shaped relationship.

More recently, Choy (2011), using time series analysis, refuted Bon's findings and instead observed an inverted U-shaped curve with a long-tailed end on the right hand side. Choy's main argument was that the construction sector continues to play a role in economic growth beyond the AIC stage of growth. However, Choy failed to explain how the construction sector affects economic growth at this stage.

Since the pioneering work of Strassmann in 1970, much attention has been paid to the role of the construction sector in the national economy. Authors such as Myers (2008), Hillebrandt (2000), Tan (2002) and Wells (1986) all emphasized the importance of the role that the construction sector play in economic growth. However, going through their work, one gets a sence that, in the main, they seemed to base their work purely on the power of their argument.

Econometric analysis of the construction sector of Cape Verde, undertaken by Lopes *et al.* (2011) to test whether construction activity contributes to economic growth, concluded that growth in the construction sector followed economic growth. Growth in construction output was shown to have no effect on economic growth. Therefore, the notion that construction drives growth is questionable.

The recent global financial crisis has made it the preoccupation of every government to explore the minimum necessary and sufficient conditions for economic growth. So any suggestion that construction drives growth may be misleading or even disruptive. Policy makers might be misguided into believing that investment in construction will stimulate economic growth. Therefore, this research seeks to find out how the construction sector relates to economic growth, with a view to establishing if there is any basis for the public sector to invest in construction activity to stimulate economic growth. The next section examines the relevant theory that can be applied to explain the relationship of the construction sector to economic growth.

2.3 Growth theory

The purpose of this section is to discuss the theories that underpin the relationship of the construction sector to economic growth. Earlier works on theorizing about the growth process can be ascribed among others to the pioneering works of Ramsey (1931) on optimal saving, Keynes (2007) on the general theory and of Von Neumann (1945) on balanced growth at a maximal rate. Three economic growth theories are discussed here, namely: Harrod-Domar, Solow and endogenous growth theories.

2.3.1 The Harrod–Domar theory

This model was developed by RF Harrod and ED Domar in the l930s. It was developed to help analyse the business cycle. As indicated earlier on in this chapter, economic historians such as Thomas 1954, Kuznets 1960 and Chenery 1963, focused mainly on explaining building cycles in the construction sector. Cootner (1963) explained building cycles in the context of production functions. However, the construction sector was not singled out for separate analysis of statistical significance.

The Harrod-Domar model suggested that savings provide the funds necessary for investment. By abstaining from consumption, households make available a pool of funds that firms use to buy capital goods. This is the act of investment. Buying power is channelled from savers to investors through banks, individual loans, government and stock markets. The economy's rate of growth is perceived to be dependent on the level of saving and the productivity of investment (Nelson and Winter 1982).

Since the Harrod-Domar model was originally developed to analyse business cycles, it was later adapted to explain economic growth. According to Tourette (1964) the model concluded that:

- Economic growth depended on savings and the productivity of capital.

- It was the lack of physical capital that held back economic growth.
- Increase in physical capital generated economic growth.
- Net investment led to more capital accumulation, which generated higher output and income.
- Higher income allowed higher levels of saving.

Economic growth was seen as a function of the ability of an economy to save and of the capital-output ratio (Ray 1998). Abstention from current consumption leads to economic growth. A high savings rate was thought to increase investment, which led to increased growth. Since construction is an investment sector, it is to be expected that as more savings are accumulated by the state and the private sector, there would be more investment in construction.

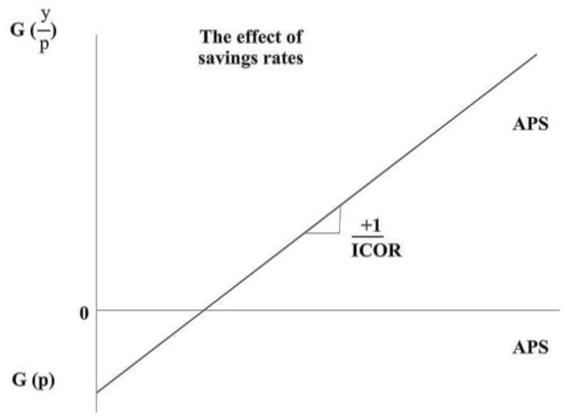
The Harrod-Domar model identified 2 important commodities: namely, consumption goods and capital goods (De la Croix and Michel 2002). Households buy consumer goods, while firms buy capital goods to expand their production or replace worn out infrastructure such as factories. By opening new factories, investment creates a market demand for capital goods. These goods add to the stock of capital in the economy. They endow the economy in the future with an even larger capacity for production, which allows the economy to grow. Where there are no savings initially, it is not possible to invest & there can be no growth.

The bulk of saving and investment is done by households and firms respectively. However, in some cases savers and investors are the same individuals. Households save by spending less in current consumption, while firms invest by acquiring new technology such as machinery in the construction sector, which increases future capacity to build.

The foundation of all models of economic growth is the concept of macroeconomic balance (Mankiw *et al.* 1992). According to Ray (1998) macroeconomic balance is achieved when investment demand is at a level that exactly counterbalances savings leakage. In relation to growth, macroeconomic balance seeks to improve the performance of investments in the economy. When there is macroeconomic balance, growth is achieved at the rate of technological progress. Savings are considered to exit the production system when the demand for consumption goods falls short of the income that created the demand. Investors fill this gap by stepping in with their demand for capital goods.

If investment exceeds the amount required to replace depreciated capital, positive economic growth is achieved. At this point, savings lead to investment. Therefore, the volume of savings and investment is an important determinant of growth. The Harrod-Domar model has both descriptive and prescriptive value. Growth is dependent on certain parameters. Such parameters are determined by people's tastes and technology, in a free market economy. In a planned economy the government uses its power to manipulate these parameters to influence growth (De la Croix and Michel 2002).

Given a government's growth objectives and existing technological conditions, the Harrod-Domar model can be used to obtain policy clues. Figure 2.5 shows that an increase in the savings rate (APS) had the potential to increase the growth rate of per capita income. The size of the increase would be inversely proportional to the size of the incremental capital-output ratio (ICOR). Existing technological conditions include, among other things, the prevailing ICOR. The higher the ICOR , the lower the productivity of capital (see Figure 2.6). So the ICOR gives an indication of the inefficiency with which capital is used.



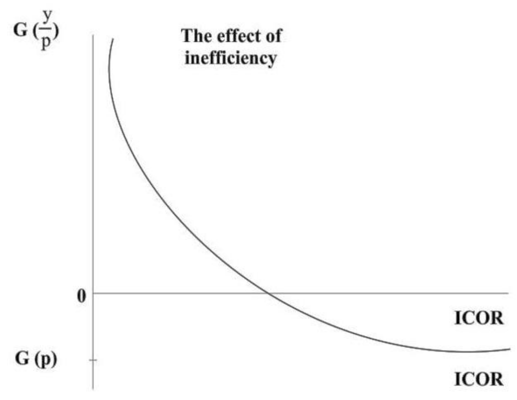


Figure 2.5: The effect of savings rates
Source: Adapted from Sato 1964

Figure 2.6: The effect of inefficiency
Source: Adapted from Sato 1964

If the ICOR was 3, a 6% increase in the savings rate would be needed to increase the growth rate of per capita income by 2%, assuming that both the ICOR and the rate of population growth *G(p)* remained constant.

The major parameters of the Harrod-Domar model, that is, investment and savings are not just aggregate objects. They have important components that must be understood separately. Let us consider the model captured by the equation:

$$s/\theta = (1+g^*)(1+n)-(1-\delta)$$

where s denotes ability to save and invest, θ denotes capital-output ratio, g^* denotes rate of per capita growth, n denotes rate of population growth, and δ denotes the rate at which capital depreciates. The Equation incorporates important factors underlying growth. It provides that the growth rate is a function of savings rates, capital-output ratios, population growth rates and depreciation rates.

While this might make good sense, in some cases it does not. The very parameters that are used to predict growth rates may themselves be affected by the growth process. Variables such as the savings rates and capital-output ratios which the model considers to be exogenous to economic growth, may actually be endogenously determined. Two of the parameters used in the Harrod-Domar model are discussed separately hereunder:

(a) Savings

The model saw the savings rate as an important factor in the economic growth process. The rate of savings may be influenced by the overall income per capita in the economy. Distribution of that income among the population may also affect the savings rate. Therefore, it is to be expected that economies with low levels of income will have poor rates of savings. In some instances, it may even be impossible to save. Growth initiatives in economies that suffer poor savings have to rely on other sources of capital accumulation. External credit and aid are some of the options (Ray 1998).

Growth in the economy creates room for saving. As incomes change, the savings rate that enters into the Harrod-Domar formula will change. Over time, the growth rate of an economy will behave in a way that mirrors the movement of the savings rate with income. However, economic growth does not necessarily mean savings will grow. Even developed economies have difficulty motivating consumers to save. Despite the fact that the rich have the capacity to save, their need to accumulate wealth may be blinded by the mere knowledge that they are ahead of many.

(b) Population growth

Population growth, like savings rate might vary with the level of per capita income. The Harrod-Domar model assumed that population growth rates systematically change with the overall level of development of a society. If this assumption holds, then population is another reason for the variation of per capita growth rates.

Demographic transition has implications for per capita economic growth. It refers to the process of transition of economies from high birth and death rates to low birth and death rates as the economy develops (Krugman and Wells 2006). According to an approximate version of the Harrod-Domar equation by Ray (1998)

$s/\theta = g^{*} + n + \delta$.

In this equation, *s* denotes ability to save and invest, θ denotes capital-output ratio, g^{*} denotes rate of per capita growth, *n* denotes rate of population growth, and δ denotes the rate at which capital depreciates. The Harrod-Domar model suggests that there are situations in which a boost to certain economic parameters may have sustained long-run effects (Mankiw *et al.* 1992). Where the population growth rate exceeds income growth, a jump in the savings rate can shift the rate of overall income growth to a level that outstrips the population growth rate. A government policy to boost savings does not have to be permanent. Once the economy reaches a certain level of per capita income, the old savings rate will be enough to keep it from sliding back. This is because population growth rates fall of their own accord in response to the higher standards of living (Krugman and Wells 2006).

The provision of incentives to have less children can reduce population growth. Such an intervention can also promote economic growth. How and why so? According to Klasen and Lawson (2007), both theoretical considerations and empirical evidence suggested that high population growth puts a considerable break on per capita growth prospects. In their case study of the economy of Uganda, Klasen and Lawson examined the impact of population growth on per capita economic growth using panel data. As the economy become rich of its own accord, population growth rates will be endogenously induced to fall (Krugman and Wells 2006). The idea that policy intervention can have lasting long-run effects is important.

The savings and population growth factors discussed here, which the Harrod-Domar model viewed as exogenous may well be influenced by the outcomes that they supposedly cause.

For instance, savings might be influenced by income or its rate of growth. However, this should not be construed to mean that there is no causal relationship at all between savings and growth rates. The arguments here have also shown that whilst factors such as population growth rates are given as exogenous in the Harrod-Domar model, they are equally capable of being endogenous. The provisions of the model can alter policy assumptions relating to construction as an investment sector.

The key to economic growth is to expand the level of investment. Policies must encourage saving and the generation of technological capabilities that enable firms to produce more output with less capital. The Harrod-Domar model, among others, showed that through its influence of investment, the construction sector plays a part in the economic growth process.

The Harrod-Domar model explained the economic growth process in terms of the level of saving and the productivity of capital. However, it failed to explain the influence of technical change. Parameters in the model were seen as given. This presented a strong case for criticism of the Harrd-Domar model. While the model identifies important factors in the growth process, it fails to explain why growth rates systematically differ at different levels of income. Poor countries with low levels of income are expected to borrow to finance investment. This may cause repayment problems for such countries. Dissatisfaction with the model led to the development of the Solow growth model.

2.3.2 Solow growth theory

This model provides that capital and labour work together to produce output. It differs from the Harrod-Domar model based on the law of diminishing returns to individual factors of production. If there is plenty of labour relative to capital, increasing capital will increase total output. Where there is shortage of labour, capital-intensive methods are used at the margin and incremental capital-output ratio will rise (Ray 1998).

The capital-output ratio changes with the per capita capital available in the economy. Higher per capita stock raises the capital-output ratio. However, this contrasts with the Harrod-Domar model, where the assumption of a constant capital-output ratio rules out diminishing returns.

As per capita capital increases, the output-capital ratio falls because of a relative shortage of labour. This is graphically illustrated in Figure 2.7 as *y=f(k)*, where *y* is output per unit of labour and *k* is capital per unit of labour.

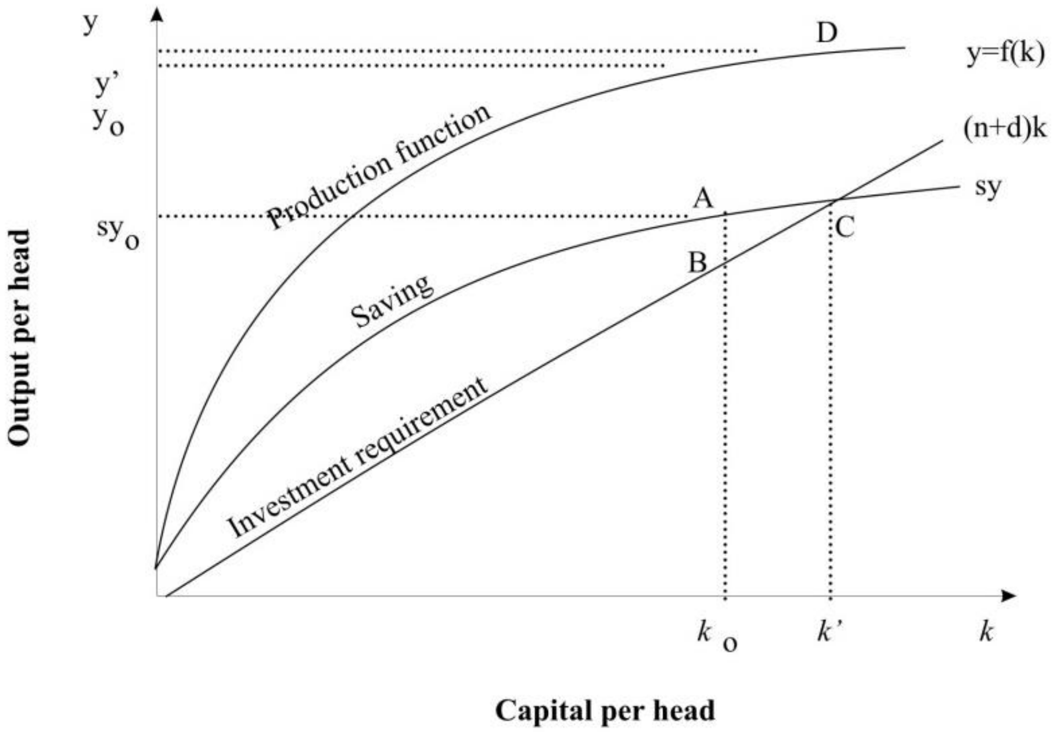


Figure 2.7: Solow growth model
Source: Adapted from Solow 1988

The Solow model identified three functions: the production function, the savings function and the depreciation function. The savings function (*sy*) shows that a constant proportion of income is saved by every individual. The depreciation function or investment requirement (*dk*) shows that a certain volume of investment is required to replace the capital products that are used up in production each year (depreciation). If a constant proportion of capital is depreciated every year, then this can be depicted as a straight line. If savings = depreciation, such as the case is at point C in Figure 2.7, then the amount of new investment undertaken is just sufficient to replace used-up capital every year. All points to the left of C represent accumulated savings that exceed depreciation and when this happens, net investment takes place, which increases the economy's capital stock (Solow 1988).

The Solow model explains that the economy always moves towards the steady state. However, Kambhampati (2004) stated that any growth that takes place within this model is likely to be short-run. This suggests that the Solow model cannot explain long-run growth. The model requires that capital increases faster than labour for growth to occur. But when this happens, decreasing returns will decrease the marginal contribution of capital to output, and will force a decrease in the rate of growth of output (Ray 1998).

For long-run growth to occur within the Solow model there is need for the production function to shift upwards, which implies that there should be technical change in the economy. Capital at this level is employed more productively, so that for each unit of capital, output is higher. The upward shift in the production function affects the decreasing returns to scale within the model and returns in long term growth. The model fails to explain technical change, but considers that it is a residual. Any growth that cannot be explained by increases in labour or capital inputs is attributed to technical change (Kambhampati 2004).

In the Solow model, parameters such as the savings rate have only level effects, as opposed to the growth effects perceived by the Harrod-Domar model. There is a steady-state level of per capita income to which the economy must converge, irrespective of its historical starting point. Regardless of the initial per capita capital stock, economies with similar savings rates, depreciation rates, and population growth rates will converge to similar standards of living in the long run (Mankiw 2007).

In the absence of technical progress, an economy cannot sustain per capita income growth indefinitely. Capital must grow faster than population to achieve sustained per capita income growth. However, the hypothesis of diminishing returns implies that marginal contribution of capital to output must decline. This eventually forces a decline in the growth rate of output (Ray 1998).

The introduction of technical change counters the argument of diminishing returns. The production function must shift upwards over time if new knowledge is gained and applied. In the absence of technical progress the production function is incapable of attaining sustained per capita growth. Technical progress is considered to embrace increased productivity borne by education.

The equation

$$K(t+1) = (1-\delta)K(t)+sY(t)$$

describes the accumulation of capital (Ray 1998). Where *K* represents national capital stock, *t* represents period, δ represents depreciation, *s* represents the ability to save and invest (saving rate) and *Y* represents total output. According to Ray, the equation is valid with or without technical progress.

It is necessary to make a distinction between the working population *P(t)* and the amount of labour in efficiency units *L(t)* used in production. In the extended Solow model, the productivity of the working population is constantly increasing. Ray (1998) postulated this increase in productivity as

$$L(t) = E(t)P(t)$$

where *E(t)* denotes the efficiency or productivity of an individual at time *(t)*. While population grows over time, efficiency also grows. Thus,

$$E(t+1) = (1+\pi)E(t)$$

where π is the rate of the technical progress.

The adapted Solow model is modified to reflect as

$$(1+n)(1+\pi)\hat{k}(t+1) = (1-\delta)\hat{k}(t)+s\hat{y}(t)$$

where k represents the capital per efficiency unit of labour and y represents the output per efficiency unit of labour. k produces y. If there is too much k, a shortage of effective labour will result. The output-capital ratio will also fall (Ray 1998).

If the amount of capital per effective labour rises, it means that physical capital is growing faster than the rate of population growth and technical progress. Diminishing returns set in and output per efficiency unit rises but not in the same proportion. The adapted Solow model reflects that fresh savings generated also fail to rise proportionally. This negatively affects the growth rate of capital per efficiency unit. The progression moves towards the steady-state. However, although capital per efficiency unit converges to a stationary steady-state, the amount of capital per member of the working population continues to increase. The long run increase in per capita income takes place at the rate of technical progress.

The Solow growth model explained the economic growth process by focusing on productivity, capital accumulation, population growth and technical progress. However, like the Harrod-Domar model, the Solow model also failed to explain how or why technical progress occurs. The parameters in the model were seen as given. The Solow model also failed to take account of entrepreneurship and the strength of institutions in facilitating economic growth. These criticisms led to the development of the endogenous growth models.

2.3.3 Endogenous growth theory

The endogenous growth theory was developed in response to criticism of the Solow and Harrod-Domar models of economic growth. It provided that firms which benefited from expanding would not expand because some of the benefits of increased production accrue not to the firm but to agents outside the firm. While there may be increasing returns to the economy overall, the returns to the firm itself may be constant or even decreasing. The external benefits that accrue to other firms and consumers within the economy imply that the aggregate production function will experience increasing returns to scale (Barro 1991).

Figure 2.8 illustrate a constant marginal product of capital. The production function is now a straight line as opposed to the curve in the Solow model. Saving is greater than required investment. The higher the savings rate, the bigger the gap of saving above required investment and the faster is growth. The concept of diminishing returns is changed. The assumption now is constant returns to scale of capital. There are substantial external returns to capital. Both physical and human capital is considered important (Dornbusch *et al.* 2004).

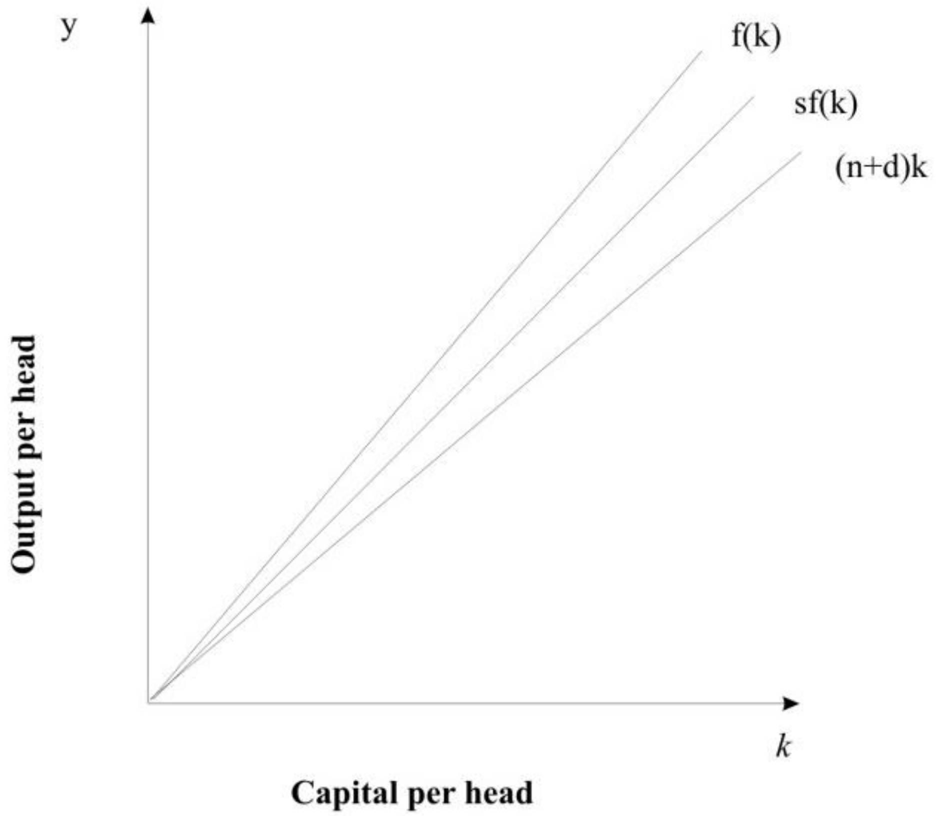


Figure 2.8: Endogenous growth model

Figure 2.8 also shows that a production function that does not incorporate diminishing returns remains a straight line function. This indicates that output per head can grow indefinitely so long as capital injected is increasing. The savings function (*sf(k)*) is always above depreciation *(n+d) (k)*, and as long as this is the case, net investment is taking place, which will increase the capital-labour ratio in the economy, and will therefore lead to growth (Barro 1991).

Kambhampati (2004) stated that technological progress arises from research and development (R&D) expenditure, which has a private return for the firm undertaking the investment and the economy, including those that do not undertake this investment. The returns to scale to the individual firm may be constant, but those accrued to the entire economy may be increasing. This sort of progress arises both from deliberate innovations which are undertaken by firms and from spill-overs from one firm to another.

There are no intrinsic characteristics of economies that cause them to grow over extended periods of time (Todaro and Smith 2009). All economies will converge to zero growth in the absence of technological advance. The Harrod-Domar and Solow models failed to explain technical change. The determinants of technological advance could not be analyzed. This was because the models were completely independent of the decisions of economic agents.

Endogenous growth theory seeks to explain the existence of increasing returns to scale and the divergent long run growth patterns among economies. A simple equation

$$Y = AK$$

is used to express most endogenous growth theories. *A* represents any factor that affects technology, while *K* represents both physical and human capital. There are no diminishing returns to capital in the formula. The possibility exist that investments in physical and human capital can generate external economies and productivity improvements that exceed private gains by an amount sufficient to offset diminishing returns (Dornbusch *et al.* 2004).

Human capital has considerable external benefits. Investment in human capital benefits directly, the individuals who undertake it, by increasing their earnings and quality of life.

Improved performance of the economy is another benefit that indirectly gets shared by other individuals in society at large. Where investment in education will have decreasing returns to private individuals undertaking it, it could have increasing returns to society overall.

According to Dornbusch *et al.* 2004 the endogenous growth theory has the following implications for growth:

- There is no force leading to the equilibrium of growth rates across closed economies. National growth rates remain constant and differ across countries, depending on national savings rates and technology levels.

- There is no tendency for per capita income levels in capital-poor economies to catch up with those in rich economies with similar savings and population growth rates.

These facts mean that a prolonged recession in one economy can lead to a permanent increase in the income gap between itself and wealthier economies.

The theory explains aberrant international flows of capital that aggravate wealth inequalities between developed and developing economies. It states that developing economies have potentially high rates of return on investment with low capital-labour ratios. However, these are eroded by lower levels of complementary investments in human capital, infrastructure or R&D (Ray 1998).

The endogenous growth theory explains technological change as an endogenous outcome of public and private investments in human capital and knowledge-intensive industries. Unlike the Solow model, the endogenous growth theory suggests an active role for public policy in promoting economic growth. This may be done through direct and indirect investment in physical and human capital formation. To explore the theory further, the Romer model is discussed.

(a) Romer endogenous growth model

This model addresses technological spillovers in the production process. Growth processes are considered to derive from the firm or industry level. Each industry individually produces with constant returns to scale. The economy-wide capital stock *k* positively affects output at the industry level. This leads to increasing returns to scale at the economy-wide level (Todaro and Smith 2009).

Each firm's capital stock is considered to include its knowledge. This part of the firm's capital stock is essentially a public good. According to Krugman and Wells (2006), a public good is a good that is both non-excludable and non-rival in consumption. By its nature, the producer cannot charge consumers.

The Romer endogenous growth model treats learning by doing as learning by investing (Todaro and Smith 2009). This type of endogenizing explains why growth might depend on the rate of investment. Todaro and Smith abstracted from the household sector, an important feature of the original Romer model as:

$$Y_i = AK_i^{\alpha} L_i^{1-\alpha} \overline{K} \beta$$

Where Y represents total output, A represents any factor that affects technology, K represents both physical and human capital, L represents labour, while β represents the per capita growth. According to this model, the possibility exists that investment in physical and human capital can generate external economies and productivity improvements that exceed private gains by an amount sufficient to offset diminishing returns. This would result in sustained long run growth.

Tordaro and Smith assumed symmetry across industries for simplicity, so that each industry would use the same level of capital and labour. This yielded the production function:

$$Y = AK^{\alpha+\beta} L^{1-\alpha}$$

A was assumed to be a constant rather than rising over time. No technological progress is assumed in this equation. The resulting growth rate for per capita income in the economy would be:

$$g - n = \frac{\beta n}{1-\alpha-\beta}$$

Where g is the output growth rate and n is the population growth rate. In the absence of technological progress, as in the Solow model with constant returns to scale, $\beta = 0$ and so the per capita growth would be zero.

The Romer endogenous growth model assumed a positive externality, that is $(\beta > 0)$. It is also given that $g-n>0$ and Y/L is growing. Therefore, the equation

$$g = \frac{n(1-\alpha)}{1-\alpha-\beta}$$

represents endogenous growth that is not given exogenously by increases in productivity. While technology plays an important role in the model, exogenous changes in technology are not necessary to explain long run growth. The emphasis that the model puts on investment in physical capital, among other factors, to achieve long run growth suggests that the endogenous growth theory is more relevant to explaining the growth phenomenon as it relates to the construction sector.

A major criticism of the endogenous growth theory is that it remains dependant on a number of assumptions of the Harrod-Domar and Solow models. Most of the assumptions are inappropriate for developing economies. Todaro and Smith (2009) cited the example that the theory assumes that there is but a single sector of production. They argued that this does not permit the crucial growth-generating reallocation of labour and capital among sectors that are transformed during the process of structural change.

In developing economies, growth is hindered by inefficiencies arising from poor infrastructure, inadequate institutional structures and imperfect capital and goods markets.

The endogenous growth theory does not take this into consideration. Therefore, its applicability for the study of growth is limited. However, it is worth noting that the endogenous growth theory is more applicable than the earlier theories.

The endogenous growth theory fails to explain low rates of factory capacity utilization in low-income countries where income is scarce. Allocation inefficiencies are common in economies undergoing the transition from traditional to commercialised markets. The impact of such inefficiencies on short and medium term growth is less understood because the endogenous growth theory only emphasizes the determinants of long term growth rates.

The endogenous growth theory distinguishes itself from the Solow and Harrod-Domar models by emphasizing that economic growth is an endogenous outcome of an economic system (Romer 1994). Its main distinguishing factor from the previous theories is that it does not view economic growth as being influenced by forces outside the system. The theory uncovers the private and public sector choices that cause the rate of growth of the residual to vary across economies.

2.3.4 Theoretical underpinning of thesis

The purpose of this section is to explain why growth theory is important for this research. The construction sector influences investment. According to Hillebrandt (2000), construction products are wanted, not for their own sake, but on account of the goods and services which they can create or help to create. Construction products, such as roads and factory buildings are considered as investment goods because they are used to create other commodities. Good transport infrastructure and the availability of factories attract investment into other sectors of the economy, such as manufacturing.

The construction sector also creates, builds and maintains the workplaces in which businesses operate. It builds the homes in which people live. It also builds schools and hospitals that provide the crucial services that society needs. Increased demand for construction inputs such as cement and steel influences investment in the manufacturing sector. The provision of infrastructure is vital for any economy to prosper.

In most economies, the construction sector provides about half the gross domestic fixed capital formation (Wells 1986). This, allied with the its approximately 10% contribution to the national output of most economies around the world (Hillebrandt 2000), suggests that the sector is too important to ignore. Economic growth theories since Harrod-Domar have shown the importance of investment in determining economic growth. More recently, both the Solow and the endogenous growth theories continue to attribute an important role of the construction sector to capital formation.

The construction sector is part of a unified system of production, consumption and distribution. It provides essential infrastructure to support other sectors of the economy, hence it is considered an investment sector. It is envisaged to play a role in influencing investment through capital accummulation. Apart from savings, capital and labour, the Harrod-Domar and Solow growth theories viewed growth as being influenced by technological factors which were exogenous to the models. Lately, the endogenous growth theory provided that over and above savings, capital and labour, economic growth was influenced by technological advance through deliberate actions of individuals within the economy. It is not just given as the Harrod-Domar and Solow models purported.

The three growth theories discussed here advance our understanding of the economic growth process as it relates to the construction sector. The contribution of construction products to capital formation is emphasized. The theories provide the intellectual framework for much of the debate over public policy aimed at making better use of the construction sector and promoting long run economic growth. Therefore, growth theory is considered relevant and appropriate for explaining the economic growth phenomenon as it relates to the construction sector. Thus, growth theory will be applied throughout the research in explaining the relationship.

2.4 Synthesis of construction and growth

The literature reviewed here show that so much of what has become popular thinking regarding the relationship of the construction sector to economic growth is mainly grounded in the power of argument of the major writers. The construction sector is considered as a driver of the economic growth process, without explaining what causes what to happen and why. The growth theories discussed here pointed to one or more of several contributing factors to the process of growth. The most important factors were identified to be capital accumulation, both physical and human, as well as technical progress.

The construction sector is considered an investment sector. This is because it provides the necessary infrastructure to support economic growth. The endogenous growth theory discussed in subsection 2.3.3 suggested that a higher level of capital accumulation by the economy as a whole raised the productivity for all individual firms. This increases the rate of return from investment.

However, it does not follow that providing incentives and increased spending on construction projects will necessarily lead to economic growth. The literature points to the significance of the construction sector in economic growth, but the exact nature of the relationship is still not clear. Theory is a powerful tool, without which, solving complex problems is all the more difficult (Christensen 2012). The relationship of the construction sector to economic growth is not obvious. Thus, applying the growth theory will help lead to more detailed insights of the relationship.

The relationship of the construction sector to economic growth can be traced back to the industrial revolution where it played a very important role in providing the much needed infrastructure. Most infrastructure projects affect the natural environment. Mankind requires houses, roads and buildings to work and socialise. In an empirical study to explore the role of the natural environment in supporting and contributing to growth, Everett et.al (2010) stated that new ideas and their transmission, in combination with the accumulation of labour and capital, have enabled sustained growth.

How is the natural environment related to construction? Land is considered a major factor in the production of buildings and infrastructure (Peng and Wheaton 1994). In its production processes, the construction sector also utilises a large amount of natural resources. The sustainability of the environments where construction activity takes place have in recent decades become very important. According to the World Bank (1994), any construction project should be economically and financially sustainable in terms of growth and efficient use of resources.

The production process in the construction sector has been shown to utilise labour as an important input. The quality of available labour is important for productivity. Better educated and trained workers learn faster and develop new ideas more easily. This facilitates technological advancement, which is a major factor in the growth process. In a survey to establish the precise connection between the industrial revolution and the beginnings of growth, Mokyr (2005) argued that economists had become accustomed to associate long-term growth with technological progress. These views were embedded in the Solow growth theory and more recently in the endogenous growth theory.

How is technological progress related to construction? Technological progress in the construction sector has been shown to entail advances in scientific and technical knowledge such as the construction of energy efficient buildings. It also involves improvements in the methods of organisation and management of construction projects. Technological progress is regarded as a key determinant in the growth process. Ofori (1994) observed that in the construction sector, technological progress embraced advances in materials, plant and machinery, organisation, procedures and information systems used in planning, designing, constructing, maintaining, repairing, altering and demolishing buildings and infrastructure. Innovation and invention in the construction sector is achieved through R&D as well as on-the-job-practice.

The Harrod-Domar theory, as did the Solow theory, regarded technology as an exogenous mechanism that made productivity grow. The endogenous growth theory viewed technology as being produced within the system by the rational and purposeful application of R&D, coupled with the growth of complementary human and physical capital. Is technology alone a prerequisite for growth? No. Everett *et.al* (2010) indicated that to achieve growth, technology, in combination with labour and capital is necessary. Mokyr (2005) provided that people are inherently innovative and that if only the circumstances were right, technological progress would be guaranteed. What circumstances was Mokyr referring to? According to Sloman *et.al* (2012), if growth is to be sustained over the years the key is growth in investment and productivity. Therefore, growth policies must be based on much broader considerations.

The importance of any sector in the economy can be estimated by examining the linkage effects it has with other sectors. It's profitability may be dependent on investments in other sectors. Ray (1998) argued that it is important to look beyond just the intrinsic profitability of sectors such as construction. Any sector of the economy may be considered important not because of its intrinsic profitability but because it spurs other sectors that are. While highway development might raise the demand for inputs that go into road construction, the main economic benefits could be in manufacturing and exports.

The construction sector uses inputs from other sectors in its production processes. This may include cement from manufacturing and fuel from the energy sector. The construction sector may also supply inputs to other sectors such as factories to manufacturing and road infrastructure to the energy sector. These links represent the backward and forward linkages that the construction sector has with other sectors of the economy. They reinforce growth and also help distribute benefits across sectors.

Of all issues facing policy makers today, none is so compelling as the question of economic growth. If anyone knew the exact combination of circumstances or factors that drive economic growth, there would be no LDCs by now. The next chapter reviews relevant literature and theory relating to state investment in the construction sector.

Chapter 3: Nexus of state and construction sector

The previous chapter gave a detailed account of literature on the relationship of the construction sector to economic growth. Clearly there is lack of common ground on the nature of the relationship and the theoretical reasoning that underpins it. This chapter explores how the public sector affects the construction sector.

3.1 Established views on state intervention

Governments and public sector agencies focus on the building of required infrastructure without considering any effects of their actions on the construction sector (Ganesan 1982). Making an investment in a building generates wages for those who produce it. In turn, this generates consumer spending among those wage-earners and so generates profits for manufacturers of consumer goods, and so on, right through the macro economy. The multiplier is an important concept for the construction sector because it explains why the sector sometimes is used to regulate the economy.

Given the fact that construction is labour-intensive, when the industry is working at full capacity, large sections of the nation's work force are normally active. However, the difficulty in managing the economy in this way is that when a boost is needed it is needed immediately and for a short or at least controllable period of time. For instance, it is no good beginning work on a multimillion rand office block to regulate the economy. The work will take too long to get underway and may be still too far to complete when government wants to apply brakes to the economy. The accelerator principle, demonstrates how investment goods are subject to larger fluctuations in demand than are the consumer goods to which they relate (Samuelson and Nordhaus 2001).

The debate on the relationship between the public sector and the construction sector is predominantly based on Keynesian economic philosophy. Keynesians emphasize the role of the state in developing the economy, as opposed to relying on market forces. When there is less spending in the economy, they advocate that government must intervene to create demand. Most governments intervene by making investment in the construction sector. The construction sector is favoured to channel such investments due to the characteristics that it exhibits. Government intervention through spending in construction activity makes up for the shortfalls in demand.

What causes shortfalls in demand? Lynn (2003) provided that both markets and the state have stake in influencing and shaping a country's economy. He said the failure of markets to function efficiently undermines economic performance, which negatively impacts demand. Businesses need to supply the optimal amounts of all goods and services demanded by society, otherwise too much or too little output gets produced. According to Todaro and Smith (2009), government can play a key role in addressing market failure. However, the appropriate role of government in the economy has been a subject for intensive debate. Such debate is important if we are to understand how the state affects the constrution sector.

Kambhampati (2004) pointed to the East Asian example of how an economy can succeed using highly selective and strategic government intervention. China, Hong Kong, Indonesia, South Korea, Malaysia, Singapore, Taiwan and Thailand all carry the historical legacy of a strong and economically active state. According to Fogel (2009) these economies all grew vigorously from 1965 on. A majority of these economies experienced vigorous growth throughout the second half of the twentieth century. Their growth rates far exceeded the previous growth rates of the industrialized world (Fogel 2009). The main argument is that selective state intervention played a major role in the economic progress of these economies.

What is selective state intervention? This refers to any type of intervention or government policy that attempts to improve the business environment or to alter the structure of economic activity towards sectors, technologies or tasks that are expected to offer better prospects for economic growth or societal welfare than would occur in the absence of such intervention (Noland 2004). Kambhampati (2004) explained that selective state intervention is best represented by the East Asian economies.

Is state intervention alone enough to overcome inefficiencies? According to the Panayotou (2003), economic institutions within which human activities are conducted are important. He argues that these institutions need to be designed so that they provide the right incentives. Such measures will not only promote greater efficiency in the allocation of resources at all income levels, but they would also assure a sustainable scale of economic activity (Arrow *et al.* 1995). In the context of the construction sector, this ensures that only needed infrastructure is built. Another important connection to be made between the discussion of a strong state and the construction sector is that construction activity is vital to the achievement of national socio-economic development goals of providing shelter, infrastructure and employment.

In their study of developmental states, Doner *et al.* (2005) argued that the political elites of the East Asian countries were compelled to build necessary economic institutions as they faced three fundamental challenges. First, the credible threat that any deterioration in the living standards of popular sectors could trigger unmanageable mass unrest. Second, the heightened need for foreign exchange and war materiel induced by national insecurity. Third, the hard budget constraints imposed by a scarcity of easy revenue sources. Therefore, economic institutions do not necessarily arise from conscious choices to enhance mutual welfare. Construction activity may result in externalities such as pollution. This presents the need for economic institutions that will compel all users of environmental resources to take account of the social costs of their actions.

The empirical analysis that Doner *et al.* (2005) did, revealed a causal mechanism through which systemic vulnerability actually produces developmental states. Side payments that the elites delivered to popular sectors led to the creation of new institutional capacities in South Korea, Singapore, and Taiwan. The institutions assisted in the implementation of policies designed to secure mass acquiescence such as land reform, advanced technical training, and subsidized public housing.

How do economic institutions influence the functioning of the construction sector? As indicated above, economic institutions can assist in compelling companies that engage in construction activity to take responsibility for their actions that have negative impacts on the natural environment such as pollution. They can also assist in combating corruption, which undermines the provision of public goods (Sohail 2008).

How do economic institutions emerge? According to Granovetter (1992), economic institutions do not emerge automatically in response to economic needs. They are constructed by individuals whose action is both facilitated and constrained by the structure and resources available in social networks in which they are embedded. This can be seen in many accounts from developing economies where firms would greatly reduce transactions costs but cannot be constructed.

Ray (2007) concurred with Granovetter in that economic institutions begin as accretions of activity patterns around personal networks. Their structure reflects that of the networks, and even when those are no longer in place, the institutions take on a life of their own that limits the forms that future ones can take. Therefore, economic problems and technology do not call forth organizational outcomes in some automatic and unconditional way. Rather, these economic conditions restrict what the possibilities are. Such restriction then triggers individual and collective action, which is channeled through existing personal networks to determine which possibility actually occurs.

What is the importance of economic institutions in the construction sector? Economic institutions in the construction sector are important in two ways (Oliver 1997): first, with respect to regulatory frameworks. Second, with respect to the allocation of resources. Oliver studied the influence of organizations' relationships to the institutional versus task environment on organizational performance in the Canadian construction industry. Regulatory stringency and resource stringency were proposed as key determinants of the relative importance of institutional versus task environment relations in predicting organizational profitability and productivity. Results favoured the contribution of task environment relations to organizational success in support of an economic or strategic perspective on organizations.

State intervention in the construction sector can take a number of different forms. The state may intervene through regulatory framework, investment in infrastructure or through welfare policy. The management of the state and the administrative structure of its agencies influence the form and scale of intervention.

The sheer size of the construction sector and the complexity of construction activity mean that a wide range of regulations and standards are required for it to function efficiently. This may be concerned with areas such as energy consumption, environmental risks, health and safety, and the quality of construction products. In a study that considered the relevance of environmental management to construction organizations, Kein *et al.* (1999) observed that construction activities had a myriad of environmental implications that must be regulated. State intervention is this regard enables organizations that comply to actively address environmental issues. The same would go for legislation that covers other areas of the construction sector such as health and safety.

The state may also intervene to regulate investment in infrastructure. In an empirical examination of the relationship between the quality of the regulatory framework and FDI in infrastructure, Kirkpatrick *et al.* (2006), found that the state may pursue policies to encourage private sector participation in the financing and delivery of infrastructure projects. However, in the light of natural monopoly characteristics of infrastructure utilities, privatization risked the creation of private-sector monopolies. Therefore, the state needed to develop strong regulatory capabilities to police the revenues and costs of the privatized utility firms. According to Kirkpatrick *et al.* this had to be done cautiously to ensure that regulatory credibility among investors was not undermined.

State intervention in the construction sector may also come in the form of investment in infrastructure or through welfare policy. The state makes investments in physical infrastructure and provide social services as a public good (Lynn 2003). The fact that most infrastructure represents a strong public interest means that the public sector must intervene in the interest of its citizens (World Bank 1994). However, the view that problems with the infrastructure delivery required state intervention allied with the faith that the public sector could succeed where markets appeared to fail is questionable. This debate is taken up in the next section that examines the role of the state in construction activity.

3.2 Role of public sector in construction

The purpose of this section is to discuss relevant literature on public sector intervention in the construction sector. As noted in the previous section, the investment aspect of public sector intervention in the construction sector is based on Keynesian economic philosophy, which emphasized the role of the state in the economy. A significant component of public sector investment in infrastructure goes into the construction sector. This will be examined further in chapter 5.

The suggestion that state intervention in the economies of the East Asian region led to the success of the transition of the region from LDC to NIC status is an important one. It would be of interest to establish which major sectors of the economy were used by these governments and the strategies that were used. This would help enlighten us as to the role that the construction sector might have played.

Kambhampati (2004) stated that the East Asian region has provided the most successful examples of transition from LDC to NIC status in the 20th century. It is increasingly being accepted that although the East Asian countries were certainly less interventionist than socialist economies, they were certainly more interventionist than early writers had suggested. More importantly, state intervention in these economies was highly selective and strategic. This meant that state intervention was more effective than in most other economies.

Following the political reforms of 1979, China has presented an interesting narrative regarding state intervention in the economy (Urata 2011). State-led growth in China has made it possible to finance expensive infrastructure developments. According to the OECD (2010), the core of state growth has come from local governments that have acted as both regulators and advocates of local enterprise growth. However, this has resulted in housing being unaffordable to middle and low-income households. State intervention in China also places challenges on the capability and integrity of administrative systems and their ability to respond efficiently to changes in demand.

India has also seen tremendous economic progress since the 1991 reforms (Urata 2011). Both China and India have experienced rapid growth over the past decade. In comparison with India, China is strong in the speed and extent of its infrastructure development but weak in its fostering of private companies. India has an edge in the sustainability of its competitiveness, owing to the advent of robust privately operated businesses but suffers from a shortage of infrastructure.

What is the role of the public sector in the construction sector? In a survey of the economics of development, Stern (1989) investigated how standards of living in the population were determined, how they changed over time, and how policy would be used in influencing these processes. In his findings, Stern asserted that the only role for the public sector should be to establish and preserve law and order and the defence of the realm. To go any or much further, he claimed, would constitute an unacceptable interference with freedom and liberty.

Ofori (1988) employed a chronological approach to study the role of the role of the construction industry in Singapore's economy between 1960 and 1986. He discovered that the government of Singapore used direct investment in construction to address inefficiencies in the economy. This established the infrastructure required and closed gaps left by the market system. But what was the impact of such government intervention on the construction sector?

In his empirical analysis of US economic policy, Reidl (2010) challenged the notion of government intervention in the economy. He provided that the economic theory behind the stimulus was founded on the work of Keynes. It began with the idea that an economic shock left demand persistently and significantly below potential supply. As people stop spending money, businesses pull back production and the ensuing vicious circle of falling demand and production shrinks the economy. The construction sector suffers demand shortfalls when this happen.

Keynesians believe that government spending can make up for shortfalls in demand. Their models assume that in an underperforming economy, government spending adds money to the economy, which creates demand. Employment opportunities provide income for workers to spend and circulate through the economy, creating even more jobs and income through the multiplier effect (Krugman in Keynes 2007). But what are the implications of this on the functioning of the construction sector?

Building on the work of Keynes, Mitchell (2005) undertook a comprehensive research to evaluate the impact of government spending on economic performance in the US. He provided that policy makers are divided as to whether or not government intervention was necessary. So, there is no conclusive evidence on whether public sector intervention helps or hinders the functioning of the construction sector.

The public sector intervenes in construction activity mainly to provide infrastructure. Among other factors, public sector interest in the provision of infrastructure is intended to safeguard the interest of the public. Infrastructure investment is a major issue in developing economies. A majority of them lack access to basic infrastructure such as electricity, water, roads (Freedman *et al.* 2009).

As provider of infrastructure, public sector intervention in the construction sector seeks to address inefficiencies of market failure. However, the delivery of infrastructure is riddled with both market and government failures. This leads to some contradictions as to the justification for public sector intervention. The next section examines the theory of market and government failure in the context of public sector intervention in construction activity.

3.3 Importance of private sector investment in construction

While this chapter focuses predominantly on the nexus of state and construction, it is worth mentioning that the private sector also plays an important role in the development and financing of infrastructure projects. The main feature of private investment is the public private partnership (PPP). PPP has been used in the UK to provide public facilities and services through the private finance initiative (PFI). Despite some challenges, PFI projects have been undertaken successfully.

PPP projects draw the public and private sectors together to share the risks and rewards. Such approaches range from simple contracting-out of services to the involvement of the private sector in the financing, design, construction, operation, maintenance and, in some cases, concessional ownership of major infrastructure facilities (Robinson *et al.* 2002).

According to HM Treasury (2000), the PPP procurement system is underpinned by public sector desire to resolve financial constraints in the provision of infrastructure projects. This is achieved by calling upon private management skills to increase the efficiency, effectiveness and quality of facilities and services delivery.

The private sector may get involved in one of several ways. This ranges from simple service provision without recourse to public facilities, through service provision based on public facilities usage, up to and including full private ownership of public facilities and operation of their associated services. The public sector of most economies believes that the PPP procurement system can provide a wide variety of net benefits for society. According to (Robinson *et al.* 2002), such benefits include enhanced public sector capacity, innovation in delivering public services, reduction in the cost and time of project implementation and transfer of major risk to the private sector. These benefits serve to secure value for money for taxpayers in the delivery of much needed infrastructure.

The essence of the PPP procurement system can be summarized as a long term contract arrangement between private and public sector entities. On the basis of input and output sharing, the private sector carries out the delivery of the infrastructure. However, it is not only the total level of investment that matters, but also how it is split between the public and private components (Khan and Kumar 1997).

Grimsey and Lewis (2002) argued that limitations upon the public funds available for infrastructure projects led governments to invite private sector partners to enter into PPP contracts. There is a need to ensure that value for money is achieved on the part of the public sector. To the project sponsors, such ventures are characterised by low equity in the project vehicle and a reliance on direct revenues to cover operating and capital costs, and service debt finance provided by banks and other financiers. Risk evaluation is complex, requiring the analysis of risk from the different perspectives of the public and private sector entities.

Therefore, PPP projects are viable only if a robust, long term revenue stream, over the period of the concession, can be established.

The private provision of infrastructure benefits society more when project risks are distributed appropriately between private and public sectors (Loosemore 2007). However, this is not easy. Infrastructure projects present technical, legal, political and economic risks. Such risks are easily under estimated and allocated to parties without the knowledge, resources and capabilities to manage them effectively. The result is increased costs, project delays and infrastructure that fail to deliver value for money to the community.

Clearly, many complex risks can interfere with the delivery of infrastructure projects through private sector investment. In both large and small PPP projects, risk management can be a challenge. Therefore, while the private sector may be keen to take over the traditional role of the public sector in financing, procuring and managing infrastructure delivery, some serious considerations of risk distribution between the public and private partners are essential. The role of the public sector in promoting and gauranteeing PPP projects is discussed further in the context of the SA construction sector in chapter 5, section 5.2.

3.4 Theory of market and government failures

The purpose of this section is to discuss the theoretical framework that underpins public sector intervention in the construction sector. There are some similarities between state intervention in the economy in general and state intervention in the construction sector in particular. The two will be considered separately, to ascertain if there are any similarities in the motivating forces for such intervention. A third dimension to the two arguments is also considered separately. This examines the counter arguments against public sector intervention in the construction.

3.4.1 General arguments for state intervention in any sector of the economy

This subsection discusses the rationale commonly used to justify public sector intervention in the economy. The public sector intervenes in the economy in the interest of improving society's welfare when markets fail. Why do markets fail? Krugman and Wells (2006) outlined three principal reasons:

(a) Spillover effects

Individual actions have side effects that are not properly taken into account by the market. In the context of the construction sector, a monopolist can manipulate the market price of construction goods and services in order to increase profit.

(b) Externalities

Actions of individuals sometimes have side effects on the welfare of other individuals that markets do not take into account. Pollution and traffic congestions are typical examples of externalities that are prevalent in the construction sector.

(c) Non-excludability

Some goods, by their very nature, are unsuited for efficient management by the markets. Infrastructure such as water and electricity are not easy for markets to limit people's access to and consumption.

Winston (2006), in his analysis of the empirical evidence on the economic impact of government policies to correct market failures, provided that economic theory identified many situations where a market failure may arise. He indicated that economic theory suggested ways of how the government could correct market failure and improve economic efficiency. Winston's empirical analysis revealed that potential market failures such as market power and imperfect information did not create large efficiency losses. However, he also found that market failures arising from externalities such as air and water pollution, hazardous wastes, and traffic congestion do impose significant social costs that government policy could reduce efficiently.

Can markets correct themselves? Winston (2006), as did Wolf (1979), found that market failure was less common and less costly than might be expected because market forces tend to correct certain potential failures. Winston observed that households' choices of where to live and work reflect efficient sorting to reduce the costs of congestion, airplane noise, and air pollution. He also found that commuters with long commutes had lower values of travel time than commuters with shorter commutes, indicating that those commuters who dislike congestion the most reduce its cost by living closer to their workplaces. According to Winston, people who had a high tolerance for noise tended to live closer to a flight path and required less compensation, as reflected in lower housing prices, than people who had a low tolerance for noise. It may be argued though that such sorting of market failure raises concerns of environmental justice, which also amounts to a different form of market failure.

Achieving an efficient and equitable level of resource allocation in the economy is a contestable issue when considering market and government failures. What exactly is market failure? According to Krugman and Wells (2006), market failure refers to the negative consequencies of the individual pursuit of one's own interest, which make society worse off. It is the idea that in certain cases free markets will not produce an efficient outcome (Weil 2009). Samuelson and Nordhaus (2001) identified that there are externalities that may manifest themselves outside the marketplace as positive externalities such as scientific discovery. They also identified negative spillovers such as pollution. There are no measures in the market mechanism to address such notions of market failure.

Weil (2009) presented a similar view on the existence of externalities that justify public sector intervention in the economy in general. He observed that there were positive and negative externalities. He indicated that positive externalities such as technological advance influenced the public sector to support R&D, while negative externalities such as pollution required the public sector to intervene with appropriate legislation to limit such externalities.

What legitimizes the state to intervene in a free market economy? Keynesians advocate that it is necessary for the public sector to intervene in the economy to ensure that the markets for individual products and services work efficiently (Harrod 1948). They believe that public sector spending can make up for shortfalls in private demand. Their models assume that in an underperforming economy, public sector spending adds money to the economy which stimulates activity.

Samuelson and Nordhaus (2001) argued that the existence of market failures meant that markets did not always lead to the most efficient outcome. The market system alone cannot increase the economic welfare of anyone without making someone else worse off. Lynn (2003) stated that there are cases where a more direct public sector intervention would be superior to imperfect markets. This suggests that the existence of a free market does not necessary eliminate the need for the public sector to play a role in the economy.

Is public sector involvement necessary? Sometimes it is. According to Krugman and Wells (2006), markets can fail to be efficient, which leads to market failure. Weil (2009), in his study of economic growth, stated that the question of government's proper role in the economy in general is one of the oldest. He provided that proposed answers ranged from a vision of minimal government interference to complete government ownership of the means of production. Lynn (2003) provided that apart from market failures, the most widely accepted case for government intervention is for public goods. Although Lynn separated this, but the fact that markets fail to provide public goods is in itself a market failure.

Why does the market mechanism fail to provide public goods? Todaro and Smith (2009) observed that most public goods have a high social value that is not reflected in their market price. Public goods such as education, defence and health services must be provided at a price below their cost, which makes them unattractive to the private sector. The public sector therefore intervenes in order to ensure a minimum welfare.

Does the public sector need to provide public goods in order to ensure minimum welfare? Not necessarily. Whilst public sector intervention may be necessary when an externality problem arises, it does not necessarily mean that the public sector must make investments to avert the externality. Perloff (2007) argued that the public sector may regulate an externality through laws that make polluters, for instance, liable for the damage they cause.

Is the existence of market failure a sufficient reason to justify public sector intervention in the economy? Probably not. Datta-Chaudhuri (1990) analysed market failures and found that there were counter arguments of government failures. What are government failures? Samuelson and Nordhaus (2001) defined government failure as a phenomenon in which government intervention lead to waste. They found that government can make bad decisions or carryout good decisions badly. Inefficiencies that arise through incompetence, malfeasance or just plain politics can undermine an otherwise positive intervention by the public sector in the economy.

How does the public sector intervene in the economy? Does it help? The public sector intervenes in the economy mainly through regulation, investment in infrastructure and provision of public goods (Weil 2009). Datta-Chaudhuri (1990) argued that ill-conceived government intervention and the implementation of counter-productive policy measures may lead to wasteful use of resources in the economy. Public sector intervention in the economy needs to be informed by an understanding of market performance and also an understanding of the capacity of the public sector to formulate and implement policies that would improve efficiency (Winston 2006). Arguments for or against public sector intervention fail to explain whether or not such intervention helps or hinders the functioning of the economy.

What kind of public sector intervention in the economy is necessary? Lambsdorf (2002) identified three major considerations to be made on whether the public sector has any reason to intervene in the economy. First, is there evidence of a serious market failure to correct? Second, is the intervention reducing the economic inefficiency? Third, is the intervention efficiently correcting the market failure and maximizing economic welfare?

Market failures, among other factors, have been used to justify public sector intervention in the economy. The inability of a free market to deliver public goods deemed to be in the public interest are common and require government intervention to provide the public good and make it available to all citizens. However, proponents of the free market system argue that public sector intervention causes a more inefficient allocation of goods and resources through government failures. What then? Is public sector intervention unnecessary? Not necessarily.

Friedman (2002), in his empirical study of public sector policies designed to address market failures, found that where markets work they were the most efficient means of meeting the needs and preferences of individuals and firms. He identified public goods, externalities, and information problems as major reasons why markets may not work efficiently. For example, sanitation is non-excludable and its use will not reduce its availability to others. This subjects public goods to being under-produced, overused and degraded. Although Friedman acknowledged that on the strength of these reasons there may be a case for public sector intervention, but he vehemently questioned government’s role in most sectors of the economy.

The justification of public sector intervention in the economy on the basis of market failure tends to overlook the argument around potential government failures. An empirical study on corruption and reform revealed that in some instances government failure occurred because public sector intervention was unnecessary (Lambsdorff 2002). This suggests that government intervention can be counter-productive. Lambsdorf concurred with Friedman (2002) in that market failure policies may be poorly implemented by the public sector. Irrespective of the intentions, policy makers may be subject to political forces that enable certain interest groups to benefit at the expense of the public.

Is evidence of a market failure a necessary and sufficient condition to justify public sector intervention? Schultze (1977), in his seminal work on the public use of private interest, raised doubts about the effectiveness of government policies based on the limited empirical evidence that was available. He raised concern that empirical evidence suggested that policy makers had attempted to correct market failures with policies designed to affect either the consumer or firm behaviour. He observed that these policies forced the economy to incur costs in situations where no serious market failure existed. While market failure provides the rationale for public sector remedies, the remedies may themselves fail for reasons similar to those accounting for market failure (Wolf 1979).

Winston (2006), in his analysis of the empirical evidence on the economic impact of government policies to correct market failures, provided that economic theory identified many situations where a market failure may arise. He indicated that economic theory suggested ways of how the public sector could correct market failure and improve economic efficiency. Like Schultze (1977), Winston's empirical analysis revealed that potential market failures such as market power and imperfect information did not create large efficiency losses. He however also found that market failures arising from externalities such as air and water pollution, hazardous wastes, and traffic congestion do impose significant social costs that public sector policy could reduce efficiently.

Does public sector intervention correct market failure? Chari *et al.* (2008), in their working paper on the facts and myths about the financial crisis of 2008, questioned the justification of public sector intervention on the basis of market failure. They argued that public sector intervention was unnecessary because market failures were by nature self-correcting. Their analysis also asserted that public sector intervention in the economy may be associated with inefficient policies that allow well-defined interest groups to accrue economic rents. It can be argued that the suggestion that market failures are by nature self-correcting may be questionable. Krugman and Wells (2006), as did Weil (2009), advocated that in the light of market failures, it was necessary for the public sector to intervene in the interest of the welfare of its citizens. The two arguments point to the fact that while public sector intervention is important to correct market failure, a counter argument exists in the light of government failures. Therefore, there is no conclusive evidence that public sector intervention can help address market failure.

3.4.2 General arguments for state intervention in the construction sector

The public sector and its agencies have notable influence in the construction sector. Why does the public sector intervene in the construction sector? Like in any sector of the economy, as discussed in the previous subsection, the market system does not always work. Jimenez (1995) argued that economic theory justified public sector intervention in construction activity. His focus was on the provision and use of infrastructure. He justified public sector intervention on the grounds of market failure.

Like Jimenez (1995), Myers (2013), in his textbook on construction economics, stated that certain circumstances in the market system may hinder productivity and efficiency of construction activity. He identified monopolies, oligopolies, subsidies, trade uninions, externalities, high transaction costs and other market imperfections as market distortions that undermine the functioning of the construction sector. These distortions result in market failure.

What are market failures in construction? According to Myers (2013), market failure refers to a situation where the free forces of supply and demand lead to either an under- or over-allocation of resources to a specific economic activity. Where market failure exists in the construction sector, the marketplace is characterised by the unrestricted price system. This causes to few or too many resources to be allocated to a specific economic activity. While the modern market economy seeks to be productive and efficient, it fails to efficiently provide public goods that are consumed collectively. Such goods may include sanitation, schools, clinics and transport infrastructure such as roads.

Jimenez (1995) identified the following traditional notions of market failure relating to the construction sector:

(a) Externalities in consumption and production

When one individual's consumption affects the well-being of others, the individual should be induced by public action to consider the social rather than just the private costs and benefit of his or her behaviour. In the case of the construction sector, most of these effects may include congestion and pollution. Infrastructure such as roads may result in externalities associated with damage to users caused by other users, that is, vehicles cause potholes which cause damage to other vehicles.

(b) Scale economies

Infrastructure investments entail large fixed costs. It is argued that this makes it difficult for the private sector to finance. Hence, the public sector is considered justified to intervene in the interest of its citizens. The high initial costs involved are often used by the private sector to justify natural monopolies and other forms of imperfect competition that enable large firms to rig markets and keep prices artificially high. However, if one takes into consideration scale effects, infrastructure delivery at lower than average costs may be possible. Apart from intervening as provider, the public sector may intervene through legislation that promotes fair competition and pricing of services.

(c) Non-excludability

Transport infrastructure such as roads have traditionally been thought to be too non-exclusionary for a private market to work well. This still applies to most developing economies, although the setting up of private toll roads in developed economies has led some to reconsider this proposition.

(d) Information problems about benefits and costs

Information regarding all infrastructure services needs to be disseminated to all citizens. Consumers cannot be expected to gather enough information to make informed decisions about the kind of housing subsidies or grants available.

(e) Achieving socio-economic objectives such as poverty alleviation

The public sector may have objectives other than narrowly defined effectiveness and cost-efficiency criteria. One is poverty reduction (Sohail *et al.* 2007). In their case study of the link between corruption and poor people's inaccessibility to infrastructure services, Sohail *et al.* found that the provision of infrastructure had been the centre stage in most government policies as a way for the poor to enhance their capacity to take advantage of income-earning opportunities.

The public sector, like markets, is imperfect. While its role in infrastructure provision is inevitable, the activities that it undertakes to correct market failure are undermined by government failure. What is government failure in construction? According to Myers (2008), government failure is the concept that public sector policy intervention in the construction sector may not necessarily improve construction efficiency. The public sector undertakes certain measures in the construction sector in order to achieve welfare goals not gauranteed by the market system.

How does the public sector intervene in the construction sector? The public sector intervenes mainly through investment in infrastructure. This means that the public sector can influence construction prices, resource allocation and total construction output. As indicated earlier, the main reason for such intervention is to correct market failure. However, such intervention may have unintended consequencies that manifest themselves as government failures, such as rent seeking and corruption.

Why does the public sector intervene through investment in construction? The construction sector is favoured because of the characteristics that the sector exhibits. Amongst other things, the construction sector is characterized by the unique features of its output, its sheer size and the variety of technologies that it employs (Wells 1986). Most construction output products have a long life span, they are large, and cannot be moved. According to Hillebrandt (2000), towards the end of the twentieth century, construction output worldwide was estimated around \$3 000 billion per annum. This constituted a construction share of about 10% of global GDP.

The construction shares of GDP for various regional economies as of 1990 were: Western Europe 30%; Asia 28%; North America 25%; Eastern Europe 7%; South America 5% and Africa, Middle East and Oceania just under 2% each (Hillebrandt 2000). While concurring with these figures, the International Labour Organization (ILO 2001) asserted that the highly uneven distribution of construction output was a reflection of global inequality in income. In their analysis, the ILO also attributed the uneven distribution of construction output to the fact that construction products were expensive. They suggested that LDCs found it difficult to finance construction projects, which caused significant infrastructure backlogs in their economies. It was also observed that economies with large savings or capacity to borrow found it easy to finance construction projects.

More recent figures indicate that the construction shares of GDP for the same regional economies as of 2012 were: Western Europe 5%; Asia 6%; North America 5%; Eastern Europe 6%; South America 6% and Africa, Middle East and Oceania about 6% each (United Nations 2012). In 1990, the average construction share of GDP for all regions was 16% (Hillebrandt 2000). Hillebrandt's analysis was the same as the one done by the UN. In 2012, the average construction share of GDP for all regions declined to only 6% (United Nations 2012). It is of interest to note that the uneven distribution of construction output that was observed in the 1990 figures had declined significantly in 2012. Also, the construction shares of GDP for Western Europe, Asia and North America declined from an average of 28% in 1990 to an average of only 5% in 2012.

The decline in the average construction share of GDP for all regions from 16% in 1990 to 6% in 2012 can be associated with the fact that as economies grow, the construction share of GDP changes. The construction sector provides infrastructure. In LDCs more infrastructure is needed hence the construction share of GDP will be high. As economies grow from LDC stage to NIC stage, the construction share of GDP will increase and reach its peak. It then declines as economies transition to the AIC stage of growth.

The public sector interest to invest in construction activity was motivated by the notion of significance attached to the construction sector. Why is the construction sector considered significant? Hillebrandt (2000) contended that whatever measure is used to estimate the value of the construction sector, an industry which produces such a large component (10%) of GDP was of great significance to the economy.

More recently, Myers (2013) propounded that a broader definition of the construction sector was inevitable. He contended that the Standard Industrial Classification (SIC) and the International Standard Industrial Classification (ISIC) limits construction output to estimating the activities of firms that construct and maintain buildings and infrastructure. In his view, the construction setor includes manufacturers of building products, equipment and components, and the various professional services provided by architects, surveyors, engineers and property managers. With this broad definition, Myers estimated that the construction sector accounts for about 15-16% of total annual GDP globally.

Apart from the economic significance placed on the construction sector, public sector intervention in is also intended to correct market failure. Gruneberg (1997) observed that historically such correction was done through legislation. More recently, Myers (2013) suggested that correction was increasingly sought through influencing prices and knowledge, as well as investment in infrastructure. What are the core market failures that the public sector seeks to correct through investment in construction activity? The provision of infrastructure, such as highways, airports, sanitation, schools and healthcare facilities poses multiple market failures (Guo *et al.* 2006). Equally, public sector intervention to correct such failures poses multiple government failures.

The primary market and government failures are related to public goods properties, sunk costs, market power and externalities (Helm 2009). Most infrastructure form part of networks and systems. These systems tend to be public goods. By their nature, once public goods are in place, the marginal costs of another consumer tend towards zero. This maximizes the economic welfare as it provides the public good to as many consumers as possible, with marginal incentives which reflect the marginal and not the average costs.

The problem that arises then is how to recover the fixed and sunk costs incurred in developing the infrastructure without creating distortions to consumption? Historically, one solution has been to recognise that the provision of much infrastructure has monopoly or market power elements (Cavaliere and Scabrosetti 2008). The investor can in principle, therefore, rely on their monopoly to exploit customers so as to recover the sunk costs. For example, road and bridge tolls are used in the development of roads.

According to Helm (2009), monopoly in the construction sector brings two problems. First, it may not last because technical progress may cut away the market. Second, it leads to political and regulatory intervention. With long-lasting assets, investors would need long-lasting market power to match their sunk costs. It may be argued that monopoly provides the seed of its own destruction. For most network systems, cherry-picking of customers is an attractive option. Entrants choose to service only those parts of the market where marginal costs are lowest, and to avoid correspondingly high-value customers. This, in turn, drives the incumbent to charge greater proportions of their fixed costs to those customers less attractive to entrants (Krugman and Wells 2006).

Helm and Tindall (2009) observed that externalities are pervasive in infrastructure. They identified that externalities fall into two broad categories, that is, environmental and social. Environmental externalities include pollution and land use. For example, a new runway or airport will raise greenhouse gas emissions and increase local air pollution. This will result in significant water runoff, significant noise affecting local people and their house prices, and take up land which can often include areas with considerable biodiversity value, such as marshes and open spaces. Pricing each and every externality is can be a very complicatded process. The fact that decisions on infrastructure are based on politics and planning, mean that they are open to political and regulatory failures.

Social aspects of infrastructure arise not only in the allocation of the fixed costs between customer groups, but also in respect of wider concerns about inclusiveness and access to essential services. Infrastructure is a core aspect of the provision of basic social goods which are essential for society to participate in. This includes health facilities, schools and transport infrastructure. No civilised society can be indifferent to these dimensions. People may die if they do not have access to hospitals and transport facilities. Therefore, it is inevitable that governments will want to influence the provision of infrastructure.

What form of public sector intervention is necessary in construction? Peacock *et al.* (1995), in their study of construction and development in Vietnam, observed that in any country, the main roles of the public sector in relation to the construction sector included:

- Acting as client for all public sector work
- Controlling all land use
- Stimulating appropriate development
- Controlling the environmental impact of development
- Participating in development of appropriate industry practices and procedures
- Endorsing appropriate standards for materials, workmanship and construction work and for safety, health and welfare in construction
- Monitoring compliance with planning and building requirements and, where appropriate, applying sanctions for non-compliance
- Providing facilities for, and supervising, education and training
- Encouraging construction research and the international exchange of information and of individuals
- Watching over the development of the construction industry and promoting its efficiency.

The provision by the public sector of infrastructure such as schools ensures that everyone in society has access to education which has a strong social benefit. In a free market, the provision of such infrastructure may be patchy and unequal. Negative externalities such as pollution may occur as a result of a construction firm's methods of production, such as burning coal as an energy source. If the public sector intervenes by taxing such production methods and uses the subsidy to encourage the use of environmentally friendly sources of energy, there is a net gain in social welfare.

What kind of public sector involvement is essential and what kind is optional? Myers (2013) and Gruneberg (1997) were in agreement with Jimenez (1995) in that the existence of market failures justified public sector intervention in the construction sector. However, Hillebrandt (2000) asserted that demand for construction products was dependent mainly on the state of the economy and public sector policies. Therefore, while public sector intervention in construction activity to correct market failures might seem essential, it was apparently not the only reason. Jimenez (1995), Samuelson and Nordhaus (2001), Lynn (2003), Krugman and Wells (2006), Perloff (2007), as well as Todaro and Smith (2009) advanced several reasons for public sector intervention. They also argued that such intervention might also be hampered by the existence of government failures. Table 3.1 summarises the market failures and government failures that they identified in relation to construction activity.

Table 3.1: Market and government failures in the construction sector

Market failures	Government failures
(a) Inequality and inefficiency in production and allocation of public goods	(a) Abuses of power and corruption in procurement
(b) Negative externalities such as pollution in construction sites	(b) Low-quality construction products
(c) Scale economies such as sanitation and roads	(c) Inefficiency delivering infrastructure
(d) Non-excludability such as parks and landscaping	(d) Politicians, bureaucrats and others acting on behalf of the 'public' may act in their own self-interest as 'utility maximisers'
(e) Information problems about	(e) The 'invisible hand' may not work in the provision of public goods such as mass transit

Market failures	Government failures
benefits and costs of construction products	systems
(f) Achieving socio-economic objectives, e.g. job creation	(f) Rent seeking – where decisions are made leading to resource allocation that maximises the benefit to the decision maker at the expense of other parties
(g) Common property such as parks	(g) Log rolling – where decisions may be made on resource allocation to projects that have less importance in return for the support of the interested party in other decision making areas
(h) Public commodities	(h) Insufficient power to make decisions on key infrastructure due to beareaucracies
(i) Lack of markets	(i) Distortion of markets – e.g. rent control, minimum wage, taxes on fuel and building material prices
(j) Distortions in capital markets	(j) Welfare impact – erosion of consumer surplus and producer surplus
(k) Safety	(k) Disincentive effects – high taxes hampering business expansion or enterprise and welfare benefits reducing the incentive to find work
(l) Monopoly, market power and price gouging	(l) Short termism – solving the 'hot topics' of the day rather than the long term important issues – e.g. ID cards versus addressing schooling facilities
(m) Corporate welfare	(m) Electoral Pressure - desire to get elected and pass 'popular' policies to capture votes, e.g. spending on public services at the risk of higher inflation and future interest rates
(n) Industrial waste	(n) Impact on the environment - e.g. building new motorways rather than investing in public transport
(o) Over-prescription of drugs	(o) Regulatory capture - regulatory agencies become dominated by the firms they are supposed to be regulating
(p) Defective equipment	(p) Imperfect information - lack of knowledge of prices, value, costs, benefits, long term effects, behavioural changes, external costs and benefits, value of producer and consumer surplus. All mean less than efficient allocation may result from government intervention
(q) Oil spills	
(r) Rainforest destruction, ozone depletion and global warming	
(s) Insurance companies	
(t) Labour exploitation, animal abuses, unhealthy food and child manipulation	
(u) Media and advertising	
(v) Minimum wage	
(w) Path dependency	
(x) Collusion and planned obsolescence	
(y) Recessions and depressions	
(z) Fraud and abuse	
(aa) Cheap building material	
(bb) Unnecessary infrastructure	
(cc) Property rights	
(dd) Unstable markets	

Source: Adapted from Jimenez (1995), Samuelson and Nordhaus (2001), Lynn (2003), Krugman and Wells (2006), Perloff (2007), and Todaro and Smith (2009)

Each of these market and government failures may impact on the functioning of the construction sector in one of many ways. In a study of public sector versus private sector provision of infrastructure, Bennett and Johnson (1979) found that there were incentives inherent in private enterprises that were typically absent in public enterprise. Such incentives lowered the costs of produced goods and services that were collectively consumed. If left to private producers, infrastructure such as water and electricity can be sold to consumers at unreasonable prices. A large proportion of citizens, especially in developing economies would have difficulty accessing such infrastructure. The public sector must therefore intervene to correct such market failures.

The inability of private firms to provide infrastructure such as roads, schools, hospitals and sanitation are externalities of market failure that make it necessary for the public sector to intervene and provide such infrastructure. The public sector intervenes in an attempt to provide public service and public goods which the private sector cannot provide, given the scale at which they are demanded. The public sector also has an obligation to ensure the welfare of all its citizens. This involves ensuring that benefits and costs in the construction sector are efficiently distributed.

From the many government failures as listed in Table 3.1, Sohail and Cavill (2006) singled out corruption and examined how it affects infrastructure delivery. They observed that institutional channels of accountability, such as, an independent judiciary, parliamentary oversight and anticorruption commisions had the potential to combat corruption and facilitate improved outcomes in infrastructure provision. Table 3.2 outlines the common forms of corruption that Sohail and Cavil identified as rampant in infrastructure delivery at the various stages of a construction project.

Table 3.2: Typical examples of corruption in infrastructure delivery

Stage of service delivery	Example of corruption
Project selection	- Corruption can negatively affect the selection of projects. For example, corruption can divert resources away from social sectors and toward major infrastructure projects. - Corruption may also encourage the selection of uneconomical projects because of opportunities for financial kickbacks and political patronage.
Planning stages	- Project used as vote winners/opportunities for personal gain not on basis of priority/availability of financial resources. - Planning in favour of high value infrastructure (white elephant projects) and against the interest of the poor. - Project requirements may be overstated or tailored to fit one specific bidder.
Inspection stages	- Weak oversight and supervision mechanisms have been created that would prevent detection of fraud and corruption. - Kick-backs can be given to persuade inspectors to turn a blind eye to slow implementation of projects, unfulfilled contract requirements, and other instances of malpractice.
Design	- Corrupt selection of consultants for feasibility studies, preparation of specifications/bid documents. - Over designed and overpriced projects to increase potential corrupt earnings during implementation. - Bribe for favourable environmental impact assessment/planning proposal/approval. - Project design has been manipulated to benefit particular suppliers, consultants, contractors, and other private parties. - The timing of the project has been altered to suit vested interests.
Bid and contract signing stage	- Political parties levy large rents on international businesses in return for government contracts. - Officials take percentages on government contracts. - Officials receive excessive "hospitality" from government contractors and benefits in kind. - Kickbacks for construction and supply contracts. - Lack of competitive/inequitable contract practices. - Inappropriate bidding procedures; excessively short bidding time or insufficient or inadequate advertising of tender. Corrupt practice on the part of bidders (e.g. unjustified complaints, misleading bids etc). - Collusion among firms or between public officials and bidders.
Construction	- Changing subcontract party after receiving bribes. - Cutting corners, ignoring rules, by passing procedures. - Payment for equipment, materials or services which were not supplied. - The provision of equipment or goods of lower then specified quality (typical examples include lesser cement or steel reinforcements). - Concealing substandard work. - Bribe the relevant official to certify that the work was done according to specification. - Non-implementation. - Unjustified complaints from contractors as a way to obtain unjustified contract price increases. - Duplication of payments, alteration of invoices, lack of supporting records, ineligible payments, overbilling, misuse of funds (i.e. for purposes other than those aligned to project needs), misappropriation of discounts from suppliers/contractors, unauthorised payments etc. - Unauthorized use of project property. - Theft of materials, equipment or services.
Service delivery	- Ghost/absent workers. - Siphoning off supplies to market. - Favouritism in hiring/promotions. - Use of contacts/money to get better/faster service or to prevent delays. - Elite capture of infrastructure services
Maintenance and management stages	- Corruption in procurement of equipment and spare parts. - Withholding needed approval/signatures of gifts/favours.

Stage of service delivery	Example of corruption
	- Corruption increases costs meaning lack of resources for operation and maintenance (O&M). - Bribes to win O&M contracts/ personnel appointments. - Lower standard of construction creates need for expensive repair and maintenance.

Source: Sohail and Cavill 2006

As illustrated in Table 3.1, government failures may manifest themselves in one of different ways. Amongst other things, they may be reflected in various forms of corruption as discussed above. Infrastructure programmes and public sector policies that are intended for helping the poor may end up benefitting the more affluent members of society. According to the Construction Industry Development Board (CIDB 2008) of South Africa, in projects where corruption is prevalent, large-scale construction firms benefit more than small-scale construction firms from public sector infrastructure programmes that seek to support emerging construction firms in developing economies. To maximize their gains, the large-scale construction firms collude with public sector officials to inflate construction prices.

What causes the lack of accountability on public officials? According to Raga and Taylor (2005), public officials are expected to be accountable to their immediate superiors, the political leadership and the public at large. Public accountability rests on giving an account and on being held to account. However, the problem with being held to account is that it may be used to outmanoeuvre political rivals. How then can accountability be used for positive purposes in the public sector? How do government departments related to the construction sector achieve efficiency, effectiveness, responsiveness and transparency? What is the effect of unethical behaviour in the construction sector?

Government failure such as corruption compromises the extent to which infrastructure gets delivered to poor communities that need it the most. It results in the delivery of infrastructure projects that are unnecessary, unsuitable, defective or even dangerous to the public (Estache and Kouassi 2002 in Sohail and Cavill 2006). Resources are diverted towards large capital-intensive infrastructure projects. This significantly affects poverty reduction. It also increases the cost of public services, lowering their quality and often all together restricting poor people's access to such essential services as water and sanitation (Sohail and Cavill 2006).

Market failure is used as the main justification for government involvement in the construction sector. It is presumed that when competition is imperfect, the consequent market failures can be corrected by the public sector. However, some contradictions emerge. Self-interested market participants may not have the capacity to correct the inefficient allocation of costs and benefits in the construction sector. Where the public sector intervenes, policy makers may have neither the appropriate incentives nor accurate information to correct market failures. Therefore, while there is no concensus on the optimal form of public sector intervention, clearly, the various notions of market failure discussed provide a prima facie case for considering public sector intervention in the construction sector.

3.4.3 Counter arguments against public sector intervention in construction

Market failures, among other factors, have been used to justify public sector intervention in the construction sector. However, proponents of the free market system argue that public sector intervention causes a more inefficient allocation of goods and resources through government failures. Does public sector intervention improve market performance? Does it correct market failure? Does it maximize economic welfare?

Friedman (2002), in his empirical study of public sector policies designed to address market failures, found that where markets work they are the most efficient means of meeting the needs and preferences of individuals and firms. He identified public goods, externalities, and information problems as major reasons why markets may not work efficiently. Although Friedman acknowledged that on the strength of these reasons there may be a case for public sector intervention, but he vehemently questioned government's role in most sectors of the economy including the construction sector.

Is evidence of a market failure a necessary and sufficient condition to justify public sector intervention? Schultze (1977), in his seminal work on the public use of private interest, raised doubts about the effectiveness of government policies based on the limited empirical evidence that was available. He raised concern that empirical evidence suggested that policy makers have attempted to correct market failures with policies designed to affect either the consumer or firm behaviour. He observed that these policies forced the economy to incur costs in situations where no serious market failure existed. While market failure provides the rationale for public sector remedies, the remedies may themselves fail for reasons similar to those accounting for market failure (Wolf 1979). Therefore, it is difficult to justify public sector intervention on the basis that there is evidence of a market failure.

Does public sector intervention correct market failure? Chari *et al.* (2008), in their working paper on the facts and myths about the financial crisis of 2008, questioned the justification of public sector intervention on the basis of market failure. They argued that markets can correct themselves, which makes public sector intervention unnecessary. Their analysis also cited that government intervention may be associated with short-sightedness, inflexibility, conflicting policies of government agencies, political forces that allow well-defined interest groups to influence elected and unelected officials to initiate and maintain inefficient policies that enable the interest groups to accrue economic rents. Whether or not public sector intervention can correct market failure remains a subject for debate.

The justification of public sector intervention in the construction sector on the basis of market failure tends to overlook the argument around potential government failures. An empirical study on corruption and reform revealed that in some instances government failure occurred because public sector intervention was unnecessary (Lambsdorff 2002). This means that government intervention can be counter-productive. Lambsdorf (2002) concurred with Friedman (2002) in that market failure policies may be poorly implemented by the public sector. Irrespective of the intentions, policy makers may be subject to political forces that enable certain interest groups to benefit at the expense of the public.

Does the use of government agencies help in solving social problems of market failure? Khan and Sokoloff (2001), in their study of intellectual property institutions, found that although government agencies may strive to solve social problems, they may contribute to policy failures as a result of short-sightedness, inflexibility, and conflicts. They argued that some policies may be a well-intentioned response to an economic crisis, but some policymakers lacked the vision to modify or eliminate policies that are counter-productive. Is the use of antitrust authorities productive? In the construction sector, antitrust agencies are used to prohibit illegal practices such as price-fixing conspiracies and predatory acts designed to achieve or maintain monopoly power. According to Winston (2006), antitrust authorities find it difficult to formulate consent decrees in monopoly and merger cases that benefit consumers in the long run. He also asserted that when viewed in their totality, market failure policies often conflict: policymakers want to use the antitrust laws to promote competition, but they enact policies that are not justified on market failure grounds. Difficulties in resolving inter- and intra-agency policy conflicts make it all the more difficult for antitrust agencies to deal with market failure.

More recently, Reidl (2010) identified the following reasons for failure:

- Positive & negative externalities
- Short-term and long-term environmental concerns
- Lack of public goods
- Under-provision of merit goods

- Over-provision of demerit goods
- Information gaps and asymmetries
- Abuse of monopoly power
- High levels of relative poverty

Is market failure sufficient to justify public sector intervention in the construction sector? According to Weil (2009), it is a question of degree. The reasons for public sector intervention may not be sufficient to justify the degree of intervention at one point or another. Market failures in the construction sector include externalities such as pollution and traffic congestion. Whilst it may be justifiable for the public sector to intervene to minimise the impact of market failures, it is of interest to establish if the problem of the existence of government failures does not reduce the usefulness of such intervention.

What is the fundamental impact of public sector investment in construction? Building on the work of Keynes, Mitchell (2005) undertook a comprehensive research to evaluate the impact of government spending in the US. He provided that policymakers are divided as to whether government intervention in the economy helps or hinders the functioning of sectors such as construction. Most governments intervene in the economy through infrastructure investment on the assumption that it maximises job creation and investment in other sectors of the economy through the multiplier effect. In the light of government failures, Reidl (2010) raised some scepticism over such intervention by the public sector.

Clearly, while public sector intervention in construction is arguable necessary to deal with market failures, this may be shadowed by government failures. Wells (1986) identified some difficulties that arise when governments attempt to act to secure a more efficient construction sector. She argued that attempts to stabilise demand through 'ironing out' of the peaks and troughs is not only difficult to achieve but perhaps misguided. What is the impact of the public sector increase and/or decrease of its investments in construction? No evidence exists to support the assumption that stabilisation of construction output is a necessary and sufficient condition for the provision of continuity of demand in the construction sector. So, what then is the impact of public sector intervention in construction?

The literature reviewed here points to substantial failure in public sector efforts to correct market failures. However, the unintended inefficiencies and social costs of market failure make it difficult to rule out public sector intervention as unnecessary. The market's inability to produce efficient and socially preferred outcomes serves as rationale that provides only a necessary but not sufficient condition for public sector intervention in the construction sector. What then is the necessary action required to establish sufficiency for public sector intervention, if at all?

The dependence of the construction sector on the public sector as a client means that the public sector is able to increase or reduce the demand for construction work by actions of its own proposed projects. It is argued that the public sector intervenes, amongst other reasons, to create construction demand as a result of the identified inadequacies of the market system. It is therefore of interest to understand the effect of such intervention by the public sector on the overall functioning of the construction sector.

Construction uses inputs from other sectors in its production process. This may include cement from manufacturing and fuel from the energy sector. This represents the construction industry's backward linkage. Again, construction may supply inputs to other sectors such as factories to manufacturing and road infrastructure to the energy sector. This represents the forward linkage. These linkages help distribute construction benefits across sectors of the economy. The construction sector cannot exist in isolation. An understanding of the public sector's impact on the construction sector would enable policy makers to make informed policies regarding public sector investment in construction.

Most writers in this area argue from a position that construction is a potential agent of economic development and that there is need to accelerate investment in construction projects. Accelerating investment in construction projects is easily achieved through public sector investment. However, there are no firm conclusions that have been drawn regarding the impact of public sector investment in construction. A lot has been said about construction being a potential agent of economic development without explaining why and how it is so. This can be misleading to policy makers. Clearly, there is need for further investigation of the impact of the public sector on the construction sector.

Public sector investment is considered a crucial component of development as it provides the infrastructure through which goods are transported, the economy is powered and households and businesses are connected to services and markets. Allied to providing physical infrastructure, the construction sector is of paramount importance as it is also perceived to create the necessary jobs, which is a major concern for the public sector. Given the indispensable role that the construction sector is deemed to perform in the economy, the impact of public sector intervention needs to be understood.

3.5 Synthesis of state and construction sector

The public sector has a major influence on the construction sector of most economies. It controls the economic parameters in which the construction sector works, such as the rate of interest and the system of taxation. In addition, the public sector is a client for much large building and civil engineering work. The sheer size of the construction sector and the investment goods it provides mean that changes in its output will affect the size of the GDP both directly and indirectly. It also means that what is happening to the construction sector must be a matter of national concern.

Whilst the construction sector exhibits features that make it attractive to the public sector, the wisdom of public sector intervention in construction is questionable. In the main, such intervention is driven by the desire to correct market failure, minimize economic inefficiencies and achieve economic welfare. However, the existence of government failures undermines public sector intervention in the construction sector.

Much of the discussion of markets and governments has been dominated by the idea of market failure. The theory of market and government failure gives insight into what constitute failure. While it acknowledges market failure, it highlights the problems of public sector intervention. Government failure is fundamentally based on ideas of the way in which governments actually function and the incentives they create for individuals inside and outside the government.

Most governments intervene in construction activity and many of the reasons are virtually inescapable. How should government intervene in the construction sector? While some writers in this area (Jimenez 1995, Hillebrandt 2000, Winston 2006 and Perloff 2007) agree that public sector intervention is necessary, the difficult question is that of the best way to intervene given certain objectives, concerned with efficiency, equity and constraints on action. How will any suggested policy be received, manipulated, obstructed or supported by various players? What is the underlying impact of public sector intervention in the functioning of the construction activity?

The existence of market failure *per se* does not necessarily mean that the public sector must intervene. A typical response to a market failure could be the proposal of a tax or bargaining mechanism to deal with it. For example, a polluter may be taxed according to the marginal damage caused to the environment. So why do some economies opt for public sector intervention to correct market failure?

The economy and political system under consideration at any given point can determine the difference between success and failure to address market failure. Not all political systems are corrupt and not all governments are incompetent. Competent governments may or may not be manipulated by special interest groups. Therefore, there is need to be wary of taking a universal view on the balance of considerations embodied in the theory of market and government failure.

The historical literature on public sector intervention in the construction sector considered shows that writers have ranged dramatically in their views of market and government failures. There are problems and virtues of both the free market and public sector intervention. The problem should not be viewed as one of a simple choice. There is no doubt, however, that whether one sees a very large or very small role for the market depends on how one judges the seriousness of the problems with markets and public sector intervention. While the balance of opinion among writers in this area is critical of the problems of public sector intervention, the problems of the market in infrastructure are also a matter of concern to policymakers.

There is no conclusive evidence on the ability of the public sector to correct market failures. Does this mean that public sector investment is not necessary? No. It is necessary to understand what the public sector can do effectively as well as where it is likely to perform badly. While it may be damaging to efficiency if it tries to exert detailed and universal control of production decisions, the public sector can be effective with direct action in improving infrastructure such as water supply, roads, schools and health facilities. How then, is the public sector involved construction activity? This question is investigated to some depth in chapter 5.

Chapter 4: Research design

The purpose is to carryout an empirical inquiry into the fundamental dynamics of the relationship between construction activity and economic growth. The main focus is the logical problem of how the relationship between the construction sector and economic growth influences economic policy. The previous two chapters dealt with the relevant literature on the relationship in depth. Clearly, there is lack of common ground in the understanding of the nature of the relationship and theoretical reasoning applied in explaining it.

4.1 Selected research methods

Two methods were selected for the study. A sectoral analysis and time series statistical analysis are described and justified. The relationship of the construction sector to economic growth is a complex one and requires careful consideration in terms of how potential data is sourced and consolidated. The two research methods identified above are thus chosen on the understanding that they are more likely to illuminate the research questions.

First, from time to time, the public sector intervenes in the construction sector by making investments in infrastructure. This is done for various reasons as revealed in the literature. However, it is not clear if consideration is given by policy makers to how such intervention affects the construction sector. This then triggers the question of how the public sector gets involved in construction. The impact of public sector investment on the functioning of the construction sector is also of interest. A sectoral analysis of the construction sector of SA is undertaken to investigate this.

Secondary data sourced from various public sector documents and reports is used in the analysis. The data is examined using the theory of market and government failures to establish whether public sector investment hinders or enhances the functioning of the construction sector. The investigations first consider the structure of the public sector of SA, as it relates to the construction sector. The impact of different configurations of the structure since the 1994 democratic transition is analyzed.

Allied to the analysis of structure is the tracking of public sector investment flows. Specific emphasis is on understanding how construction projects are funded by the public sector and how the monies are spent. Public sector investments that go into various areas of priority such as infrastructure are tracked to understand if allocated funds are used on designated projects. The way in which the public sector makes investment decisions is also investigated. The rollout processes involved in the delivery of construction projects are also analyzed to establish the efficiency of delivery mechanisms used.

Apart from giving a description of how the public sector interacts with the construction sector, the collected data is arranged such that it addresses the question of how public sector intervention impacts on the functioning of the construction sector. Relevant public sector policies are discussed to find out whether they enhance or hinder the functioning of the construction sector. The theory of market and government failures is applied to the reasoning to ascertain how the construction sector is affected by overall public sector investment.

Second, the literature review revealed the importance of the construction sector to economic growth. However, the basis for this is unclear. Therefore, the aim is to ascertain what the relationship is, with a view to determining whether the construction sector has any potential contribution to economic growth. A time series statistical analysis is used to carry out this investigation.

Time series construction output and GDP data for SA and the UK is reviewed and analyzed to arrive at the thesis conclusion and inferences about the nature of the relationship. The secondary data collected is examined using a number of statistical analyses to establish whether the construction sector follows economic growth or *vice versa*. The data is first presented graphically to establish dominant patterns in the movement of TCO and GDP over time. Common trends in the movement of the two variables over time is analyzed using moving averages. Analysis of correlations is then employed to identify and measure the associations that exist between the two variables.

The above-mentioned analyses revealed that the construction sector accompanies economic growth at certain points in the time series. Certain points in the time series were observed where growth in the construction sector occurred despite a decrease in economic growth. The regression analysis was then undertaken to fit a trend line to the data. According to Pellicer *et al.* (2009), the regression analysis estimates the quantitative influence of variables upon each other over time.

On the understanding that economic time series tend to be nonstationary, further analysis of the data is necessary. The use of nonstationary data can lead to a spurious regression where the results can appear excellent and impressive, but in reality be worthless and without meaning. The t-ratio and the f-ratio in a nonstationary series will not follow their distribution, hence the standard assumption may not be valid (Brooks 2002).

The cointegration technique was then used to analyze the data further, with a view to obtain statistically and economically meaningful regression results. This technique is used to indicate the existence of a long run equilibrium among economic time series (Engle and Granger 1987). If two or more series are nonstationary, but a linear combination of them is stationary, then they are considered to be cointegrated (Wei 2006).

Apart from the statistical analysis of the data as discussed above, major turning points in the movement of both TCO and GDP over the time series were analyzed. The turning points were scrutinized against major public sector policies at each time to ascertain the impact that policy has on the performance of the construction sector. All these analyses were applied to the TCO and GDP data for both the SA and UK economies. Chapter 6 deals with the SA data, while chapter 7 deals with the UK data. A discussion that compares and contrasts the findings then follows in chapter 8.

The discipline of economics is very broad. According to Backhouse (1994), there is no clear phenomenon that economists may use to determine how different issues should be researched. Does this mean that methodology does not matter? Not necessarily. Methodology is the attempt to govern the appraisal of particular economic theories by an account of theorizing in general (Weintraub, 1989). Backhouse argued that when economists do economics they are concerned to persuade. What is it that economists find persuasive? What persuades economists is not empirical testing or successful prediction, but things that no explicit methodology took into account (Backhouse, 1994).

Brockwell and Davis (1991) stated that the aims of time series analysis were to describe and summarise time series data, fit low-dimensional models, and make forecasts. In the measurement of relationships, time series can be important in interpreting regression analyses to measure the degree of fit achieved (Cox 1981). Pierce (1979) provided that it was common to use a squared multiple correlation coefficient, R^2, essentially a dimensionless measure giving the proportion of variance explained, i.e. comparing two variances. He indicated that in estimating this, an adjusted value is used. The adjusted value is designed to produce a stable value as more irrelevant parameters are added. Brooks (2002) raised a concern that the squared multiple correlation coefficient (R^2) gives no idea of the absolute magnitude of error variation and that its value is strongly dependent on the range of variation of the explanatory variables.

Pierce (1979) stressed that there were a number of different variances that may be relevant in a time series and therefore a number of R^2s with extremely different numerical values may arise. Brooks (2002) provided that collected data needs to be seasonally adjusted. He indicated that the next step in processing the data is to log it, and this involves transforming the data using the natural logarithm. Logging time series data is helpful when analysing data, particularly since data in this form is easier to work with. Brooks stated that the most important issue to consider for modelling time series data in modern times is to test for stationarity of the collected data so that it is made ready for processing. He cautioned that using non–stationary data can lead to a spurious regression where the results may seem excellent and impressive, but in reality be worthless and without meaning. Moreover, the standard assumptions in a non-stationary series may not be valid, as the usual t-ratio and fratio will not follow their distribution. A stationary series has a constant mean, constant variance and constant autocovariances for each given lag. In this regard, it is imperative to carry out the stationarity test first before modelling. To test for stationarity, many approaches are advocated, from those that test if a series has a unit root, such as the Augmented Dickey Fuller test and the Phillips–Perron (1988) test, to ones with a hypothesis of stationarity developed by Kwiatkowski *et al*. (1992).

4.2 Data collection

A two-pronged approach was followed in the data collection process. A sectoral analysis investigating how the public sector of SA gets involved in construction was undertaken. Time series construction output and GDP data for the UK and SA was also collected, reviewed and analyzed to arrive at the thesis conclusion and inferences about the nature of the relationship of the construction sector to economic growth.

4.2.1 Sectoral analysis data

A sectoral analysis on how the public sector of SA gets involved in construction was undertaken. Why a sectoral analysis? A sectoral analysis studies the size, demographic, pricing, competitive and other economic dimensions of a sector (Davis 1998). The focus in this case is the public sector in relation to its role in construction. Why base it on SA? It is considered prudent to base the analysis on an economy at LDC stage of growth, where the infrastructure backlog is likely to be high. If construction is an important sector as it is purported to be in the literature reviewed, basing the sectoral analysis on a LDC such as SA is logical. Generalization is based on the theory of market and government failures.

Secondary data sourced from various government documents was used for the sectoral analysis. The public sector of SA is made up of 3 spheres of government (national, provincial and local governments) as well as a myriad (±700) of state owned enterprises (SOEs). The national government consists of 34 national departments. Relevant data for the analysis was sourced from 8 of these departments and 5 SOEs. Why? It was identified that they deal with infrastructure development.

What sort of data was collected? The data included departmental reports, capital expenditure reports and public sector policy documents. A chain of evidence was created to manage the data collection process and it was maintained throughout the research.

How was the evidence gathered analyzed? Analysis of the evidence collected relied predominantly on the theory of market and government failures, which was used to explain the how the public sector of SA gets involved in construction. The theoretical underpinning of the economic analysis was used as a guide on the research boundaries. Analyses of all data was dealt with in detail, to demonstrate that all major rival interpretations were covered and that the fundamental impact of public sector investment on the construction sector was explained.

4.2.2 Time series data

Construction output and GDP secondary data for SA and the UK was collected from a number of sources. For SA, the data was sourced from electronic archives of Statistics South Africa (Stats SA), SA national treasury and the SA reserve bank (SARB). Similar data for the UK was sourced mainly from the Office of National Statistics (ONS) and Her Majesty's Treasury (HM Treasury). It was considered that time series data on construction output and GDP would help to determine the trends and get a handle on the intricate dynamic interrelationships between the construction sector and economic growth.

Collected data ranged from annual, quarterly and monthly output reports illustrating real and nominal figures. Key variables of construction output data included housing, infrastructure and repairs & maintenance for both the public and private sectors. GDP data came in the form of detailed national account statistics and economic output reports. For both SA and the UK, the national account statistics broadly present output, expenditure, and income activities of the major economic actors. GDP data comes in variables such national income and expenditure. National income includes such variables as wages and profits, whilst expenditure include variables such consumption and investment.

Time series analysis of the secondary data collected for SA was benchmarked against similar data for the UK, to ensure a balanced analysis. SA and UK data were presented and discussed separately. Comparison was then drawn between the two. It was considered prudent to use the SA and UK data, given the fact that the two economies are at two different developmental trajectories. The UK is an AIC whilst SA is a LDC. For the UK, older construction data was available (from 1955) whilst for SA, relevant construction data only started to be documented in 1993 by Stats SA. The initial aim was to study construction output data covering the last 100 years.

Annual construction output and GDP data covering the period 1955 to 2011 was used for the UK. For SA, construction output and GDP data covering the period 1986 to 2011 was used. The construction output data consisted of the following variables, that is, new infrastructure, new housing, infrastructure repairs and maintenance (R&M) and housing R&M. GDP data at 2009 constant prices was used for both the UK and SA.

Statistical and graphical analysis of collected data was then undertaken to establish the correlation of construction and economic growth. Trends in construction output and GDP were tracked using 3, 5 and 8 year moving averages and correlation analyses. Leads and lags in construction output and GDP were tracked over time using regression analyses and identified patterns were analysed in detail to establish their causes and meaning. Macroeconomic policies were also considered in explaining the behaviour of construction output over time. Allied to that was the analyses of major turning points in construction output over time, to ascertain causes and effects, if any, on GDP. Statistical regressions of total construction output and GPD were undertaken to determine the strength of relationships.

4.3 Composition of data

Construction activity covers new construction, alterations, repairs and maintenance (R&M) of buildings and civil engineering works (Hillebrandt 2000). Site assembly and installation of prefabricated integral parts of buildings or works are also included. Construction products are investment goods in that they are required not for their own sake but to produce a flow of production of goods, services or amenities over a long period. The long life of construction products means that the size of the stock is large in relation to annual production. As alluded to in the literature review, the composition of construction output statistics varies from one economy to the other. Identified differences in the SA and UK economies are discussed in the next two subsections.

4.3.1 Composition of SA construction statistics

The construction sector is considered to be of strategic importance to the SA economy. It delivers the buildings and infrastructure needed by the rest of the economy and society. The SA construction sector is defined according to the International Standard Industrial Classification (ISIC). It comprises all those organisations and persons concerned with the process by which building and civil engineering works are procured, produced, altered, repaired, maintained and demolished.

The construction statistics published by Stats SA cover each and every part of the construction sub-sectors, comprising all new infrastructure, housing developments, and repairs and maintenance (R&M). Stats SA uses the large sample survey (LSS) to compile construction output data. The LSS is a periodic survey that measures economic activity in the construction sector of SA. It is based on a sample of private and public enterprises operating in the construction sector (Stats SA 2005).

The statistical unit for the collection of construction output data is an enterprise (Stats SA 2007). An enterprise is a legal unit that include and directly controls all functions necessary to carry out its production activities. However, SA is still a developing economy and, as such, a significant component of construction work is undertaken by the informal sector. Therefore, it is unclear how Stats SA accounts for statistics of construction work that is done by the informal sector.

The SA construction sector LSS covers construction work undertaken by construction firms registered for value added tax and income tax (Stats SA 2007). The scope of such works is in accordance with the January 1993 edition of the Standard Industrial Classification (SIC), which is based on the 1990 ISIC. Table 4.1 illustrates the list of activities that are included.

Table 4.1: List of activities included in the large sample surveys

Activity	Description	Classification	% contribution to construction output
Site preparation	Demolition or wrecking of buildings and other structures, clearing of building sites, including blasting, test drilling, landfill, levelling, earth-moving, excavating and land drainage.	SIC 5010	1.9
Construction of buildings	Construction of houses, multi-storey residential buildings, other residential buildings, industrial and commercial buildings, and other non-residential buildings.	SIC 5021	35.0
Construction of civil engineering structures	Construction of roads, bridges, tunnels, railways, airports, airfields, harbours, dams, reservoirs, irrigation systems, towers and sewerage systems.	SIC 5022	27.9
Construction of other structures	Construction of swimming pools, tennis courts, fencing, carports, lapas, paving, water well drilling, and the erection and dismantling of scaffolding and cranes used in construction.	SIC 5023	2.5
Construction by specialist trade contractors	Construction of part of a structure, such as pile-driving, foundation work, concrete work, carcasswork, bricklaying, stone setting, plastering, roof covering, and the erection of steel structures.	SIC 5024	6.3
Plumbing	Laying of sewerage pipes, the installation of water pipes, wash basins, baths, water heating systems, solar heating systems, sprinkler systems, gutters and sheet metal work in all buildings and structures.	SIC 5031	1.8
Electrical contracting	Installation of electrical wiring and lighting in buildings and other structures. It excludes the erection of electric power lines classified under SIC 5022 (construction of civil engineering structures), and cable laying for computer networks classified under SIC 8690 (other computer related activities).	SIC 5032	5.9
Shopfitting	Building, assembly and/or installation of equipment, such as counters, shelves, cupboards and shop fronts, on the premises of the client in buildings.	SIC 5033	0.7
Other building installation	Building installation such as heating and air-conditioning systems, antennas, alarm systems, elevators and escalators. Also included are insulation work (water, heat, sound), industrial process piping work, commercial refrigeration work, the installation of illumination and signalling systems for roads, railways, airports and harbours, and the installation of certain plants such as manufacturing plants, electric power and transformer plants, telecommunication and radar plants	SIC 5039	6.8
Painting and decorating	Painting and decorating undertaken as a specialised service, including wallpapering, industrial spray-painting, sandblasting and anti-rust treatment of steel structures.	SIC 5041	1.0
Other building completion	Building completion activities such as glazing, floor and wall tiling, carpet laying,	SIC 5049	8.2

Activity	Description	Classification	% contribution to construction output
	floor sanding, finish carpentry, acoustical work, and the cleaning of the exterior.		
Rental of construction equipment	Rental of construction machinery and equipment (including crane lorries) with operator.	SIC 5050	2.0
Total construction output covered by large sample surveys			100

Source: Stats SA 2011

Of importance to note in Table 4.1is that it is assumed that the given statistics cover both new and R&M works. Stats SA only provides that the statistics cover all the sub-sectors of the construction sector as per the ISIC standard.

The client base of the SA construction sector comprised (Stats SA 2007): first, the government, which made a 13% contribution to total construction output. Second, state owned enterprises (SOEs), which made 15% contribution. Third, the private sector, which was the major client of the construction sector, contributing 72% to total construction output.

In view of the large number of geographically scattered construction sites from which construction output data needs to be collected, statistics on the construction sector are seldom accurate (Ofori 1994). Allied to this, is the multiplicity of enterprises involved and their often transient nature. The practice of subcontracting is widespread in the construction sector, which may pose risks of omission and double counting when collecting data.

Also, it is difficult to define the boundaries of the construction sector. The World Bank (1994) also corroborated the view that the construction sector is typified by temporary, contract-driven relationships between participants of a given project. This condition makes the collection of accurate national statistics very difficult to satisfactorily achieve. Therefore, the results of the time series statistical analysis of SA construction output and GDP data undertaken here needs to be interpreted with caution.

4.3.2 Composition of UK construction statistics

In the UK, the construction sector is defined in accordance with the Standard Industrial Classification (SIC). Table 4.2 illustrates the system of industrial classification used for statistical and government purposes in the UK. It includes general construction and demolition works, civil engineering, new construction works, and repairs and maintenance (R&M). This classification is derived from the UN's International Standard of Industrial Classification (ISIC). Firms that are recognised as comprising the construction sector embrace a range of activities including those relating to infrastructure, new construction, R&M, as well as demolition works (ONS 2012).

Table 4.2: Description of the SIC for construction in the UK

Division	Group	Class	Sub-class
41 Construction of buildings	41.1 Development of building projects	41.10 Development of building projects	
	41.2 Construction of residential and non-residential buildings	41.20 Construction of residential and non-residential buildings	41.20/1 Construction of commercial buildings
			41.20/2 Construction of domestic buildings
42 Civil engineering	42.1 Construction of roads and railways	42.11 Construction of roads and motorways	
		42.12 Construction of railways and underground railways	
		42.12 Construction of bridges and tunnels	
	42.2 Construction of utility projects	42.21 Construction of utility projects for fluids	
		42.22 Construction of utility projects for electricity and telecommunications	
	42.9 Construction of other civil engineering projects	42.91 Construction of water projects	
		42.99 Construction of other civil engineering projects n.e.c.	
43 Specialised construction activities	43.1 Demolition and site preparation	43.11 Demolition	
		43.12 Site preparation	
		43.13 Test drilling and boring	
	43.2 Electrical, plumbing and other construction installation activities	43.21 Electrical installation	
		43.22 Plumbing, heat and air-conditioning installation	
		43.29 Other construction	

Division	Group	Class	Sub-class
		installation	
	43.3 Building completion and finishing	43.31 Plastering	
		43.32 Joinery installation	
		43.33 Floor and wall covering	
		43.34 Painting and glazing	43.34/1 Painting
			43.34/2 Glazing
		43.39 Other building completion and finishing	
	43.9 Other specialised construction activities	43.91 Roofing activities	
		43.99 Other specialised construction activities n.e.c.	43.99/1 Scaffold erection
			43.99/2 Specialised construction activities (other than scaffold erection) n.e.c.

Source: Adapted from ONS 2012

Table 4.2 shows that the construction sector of the UK is defined in accordance with divisions 41 – 43 of the SIC. The definition of the sector includes the complete construction of buildings (division 41), the complete construction of civil engineering works (division 42), as well as allied construction activities, if carried out only as a part of the construction process (division 43). Also included is the repair of buildings and civil engineering works.

(a) Division 41 - Construction of buildings

This division includes general construction of buildings of all kinds. It includes new work, repair, additions and alterations, the erection of pre-fabricated buildings or structures on the site and also construction of a temporary nature. Included is the construction of entire dwellings, office buildings, farm buildings, stores and other public and utility buildings. Class 41.1 (development of building projects) includes: development of building projects for residential and non-residential buildings by bringing together financial, technical and physical means to realise the building projects for later sale.

(a) Division 42 - Civil engineering

This division includes general construction for civil engineering works. It includes new work, repair, additions and alterations, the erection of pre-fabricated structures on the site and also construction of temporary nature. Included is the construction of heavy constructions such as motorways, streets, bridges, tunnels, railways, airfields, harbours and other water projects, irrigation systems, sewerage systems, industrial facilities, pipelines, electric lines, and outdoor sports facilities.

(b) Section 43 - Allied construction activities

This division includes allied construction activities (allied trades), that is, the construction, or preparation for construction, of parts of buildings and civil engineering works. These activities are usually specialised in one aspect common to different structures, requiring specialised skills or equipment, such as pile-driving, foundation work, carcass work, concrete work, brick laying, stone setting, scaffolding and roof covering. The erection of steel structures is included provided that the parts are not produced by the same unit. Allied construction activities are mostly carried out under subcontract, but especially in repair construction it is done directly for the owner of the property.

Also included are building finishing and building completion activities. Included is the installation of all kinds of utilities that make the construction function as such. These activities are usually performed at the site of the construction, although parts of the job may be carried out in a special workshop. Included are activities such as plumbing, installation of heating and air-conditioning systems, antennas, alarm systems and other electrical work, sprinkler systems, elevators and escalators. Also included are insulation works (water, heat, sound), sheet metal work, commercial refrigerating work, the installation of illumination and signalling systems for roads, railways, airports and harbours.

Repair of the above mentioned installations is also included. Building completion activities encompasses activities that contribute to the completion or finishing of a construction such as glazing, plastering, painting, floor and wall tiling or covering with other materials like parquet, carpets, wallpaper, floor sanding, finish carpentry, acoustical work, and cleaning of the exterior. Repairs to the above mentioned completion or finishing work are also included.

Responsibility for the collection and publication of construction statistics in the UK was transferred from the Department for Business Enterprise and Regulatory Reform (BERR) to the Office for National Statistics (ONS) on 1 March 2008. The ONS has been the main source of the construction data used in this research. According to the BERR (2007), construction output is a measure of output from construction activity in both the private and public sectors. The construction statistics published by the ONS include detailed breakdowns of the various components of construction output, which include new infrastructure, new housing, new industrial, new commercial, and R&M.

Table 4.3 shows that R&M constitutes nearly 50% of TCO in the UK. This includes all public and private sector construction work carried out on houses, infrastructure and commercial buildings. According to the BERR (2007), government departments and their agencies serve as major clients of the construction sector of the UK. The underlying reasons for this trend are discussed at length in chapter 7.

Table 4.3: Value of total construction output in the UK, 1996 current prices

Type of work	TCO (£ million)	% contribution to TCO
Infrastructure	6 337	11.5%
Housing - public	1 422	2.6%
Housing - private	5 592	10.1%
Non-residential building - public	4 442	8.1%
Industrial building - private	3119	5.6%
Commercial building - private	7 015	12.7%
Repairs and maintenance	27 317	49.4%
Total (of all work)	55 244	100%

Source: Adapted from BERR 2007

The fact that the UK is a developed economy, suggests that most of the basic infrastructure required for economic growth is already in place. However, physical infrastructure such as roads is susciptible to ageing and degradation as it gets used over time. Therefore, R&M become necessary.

R&M concerns work, which is either repairing something which is broken, or maintaining it to an existing standard. For housing output, this includes repairs, maintenance, improvements, house/ flat conversions, extensions, alterations and redecoration on existing housing. For non-housing output this includes repairs, maintenance and redecoration on existing buildings, which are not housing, such as schools, offices, roads and shops. Such works are a major component of construction activity in the UK, hence the R&M component of TCO is significant compared to other types of work such as new construction work.

New construction work in the UK construction sector includes mainly extensions, major alterations or improvements, site preparation and demolition works. It excludes housing where work done on improvements, extensions and alterations and house/flat conversions is included under repairs and maintenance. New construction work also includes houses converted to other uses.

Table 4.3 also makes a distinction between public and private sector works. Public work is for any public authority such as government departments, public utilities, nationalised industries, universities, the Post Office, new town corporations, housing associations and any other public sector agencies. On the other hand, private work is for a private owner or organisation or for a private developer, and includes work carried out by firms on their own initiative. It includes work where the private sector carries the majority of the risk or gain. Most Private Finance Initiative (PFI) contracts are private.

4.4 Construction and growth

A lot has been said about the importance of the construction sector in economic growth. The assumption that the construction sector is the engine of economic growth is controversial. It suggests that construction drives growth. This research questions the existence of a relationship between the construction sector and economic growth.

A time series statistical analysis of TCO and GDP data for SA and the UK is undertaken separately. The two economies were chosen because they are at two different growth trajectories. It is anticipated that the analyses will reveal specific patterns and trends in the behaviour of TCO and GDP over time that apply to both developing and developed economies. Comparison of the patterns and trends will assist in drawing more reliable conclusions on the relationship of the construction sector to economic growth.

For SA, the TCO and GDP data used covers the period 1986 to 2011. TCO data older than 1986 could not be found. Both TCO and GDP data used in the analyses were obtained mainly from Stats SA, South African Reserve Bank and National Treasury, depending on which source provided the longest time series data. Stats SA is the original source of most national account statistics used. For the UK, the TCO and GDP data used covers the period 1955 to 2011. The data were sourced from the ONS and HM Treasury. The ONS is the major source for most of the data used in the UK analyses.

Stats SA uses an enterprise as the statistical unit for the collection of TCO and GDP data. They define an enterprise as a legal unit or combination of legal units that include and directly control all functions necessary to carry out the enterprise’s production activities. According to Stats SA (2012), the TCO data collected covers enterprises registered in the taxation system that are mainly engaged in construction. While all enterprises are legally bound to register with the SA Revenue Service (SARS) for tax, not all construction enterprises comply with this requirement (Du Plessis and Smit 2006). This is particularly so for those enterprises that operate in the informal sector. Ofori (2001) asserted that approximately 40% of construction work in LDCs, like SA, is undertaken in the informal sector.

What is the informal sector? The informal sector refers to economic activities, that is, production and distribution of goods and services by the operating units of the households which essentially differ from the formal sector in terms of technology, economies of scale, use of labour intensive processes, and virtual absence of well maintained accounts (Black *et al.* 2009). In construction, the informal sector represents that part of the work which is not enumerated and in some cases not regulated. It takes place through self-help building projects, labour-only building arrangements and informal subcontracting. In this research endeavours were made to use data from different sources. For example, data sourced from the South African Reserve Bank does factor in the informal sector. The research also highlights the need for institutions like Stats SA to consider using different data sources that provide information on the informal sector in building up the national accounts.

Like Stats SA, the ONS also uses businesses as the statistical unit for the collection of TCO and GDP data. They survey both large and small businesses that are registered with the interdepartmental business register (IDBR), to establish the value of output. Unlike in the case of Stats SA, the ONS construction output survey is large and broad ranging. Also, the number of construction companies that operate in the informal sector is minimal, given the fact that the UK is a developed economy.

The data items that Stats SA use to compile TCO include industrial classification of enterprise, details of employment, income, expenditure, profit or loss, inventories, book value of assets, and details of services rendered. Stats SA uses the standard industrial classification (SIC) based on the 1990 international standard industrial classification (ISIC). It is important to note that suitable adaptations for local conditions have been effected on the SIC that Stats SA uses. For example, R&M work is accounted for as part of new work.

According to the ONS, TCO is composed of the amount chargeable to customers for building and civil engineering work done by construction companies in the relevant period. While the ONS also uses the SIC, the categories covered in TCO is much broader than the ones covered by Stats SA. For example, R&M is accounted for separately from new work.

For SA, all currency data that is used for both TCO and GDP are presented in SA rands. For the UK, the currency data for both variables are presented in pound sterling. TCO and GDP figures used by both Stats SA and the ONS exclude value added tax (VAT). The importance of TCO data for this investigation cannot be over emphasized. According to the ONS (2012), TCO data is used widely by economic analysts and construction professionals who are interested in the construction sector. In both SA and the UK, TCO also contributes to the estimate of GDP.

As indicated earlier, time series statistical analyses of the collected TCO and GDP data for SA and the UK is undertaken separately in chapters 6 and 7 respectively. Graphical presentations of all the data are undertaken to study the patterns of movement of the variables over the time series. Analyses of moving averages, correlations and trends are undertaken to establish if a relationship exists between the construction sector and economic growth. To determine the long run relationship, the cointegration analysis is employed. Unit root tests are performed on the residuals of the regression between TCO and GDP. Major turning points in the movement of the variables is explained against the possible influence of government policy interventions.

Chapter 5: A sectoral analysis of South African construction

The previous chapter identified the research methods chosen for the investigations. This chapter investigates how the public sector of SA gets involved in construction. The extent to which the public sector should be involved in any sector of the economy is a main issue in economics. How is the public sector of SA involved in construction? This sectoral analysis seeks to find this out, in the context of the microeconomic aspects of the construction sector of SA.

The data used in this analysis is obtained from various reports and documents produced by different departments of the SA public sector and its agencies. Focus is made to those departments and state owned enterprises (SOEs) that engage in construction activity from time to time. The secondary data collected outline various issues pertaining to the flow of construction work through the various government departments and how construction firms become involved.

The flow of construction work and project funds through the various levels of government can be a very complicated process. Documents outlining such flows and how projects are funded were sourced from all the 3 spheres of the SA government (national, provincial and local governments). Given the large number of government departments (34 national departments as at 2012), analysis of the data focuses on 10 national departments and 5 SOEs that are affected the most by construction activity.

How is the collected data analyzed? The analysis concentrates on establishing how the public sector rolls out construction work and also seeks to understand the funding processes involved. This is undertaken with a view to understand if public sector involvement in construction activity helps or hinders the functioning of the construction sector. To achieve this, the data include departmental reports, capital expenditure reports and public sector policy documents.

The analysis employs the theory of market and government failure discussed in chapter 3, to determine how the public sector of SA gets involved in construction. The impact of public sector investment on the functioning of the construction sector is also explored. The theoretical underpinning is used as a guide on the research boundaries. Analysis of all collected data is dealt with in detail, to demonstrate that all major rival interpretations are covered and that the impact of public sector investment in the construction sector is explained.

5.1 Defining the SA construction sector

In the literature review and the previous chapter, the construction sector was defined in terms of the SIC and the ISIC. The SIC definition of the construction sector used in SA is a modified version of the ISIC (Stats SA 2007). Therefore, some important aspects of the sector such as R&M are not clearly accounted for in the construction statistics published by Stats SA.

According to the international council for research and innovation in building and construction (CIB 1999), the construction sector comprises all those organisations and persons concerned with the process by which building and civil engineering works are procured, produced, altered, repaired, maintained and demolished. This includes companies, firms and individuals working as consultants, main and sub-contractors, material producers, equipment suppliers and builders' merchants. Clearly, the CIB provides a much broader definition of the construction sector than that provided by the SA version of the SIC.

The construction sector comprises a wide range of products, services and technologies, which vary in terms of the economic value that they generate. This reflects differences in their use of particular factors of production and the value which they generate from them. Major factors of production include raw materials, physical capital, intangible investment, skilled and non-skilled labour as well as technical knowledge (Hillebrandt 2000).

The SIC (2007) edition used by the ONS in the UK includes infrastructure and R&M as separate divisions within the construction sector (ONS 2012). While the SIC (1993) edition used by Stats SA also includes infrastructure, it is not accounted for separately. The way the statistics are presented may be construed to suggest that construction and infrastructure mean the same thing. According to the UK definition of the construction sector, not all infrastructure forms part of the construction sector (SIC 2007). The ONS construction statistics cover the following types of work separately; public sector housing, private sector housing, infrastructure, non-housing developments, as well as R&M.

Infrastructure is defined as the basic physical and organizational structures and facilities that are needed for a society or an economy to function (Black *et al.* 2009). Included under infrastructure is water, sewerage, electricity, gas, communication, air transport, railways, harbours and roads (ONS 2011). In the SA statistics, all work that is undertaken by the construction sector such as schools, human settlements, offices, hospitals and transport networks are referred to as infrastructure (Stats SA 2007). While the percentage share of infrastructure related to construction as well as that for R&M can be easily determined from the UK construction statistics, it is not possible to do this from the SA construction statistics. Hence, the terms construction and infrastructure will be used interchangeably throughout this case study.

5.2 Relationship of the public and private sectors

The use of public private partnership (PPP) has grown over recent years as the merits of blending private sector resources and skills, with the public sector ones has become evident.

The procurement system is used in SA to reduce the burden on taxpayers in the delivery of infrastructure projects. It introduces private capital, private expertise and competitive business practices in the provision of infrastructure. According to Grimsey and Lewis (2002) the private sector is better able to provide services to a higher level of efficiency and effectiveness than the public sector. Apart from funding difficulties, infrastructure delivery through the public sector is hindered by its bureaucratic, mechanistic and politicized method of operation (CIDB 2004). Therefore, bringing in a private sector ethos into infrastructure delivery can reduce inefficiency and improve the achievement of value for money in projects.

What is PPP? South African law defines a PPP as a contract between a public sector institution or municipality and a private party, in which the private party assumes substantial financial, technical and operational risk in the design, financing, building and operation of a project (National Treasury 2007). Why is PPP necessary? PPP delivers better value for money than traditional procurement systems. According to Grimsey and Lewis (2002), PPP spreads the risks associated with infrastructure delivery between the public and private sector partners. PPP contracts seek to protect existing and future taxpayers by reducing the overall tax burden. It reduces public sector bureaucracy, which can stifle project implementation.

Russel and Bvuma (2001) provided that PPP in SA was adopted in the year 1999 as an alternative procurement system to improve infrastructure delivery. Initial guidelines that were issued by National Treasury (2002) provided that PPPs must demonstrate value for money, be affordable, be procured using transparent and competitive processes, show substantial risk transfer to the private partner and be implemented within a sound project management framework. Any government department that proposed to implement PPP projects was required to demonstrate to the National Treasury that their project proposals met these requirements.

Why use PPP? PPP is used to ensure the delivery of well maintained, cost-effective public infrastructure or services, by leveraging private sector expertise and transferring risk to the private sector. Where a project is implemented through PPP, the public sector buys a complete infrastructure facility from the private partner. It pays for these over the term of the PPP agreement, based on successful delivery. The private partner typically puts its own capital at risk, funding its investment in the project with debt and shareholder equity. Because of the financial risk the private partner takes, it is motivated to provide a high level of service, as good returns on equity will depend on the quality of services it delivers (National Treasury 2007).

How is PPP funded? This varies widely from project to project and sector to sector. It is closely linked to the funding sources that can be secured for each project. In some PPP projects, the private partner raises both debt and equity to finance the project. Frequently used PPP arrangements in SA involve the private partner setting up a dedicated business entity. Such entity is referred to as the special purpose vehicle (SPV). Its sole purpose is to deliver the project. While some PPP contracts may involve capital contribution by the institution to the initial costs of the project, some do not involve debt finance at all. In such cases, the PPP project is initially funded either wholly through corporate finance or by a combination of government funds and private equity (Russel and Bvuma 2001).

The PPP procurement system in SA is used by the national, provincial and municipal spheres of government to deliver various projects. What projects? Government head office accommodation and prisons are common features of PPP projects at the national government level. Health, tourism and education PPP projects are done mainly at provincial level. At the municipal level, the PPP procurement system is used mainly for municipal services and infrastructure projects. In all the three spheres of government, the National Treasury plays a pivotal role through its PPP unit, which was established in 2000. Apart from its regulatory function, the PPP unit provides technical support to partners in initiating and implementing PPP projects (National Treasury 2007).

Are PPP projects successful in SA? It depends. One of the major PPP projects completed recently is the Gautrain rapid rail link. With a project value of R25 billion, this is the largest infrastructure project in Africa delivered through the PPP procurement system (Hawkesworth 2011). However, some capacity constraints to implement and manage PPP projects are evident in the public sector. This frustrates potential private investors, resulting in some potential projects being aborted. A case in point is the 11 maximum security prisons that the government had committed to build through the PPP procurement system (Farlam 2005). According to Farlam, in the course of the procurement, the government realised it had vastly underestimated the costs involved and revised the number down to four and then to two.

Clearly, capacity constraints undermine the implementation of PPP projects in SA. The resultant failure of the 11 prisons is evidence that the success of PPP projects in SA is limited. A comprehensive feasibility study should have clarified the affordability limits of the government. The capacity of the National Treasury's PPP unit is also questionable in this regard. According to Hawkesworth (2011), the fundamental role of the PPP unit includes:

(a) Policy guidance, which includes providing advice on the content of national legislation, defining eligible sectors and PPP methods of project procurement and implementation processes, as well as procedures for conflict resolution.

(b) Green lighting projects, which involves deciding on whether or not a project should move forward. This needs to be done at various stages, ranging from the inception, budgeting, business case stage to final approval of the contract to be signed by the PPP partners.

(c) Technical support to government departments during the various stages of project identification, evaluation, procurement and contract management.

(d) Capacity building including training to public sector officials interested or engaged in PPP projects.

(e) PPP promotion among the public and/or private sectors.

Capacity issues present significant challenges in the implementation of PPP projects in SA. Threfore, a cautious approach is necessary when deciding on the appropriate procurement route. PPP projects pose many of the same problems inherent in the privatisation of infrastructure delivery and are not a panacea for development. The principles that underlie the PPP procurement system such as affordability, cost effectiveness, value for money, transparency and risk management should form part of the way that infrastructure delivery in general is approached. The PPP procurement system should be viewed as a means towards better infrastructure delivery.

5.3 Public sector and construction

Reinert (1999) traced the role of the public sector in the economies of western societies since the renaissance and found that the antagonism between state and market is a relatively new phenomenon. He argued that since the renaissance, the public sector has served to create well-functioning markets by providing a legal framework, standards, credit and physical infrastructure.

The public sector gets involved in construction to generate demand. Does demand need to be created in construction? Why does it not just happen? The characteristics of construction products make it difficult to determine and create their demand. The size, cost, long life and the fact that most construction products are public goods make the demand creation process very complex. According to Briscoe and Wilson (1991), the central determinant of demand for construction work is government's willingness to advance investment funds in the form of grants, spending approvals or borrowing sanctions. Hillebrandt (2000) identified five major requirements that must be favourable before demand can be created:

(a) That there is a user or potential user for the building or works in the short run and/or in the long run.

(b) That some person or organisation is prepared to own the building or works.

(c) That a person or organisation is prepared to provide finance for the construction of the product and for its ultimate ownership.

(d) That some person or organisation is prepared to initiate the process.

(e) That the environment and external conditions in which the above operate are favourable.

Public sector involvement in construction activity is necessary because very few private sector agents have the large funds necessary for infrastructure projects (Tan 2002). The fact that infrastructure projects often create natural monopolies means that the public sector is reluctant to fund private providers. Therefore, the public sector intervenes with good intentions to bridge the gap left by the private sector.

Myers (2008) concurred with Hillebrandt (2000) in that the determination of demand for construction products is a complicated process. He indicated that demand for major infrastructure projects such as hospitals, roads, schools, tunnels, police stations, prisons, museums, and fire stations is required by large numbers of individuals who are not able or willing to pay the market price for the desired facility. Assessing the demand for these products is dependent on the assessment of need, funds available, government policy, and the age and condition of existing infrastructure.

Much of the demand for construction activity is of a derived nature, in that, as much as the goods are not necessarily demanded in their own right but they are demanded for what they can add to the final good or service being produced. The construction sector provides economic infrastructure which influences investment into other sectors of the economy. Infrastructure affects the profitability of private enterprises. Its provision and upgrade can lower the cost of producing a given level of output. Markets perform better in economies with good infrastructure. The cost of transactions is reduced whilst maximising the benefits generated by the infrastructure.

How does the public sector make investment decisions concerning the construction sector? Briscoe and Wilson (1991), as did Wolf (1979) found that a central difficulty with many types of public sector investment decisions is that information on both costs and benefits is difficult to establish with any degree of accuracy. Big infrastructure projects such as motorways take long to implement. This could mean that project costs need to be revised several times before a project is complete. Cost elements such as those associated with disruption and inconvenience to people living near the proposed motorway can be difficult to estimate. Also, the benefits of an investment of this nature are not easy to work out and produce a set of income returns that can be compared to the cost estimates.

Products of the construction sector exhibit certain technological and economic characteristics that distinguish them from most goods and services. The public sector is particularly attracted by these characteristics. The World Bank (1994), in its world development report in infrastructure, identified a number of characteristics of construction products. While public sector involvement in construction is not solely in infrastructure, the following characteristics are those that cause construction products to be publicly provided.

5.3.1 Production characteristics

The construction of physical infrastructure to provide society's needs for water supply, flood control and transport is characterized by its large, elaborately designed and enduring features. The provision of such infrastructure has been technology-driven to find better and efficient ways of meeting the needs. The most general economic characteristic of modern infrastructure is the supply of services through a networked delivery system designed to serve a multitude of users, particularly for public utilities such as piped water, electric power, gas, telecommunications, sewerage and rail services.

A defining feature of most infrastructure projects is that they are dedicated to providing a specific good. Once investments are made, they cannot be converted to other uses or moved elsewhere. Coordination of service flows, such as traffic and electricity, along the system is critical to its efficiency. Such inter-connectedness also means that the network can depend significantly on service flows and the capacities at other points.

5.3.2 Consumption characteristics

The demand for infrastructure services derives from the activities of both industries and individuals. Ensuring a flow of services of at least minimum quality and quantity is considered by the public sector to be of strategic importance. Any interruption or restriction of supply would be seen as a threat to society. Given the scale at which infrastructure investments are required it may be difficult for planners to match the availability of supply with demand at all times. Costly episodes of over- or under-capacity often result.

Public goods are neither rival in consumption nor excludable. Markets work best in providing pure private goods or services. Most of the infrastructure that the construction sector produces is excludable in a specific sense. Its use depends on gaining access to a facility or network, for example by connection to the piped water, gas, or sewer system, and service use may be metered and charged for. In the case of railways, seaports and airports, access to the entire infrastructure can be restricted. However, once a user gains access to the transport facility, the degree of rivalry with other users depends on the costs, such as congestion, imposed on existing users or on the service supplier when an additional service unit is consumed.

Some infrastructure goods may be private, but may be of such a nature that spillovers or external effects are unavoidable. Such external effects may affect the environment. The characteristics of various infrastructure activities have important implications for how services should be provided. To the extent that specific infrastructure activities entail natural monopoly or depend on a network characterized by natural monopoly, they will not be provided efficiently by an unfettered market. The network component can, however, be separated from the more competitive activities of the sector, with regulation to ensure fair access to the network.

5.3.3 Public sector dominance

Public sector dominance in the provision of infrastructure may be viewed as a consequence of of the existence of the other characteristics. By its nature, infrastructure represents a strong public interest. Whilst public sector attention may be necessary, the special characteristics of infrastructure goods do not explain or justify public sector involvement. The recognition of infrastructure's economic and political importance has influenced public sector dominance in infrastructure. The belief that problems with the supply technology required a highly activist response by the public sector and the faith that the public sector could succeed where markets appeared to fail, all influenced public sector involvement.

Contrary to the world development report (WDR) arguments, the existence of government failures makes it all the more difficult to justify public sector involvement in the construction sector. The WDR did not deal with fundamental causes and effects of market failure. It dismisses public sector intervention without engaging in a robust analysis of market failures versus government failures (Myers 2008).

The World Bank (1994) argued that market forces and competition can improve production and delivery of infrastructure services. The report suggests that the role of the public sector in the economy is essential to regulate profits and to protect consumers. Whilst this may be important, it is difficult to understand how regulation alone can correct the wide range of market failures that exist in the market system.

A number of problems may arise in commercial and competitive provision of infrastructure for which markets cannot guarantee solutions. Many infrastructure services, especially those that resemble public goods, will be undersupplied if markets alone are left to determine their provision. The WDR suggested that a variety of responses and policy initiatives can help overcome the limitations of both markets and governments. The report cited initiatives such as decentralization, sound budgetary allocations to nationwide spending programs, and project planning techniques.

Public sector investment in developing economic infrastructure is considered essential. Its significance stems from the fact that infrastructure provides the basic physical facilities necessary for an economy to function. The public sector invests in infrastructure on the assumption that it creates economic activity through forward and backward linkages. Why not leave this to the markets? Samuelson and Nordhaus (2001) argued that this has to be done through the public sector as a result of all the gaps left by the private sector and to mitigate against market failures.

According to Kessides (1993) infrastructure linkages to an economy are multiple and complex. They affect production and consumption directly. They create many positive and negative externalities. They also involve large flows of expenditure. Kessides argued that although private markets must be relied upon to a greater extent, efficient allocation of resources must be based on effective demand. She provided that the government will need to retain a role in managing these markets and ensuring that social goals of equity, welfare and environmental sustainability are served. She stated that this would be achieved, especially through intervention in investment planning, regulation and financing.

5.4 Impact of the public sector on construction

The construction sector of SA has been utilized by the public sector mainly to provide economic infrastructure and public goods. The public sector predominantly engages in diverse infrastructure projects as demand generator for construction activity. As demonstrated in the literature review, policy makers use a number of reasons to justify public sector intervention in the construction sector. These include the extension of social costs and benefits of infrastructure to all.

The fundamental purpose of this case study is to understand how the public sector impacts on the functioning of the construction sector in SA. An understanding of this impact would enable policy makers to make better use of the construction sector. Secondary data on public sector investment in construction sourced from Statistics South Africa (Stats SA) and the various state departments of the SA government that deal directly and indirectly with infrastructure development is examined to ascertain the impact.

A comparison of historical data on public sector construction investment and private sector construction investment in SA is undertaken to establish the level of public spending on the construction sector. While there has been a lot of progress in policy reform with respect to the structure and operational dynamics of the public sector of SA since the dawn of democracy in 1994, the impact of its involvement in construction is unclear. In chapter 3, several arguments advanced by different writers in this area to justify why the public sector gets involved in the construction sector were examined. The impact of such involvement has not been fully understood. This chapter investigates the impact of the public sector on the construction sector of SA, to establish whether the public sector helps or hinders the functioning of the construction sector.

5.4.1 Structure of the public sector

The major task of the public sector of SA is to determine the institutional structures required in order to ensure the necessary conditions for the realisation of government's agenda to upgrade infrastructure, enhance technological capability and address the serious challenges of unemployment, poverty and inequality.[1] The public sector discharges its mandate through various departments. The way in which the various departments operate has undergone a number of changes since the first democratic elections in 1994.

It was necessary to transform the public sector from what it used to be under the apartheid government so that it becomes responsive to the needs of the majority (Wenzel 2007). As the transformation process evolved through the different administrations, from former state president Nelson Mandela, through Thabo Mbeki to the current president Jacob Zuma, the structure of the government departments had to undergo various configurations as illustrated in Table 5.1.

In what way are the changes in structure related to the construction sector? As the structure changes from one administration to the other, the roles of individual departments change. For example, when the reconstruction and development programme was closed down in 1996, its roles were split between departments like public works and housing (South African Reserve Bank, 2006). While such structural changes were done with good intentions of improving service delivery, inadequate capacity to handle infrastructure delivery by some departments has negative impacts on the construction sector.

[1] Constitution of the Republic of South Africa No.108 of 1996

The public sector of SA paid particular attention to the construction sector due to its role in infrastructure delivery. Having attained political liberation, the economic liberation of the people who were disadvantaged by the previous government became a priority of the government. Several policies were enacted to deal with inequalities in both the public and private sectors of SA. Among such policies was the black economic empowerment (BEE) policy. What is the BEE? The BEE is a programme launched by the SA government in 2003, to redress the inequalities of apartheid by giving certain previously disadvantaged groups of SA economic privileges previously not available to them. The policy advocated for the corrrection of imbalances in the construction sector that were created by apartheid. This was to be achieved by seeking to substantially and equitably transfer ownership, management and proportionate control of SA's financial and economic resources to the majority of its citizens (CIDB 2004).

Table 5.1: Departmental structure of the SA government

1994 - 1999	1999 - 2009	2009 - 2013
Finance	Finance	Finance
Home affairs	Home affairs	Home affairs
Housing	Housing	Human settlements
Agriculture and land	Agriculture and land affairs	Agriculture, forestry and fisheries
Arts, culture, science and technology	Arts and culture	Arts and culture
	Science and technology	Science and technology
Correctional services	Correctional services	Correctional services
Education	Education	Basic education Higher education and training
Defence	Defence	Defence and military veterans
Provincial affairs and constitutional development	Provincial and local government	Cooperative governance and traditional affairs
Environmental affairs and tourism	Environmental affairs and tourism	Tourism
Water affairs and forestry	Water affairs and forestry	Water and environmental affairs
Foreign affairs	Foreign affairs	International relations and cooperation
Post, telecommunication and broadcasting	Communications	Communications

1994 - 1999	1999 - 2009	2009 - 2013
Health	Health	Health
Justice	Justice and constitutional development	Justice and constitutional development
Labour	Labour	Labour
Minerals and energy	Minerals and energy	Mining Energy
Public enterprises	Public enterprises	Public enterprises
Public works	Public works	Public works
Public service and administration	Public service and administration	Public service and administration
Sports and recreation	Sports and recreation	Sports and recreation
Trade and Industry	Trade and Industry	Trade and industry
Transport	Transport	Transport
Welfare and population development	Social development	Social development
Safety and security	Safety and security	Police
	Intelligence services	State security
General affairs		Economic development
Reconstruction and development		National planning
		Performance, monitoring and evaluation
		Rural development and land reform
		Women, youth, children and people with disabilities
Total = 27 departments	Total = 27 departments	Total = 34 departments

Source: The presidency 1994-2012

The public sector of SA invests in infrastructure principally to address, amongst other things, the infrastructure backlogs emanating from the apartheid era.[2] According to Turok (2011), the fundamental aim of all the changes in the configuration of the public sector machinery since 1994 was to ensure effectiveness and efficiency in infrastructure delivery to correct the imbalances that were created by apartheid. Apartheid policies left a legacy of large infrastructure backlogs in what were formerly black areas while provision in formerly white suburbs was relatively lavish. Since 1994, the SA infrastructure departments (SAIDs) have

[2] Construction industry development board (CIDB 2004)

developed and implemented policies and funding norms that aimed to provide infrastructure in different areas more equitably (Rwelamila 2007). Public sector funding was prioritized on backlogs in infrastructure such as schools, hospitals and roads. The public sector was also determined to ensure that existing infrastructure does not deteriorate.

How much was spent? Table 5.2 illustrate both public sector and private sector investments that went into construction activity in the period between 1994 and 2011. Over this period, the percentage share of public sector construction investment was 79% of all investment that went into the construction sector. How these investments are spent is dealt with in the next section.

Table 5.2: Historical data on GSCI and PSCI in SA (R million)

Year	GSCI	PSCI	TCI	GSCI/TCI
1994	61 687	25 611	87 298	0.71
1995	73 919	26 521	100 440	0.74
1996	84 498	27 056	111 554	0.76
1997	94 635	27 987	122 622	0.77
1998	106 647	26 338	132 985	0.80
1999	104 553	25 980	130 533	0.80
2000	114 739	27 448	142 187	0.81
2001	127 859	28 800	156 659	0.82
2002	126 122	30 473	156 595	0.81
2003	142 386	31 575	173 961	0.82
2004	158 363	34 451	192 814	0.82
2005	162 651	38 558	201 209	0.81
2006	168 294	42 582	210 876	0.80
2007	174 204	45 350	219 554	0.79
2008	172 184	50 736	222 920	0.77
2009	196 447	47 684	244 131	0.80
2010	208 525	50 944	259 469	0.80
2011	169 451	52 676	222 127	0.76
Average	135 954	35 598	171 552	0.79

Source: Adapted from Statistics South Africa 1986-2011

Where: GSCI - public sector construction investment

PSCI - private sector construction investment

TCI - total construction investment

What is the impact of public sector investment on the construction sector? The percentage share of GSCI grew from a 71% in 1994 to 82% in 2001. As alluded to above, the average percentage share of GSCI between 1994 and 2011 was 79%. These figures suggest that the public sector is a major investor in the construction sector of SA.

According to Erenburg (2006) public sector spending increases the productivity of private capital. Athough Erenburg’s analysis was concerned with estimating the relationship of private and public sector investments, his findings may be construed to suggest that public sector investment may yield positive impacts on the construction sector. Therefore, it can be inferred that an increase or decrease in public sector spending in construction causes an increase or decrease in construction activity.

Rwelamila (2007) coined the abbreviation SAIDs to refer to the key government departments that deal with infrastructure. Included in the list are 5 departments, namely:

(i) Department of Public Works

This department exists to provide for and manage the accommodation, housing, land and infrastructure needs of national departments. It leads and directs the implementation of the national expanded public works programme. It also promotes growth, job creation and transformation in the construction sector. In 2012, the department spent about R8 billion (National Treasury 2013). As the principal provider of government building infrastructure, the department spends almost 100% of its budget allocation in construction related activity. Over and above the allocated budget, the public works department also rolls out infrastructure projects that are budgeted for under other service departments. For example, the following amounts were spent in infrastructure projects in 2012; the rural development and land reform department spent R8 billion, trade and industry department spent R7 billion, and the energy department spent R6 billion (National Treasury 2013).

(ii) Department of Human Settlements

This department exists to create sustainable human settlements and improved quality of household life. It supports the implementation, delivery and capacity building for effective housing programmes. Apart from coordinating and monitoring the implementation of housing projects, the department also deals with the upgrade and installation of new infrastructure such as sanitation. In 2012, the department spent R23 billion (National Treasury 2013). As the custodian for housing, the department of human settlements utilises 100% of its allocated budgets in the construction sector.

(iii)Department of Cooperative Governance

This department is responsible for the provision of household infrastructure and services to communities at local government level. In 2012, R11.7 billion (about 24% of the budget allocated to this department) was spent on the provision of infrastructure such as water, sanitation, local roads, stormwater drainage and electricity (National Treasury 2013). The delivery processes of such infrastructure creates employment opportunities and improves the quality of life in individual communities.

(iv)Department of Transport

The department is responsible for facilitating, coordinating and enabling the safe, reliable and effective movement of freight and people. It seeks to upgrade and build new roads, rail, ports and maritime infrastructure. In 2012, the department spent R35 billion (90% of the department's budget) in infrastructure projects (National Treasury 2013). The department of transport places emphasis in promoting job creation in construction and reducing its impact on the environment by promoting energy efficient solutions.

(v) Department of Water Affairs & Forestry

This department exists to ensure the efficient supply of water to people at all spheres of government, to facilitate sustainable social and economic development. As the custodian for SA's water resources, the department ensures that the resources are protected, managed, used, developed, conserved, and controlled in accordance with the relevant policy frameworks. The department spent R10 billion in developing and maintaining water reticulation infrastructure in 2012 (National Treasury 2013). About 90% of the department's expenditure go into water resource management and infrastructure development.

Clearly, the public sector plays an important role as client of the construction sector. The buildings and infrastructure that is created, mean that the construction sector contributes to enhancing the quality of life of all beneficiaries. However, the red tape associated with long supply chains negatively affect the delivery of projects on time, leading to costly project overruns (Construction industry development board 2008). The CIDB also observed that the magnitude of the monies involved tempt public officials involved in the procurement processes to manipulate the systems for personal gain. According to Sohail (2008), this leads to government failure such as rent seeking and corruption.

What has been the impact of public sector intervention in the construction sector of SA since the dawn of democracy in 1994? It is not clear if restructuring the departments has achieved any measurable improvements in the way the public sector operates, in particular, with regards to infrastructure delivery. New departments were formed and some existing ones restructured or replaced. In terms of the SA constitution, all government departments are required to be efficient, which includes observing particular ethical codes of conduct. In discharging their mandates, the SAIDs coordinated infrastructure developments that involved other service departments which are not necessarily part of the infrastructure cluster. These may include the delivery of schools for the department of education and clinics for the department of health.

How do the SAIDs coordinate infrastructure projects? The budgets for the required infrastructure is allocated to the service department. For example, the budget for a new hospital will be allocated to the department of health. For construction purposes, the budget is then transferred to the department of public works, which then serves as implementation agent for the department of health (Construction industry development board, CIDB 2004).

How did the different configurations of the public sector affect the construction sector? Various policy propositions have been employed by the public sector since 1994. These were designed to address critical issues such as the upgrading of physical infrastructure, the enhancement of technological capability and addressing the serious challenges of unemployment, poverty and inequity. According to the CIDB (2008), the construction sector has been the fastest growing sector of the SA economy since 1994. There is no obvious effect in the functioning of the construction sector that may be directly attributed to the different configurations of the departments. The SAIDs have not changed significantly since 1994 as illustrated in Table 5.1. However, the priorities that the different administrations set for themselves have evolved to some degree. Construction activity since 1994 has largely been underpinned by public sector investments in infrastructure such as roads, freight, sanitation, energy, schools and healthcare facilities. The public sector spending priorities over the period have also included infrastructure investments to support industrial development through ensuring that adequate infrastructure is in place and as a means of creating jobs.

In 2009 president Jacob Zuma's administration restructured the cabinet and created 7 new departments (Alexander 2010). These were created to deal with backlogs mainly in infrastructure delivery which had since 1994 remained major hurdles for the efficient functioning of the SA eonomy. For example, the department of housing was restructured and renamed the department of human settlements, with the fundamental mandate of addressing the slow delivery of basic housing infrastructure to citizens. This proves that the public sector interventions from 1994 to 2009 failed to address infrastructure backlogs in SA.

Has public sector intervention addressed the infrastructure backlogs created by apartheid in SA? Not necessarily. Whilst significant strides have been made, infrastructure backlogs remain a challenge for the SA government. According to the World Bank (2013), a range of enduring legacy issues from the apartheid system continues to undermine economic efficiency and job creation. The limited progress since 1994 in lifting the living standards of the majority and reducing the income inequality put the social contract under pressure and has grown into an open public debate. Service delivery protests by under-served groups suggest that parts of the population have become frustrated and disillusioned with the pace of infrastructure delivery. This resulted in wildcat strikes in various parts of the country (World Bank 2013).

A research conducted by Alexander (2010) in five municipalities that frequently experience service delivery protests revealed that such protests were about backlogs in infrastructure delivery and against the uncaring, self-serving, and corrupt leaders of municipalities. An important feature of the protests was the mass participation of civil society, in particular the unemployed youth and school students. A sense of injustice arising from the realities of poor infrastructure delivery and persistent inequality fuel the service delivery protests across the country.

The World Bank (2013) also identified that 25% of the SA population continues to live in sub-standard, informal dwellings. In 1994, this was at 21%. This signals that by 2013, the number of people that live in informal settlements had increased by 4% since the dawn of democracy. Despite the government's substantial investment in public infrastructure and free housing, spatial divisions and past development patterns persist. Wenzel (2007) argued that growth in infrastructure backlogs was fuelled by huge migrations from rural to urban areas. According to the national development plan (NDP), the required structural change to address the infrastructure backlogs will have to come from investment in employment-intensive growth, tackling the unemployment and education challenges together and improving the policy coordination and implementation capacity of the public sector (National planning commission 2012).

Some progress has, however, been achieved in the provision of social infrastructure and environmental management over the last 19 years (World Bank 2013). The World Bank reveals that public sector spending in infrastructure has supported the construction of 56 000 new classrooms and 1 700 new clinics, as well as their access to basic utility services. In addition, the report states that approximately two million free housing units have been constructed for low-income families. It states that household electrification has expanded substantially, with 73% of households electrified by 2009; and potable water supply and basic sanitation services were provided to additional nine million and 6.4 million people, respectively, during the same time period. The World Bank also reports that investment was also directed to the construction, rehabilitation and maintenance of 6,000 km of national roads and 15,000 km of provincial roads.

The public sector of SA has principally justified its involvement in the construction sector on the basis of correcting social infrastructure imbalances that were created by apartheid. After 20 years since the 1994 transition from apartheid to a democratic order, the statistics considered above present a mixed picture of the outcome. Notwithstanding the strides made, public sector intervention in the construction sector does not appear to have met the expectations of neither policy makers nor the poor. Why not? In what way has it fallen short? It may be argued here that although public sector intervention *per se* may be essential to correct underlying distortions in the market system but the existence of government failures make it all the more difficult to achieve desired outcomes.

5.4.2 Public sector investment flows

The SA constitution provides the basis for public sector financial management. Clear roles and responsibilities are assigned to the different spheres of government. The public sector of SA consists of three spheres of government and a number of state owned enterprises (SOEs). The three spheres of government are national, provincial and local governments. Public sector investment in infrastructure is channelled through the various spheres as illustrated in Figure 5.1. The investments shown in brackets were made in 2007.[3]

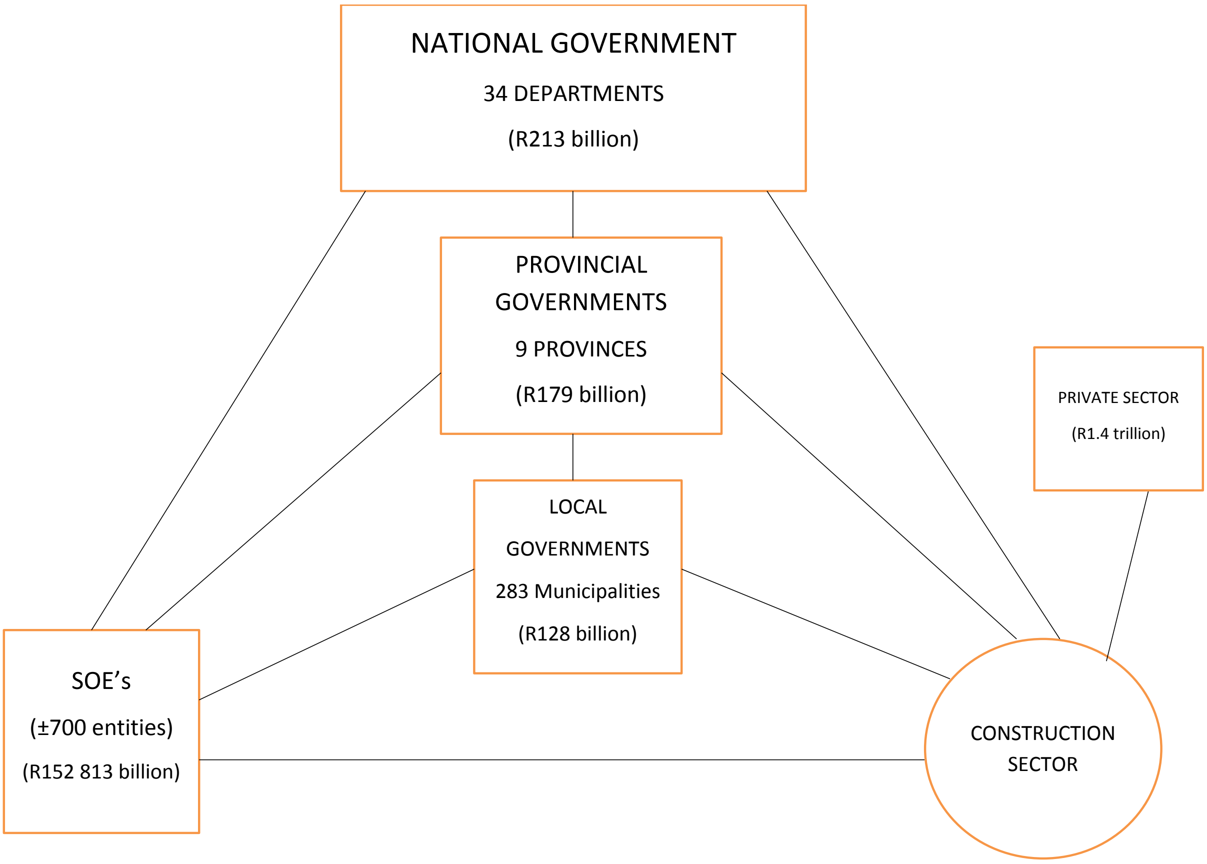


Figure 5.1: Flow of investments from public sector to construction sector

The public sector utilises the SOEs as entities through which it delivers specific infrastructure projects and services. At the level of national and provincial governments, the SOEs are linked to specific departments. Some municipalities also have their own SOEs, dedicated to

[3] Statistics South Africa (2011)

the delivery of specific services. A summary of public sector expenditure at the different spheres is shown in Table 5.3. Overall public sector spending is shown to be increasing year on year.

Table 5.3: Proportion of government expenditure to total public sector expenditure

	2004/05		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11		2011/12	
	Expenditure (R million)	Proportion (%)	Expenditure (R million)	Proportion (%)	Expenditure (R million)	Proportion (%)	Expenditure (R million)	Proportion (%)	Expenditure (R million)	Proportion (%)	Expenditure (R million)	Proportion (%)	Expenditure (R million)	Proportion (%)	Expenditure (R million)	Proportion (%)
National	167,289	30	194,723	32	212,629	31	242,632	32	289,346	32	346,103	33	359,106	31	370,688	31
Provincial	138,511	25	154,368	25	178,871	26	216,976	28	266,591	30	306,255	29	328,224	29	356,567	29
Local	97,162	17	83,410	18	128,106	20	114,450	15	139,337	16	163,177	16	191,441	17	205,084	17
SOEs	152,948	28	153,107	25	152,813	23	191,353	25	196,447	22	234,161	22	261,914	23	283,315	23
Total	555,910	100	585,608	100	672,419	100	765,411	100	891,721	100	1,049,696	100	1,140,685	100	1,215,654	100

Source: Adapted from SA National Treasury reports 2004-12

The composition of expenditure by functional category shows that 26.3% of total public sector expenditure went into economic services and infrastructure expenditure (see Table 5.4). The table shows that overall public sector expenditure on infrastructure continued to increase until 2007. About 40% of the infrastructure investment was spent by SOEs, mainly Eskom, on energy generation, transmission and distribution. Transnet also accounted for a significant share of the expenditure, which was used in developing harbours, railways and petroleum pipelines (National Treasury 2011).

Table 5.4: Actual expenditure by functional classification

	2004/05	2005/06	2006/07	2007/08
Central government administration	3.8%	4.0%	3.6%	3.9%
Financial & admin services	7.2%	6.2%	6.8%	6.8%
Social services	37.7%	37.0%	36.0%	35.3%
Justice & protection services	30.2%	29.8%	27.2%	25.8%
Economic services & infrastructure	21.1%	23.0%	26.3%	28.2%
Total	100%	100%	100%	100%

Source: National treasury budget reviews 2004-12

How did reform in the structure of the public sector affect investment flows into the construction sector? To answer this question, it is important to first understand the structure of the public sector as it relates to the construction sector. According to the department of public service and administration (DPSA), the post-1994 era has seen many rigorous structural changes being introduced as part of government's transformational drive to adapt and cope with the many dynamic contemporary challenges.[4] The DPSA observed that focused government departments and SOEs continued to be created to complement the already existing ones. Allied to this, new policies and strategies, such as the national development plan (NDP) have been put in place.[5] These transformational interventions place particular emphasis in key areas of the SA economy such as infrastructure development.

The CIDB identified 5 SA infrastructure departments (SAIDs). The NDP prioritised infrastructure development across 8 national departments and 5 SOEs, as illustrated in Figure 5.2. The departments of education, health, social development and cooperative governance, as do the other 26 departments, do not necessarily get directly involved in infrastructure delivery *per se*. Their involvement is indirect as it is limited to providing the necessary budgets, strategic guidance and political oversight.[4] The infrastructure departments and SOEs provide mainly project and programme management, while private construction companies are the ones that are engaged from time to time to do the actual project implementation. Some exceptional cases exist though where the infrastructure departments and SOEs undertake project implementation in-house.

[4] Department of public service and administration (2003)
[5] National planning commission (2012)

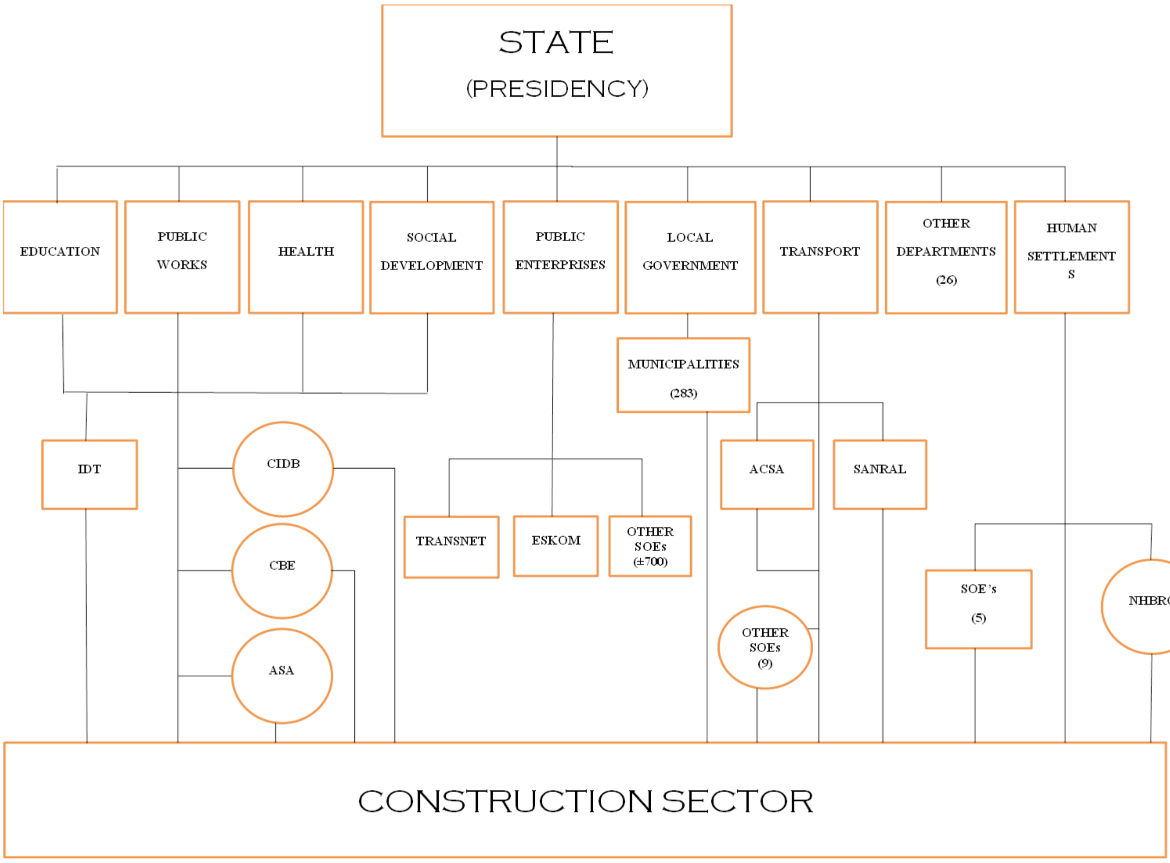


Figure 5.2: Structure of the public sector relative to the construction sector

Table 5.5: Key infrastructure departments

Government departments directly related to infrastructure				
Shortened name	Full name	Core function	Infrastructure expenditure (Rm) 2012/13	Percentage of total government expenditure on infrastructure
Presidency	The presidency	Synchronisation of the three spheres of government to achieve electoral mandate and achieve integrity of the state. Houses the presidential infrastructure coordinating commission.	-	-
Public works	Department of public works	Custodian and manager of all national governments' fixed assets. Determine accommodation requirements, render expert built environment services to client departments, acquire, maintain and dispose off such assets.	999.3	1%
Public enterprises	Department of public enterprises	Shareholder representative for government with oversight responsibility for selected SOEs.	-	-
Transport	Department of transport	Coordinating and regulating transportation, that is, roads, rail, civil aviation, shipping and freight.	26 273.6	27%
Human settlement	Department of human settlement	Establish and facilitate sustainable national housing developments.	23 458.8	24%
Government departments indirectly related to infrastructure				
Basic education	Department of education	Oversee basic education system. Funds construction of schools.	8 096.8	8%
Higher education and training	Department of higher education and training	Oversee higher education and training system. Funds construction of tertiary institutions.	1 800.0	2%
Health	Department of health	Improve health status and delivery system by focusing on access, equity, efficiency, quality and sustainability.	5 384.5	6%
Water	Department of water affairs	To ensure that all South Africans gain access to clean water, safe sanitation and also promotes effective and efficient water resources management.	5 048.3	5%
Cooperative governance	Department of cooperative governance and traditional affairs	Build and enhance the governance system in order to enable sustainable development and service delivery. Strengthen the capability and the accountability of provinces and municipalities to implement their constitutional mandate.	13 881.6	14%
25 other departments	(See Table 6.2)	Varies	12 498.2	13%
Total infrastructure expenditure			97 440.5	100%

Source: The Presidency 2013

The SA constitution provides that the country is a constitutional democracy with a three-tier system of government.1 The constitution also allows for the formation of SOEs which may be placed in any of the 3 tiers of government. Figure 5.1 and Figure 5.2 show the relationships of the different spheres of the SA government, as they relate to the construction sector.

Table 5.5 shows an outline of the major functions that each of the key SAIDs play in relation to infrastructure development. The amounts of expenditure on infrastructure for each department are also illustrated. The department of transport is shown to be having the largest infrastructure expenditure at R26.3 billion. It is followed by the department of human settlements and the department of cooperative governance with infrastructure expenditures of R23.5 billion and R13.9 billion respectively (National Treasury 2013). Why were these three departments allocated the biggest budgets in infrastructure?

In 2009, the country's administration that was elected took a decision to upgrade and build new infrastructure to steer economic growth and provide public goods (Presidential infrastructure coordinating commission 2011). Transport infrastructure, human settlements and service delivery to communities were given the highest priority. It is therefore not surprising that the departments concerned had the highest expenditure in infrastructure in the financial year 2012-13.

Table 5.5 also indicates the percentage proportion of total government infrastructure expenditure allocated to each department. The total government expenditure on infrastructure in the 2012-13 financial year was R97.4 billion. Of this amount, it is estimated that R90 billion (92%) of the total infrastructure expenditure went into infrastructure related to the construction sector (National Treasury 2013).

The infrastructure SOEs serve to complement the key SAIDs by facilitating and propelling the public sector investment processes. Apart from providing the necessary economic infrastructure, they are also mandated with creating a conducive and investor friendly environment (Wenzel 2007).

Table 5.6 outlines the list of key infrastructure SOEs as well as their core functions. The infrastructure SOEs serve to complement the key SAIDs by facilitating and propelling the public sector investment processes. Apart from providing the necessary economic infrastructure, they are also mandated with creating a conducive and investor friendly environment (Wenzel 2007).

Table 5.6: Key infrastructure SOEs

Infrastructure SOEs		
Shortened name	Full name	Core function
IDT	Independent development trust	Development agency that offers programme management and development advisory services for the eradication of poverty to government departments and other development partners.
ACSA	Airports company South Africa	Developer and operator of national airports.
SANRAL	South African roads agency limited	Strategically plan, design, construct, operate, rehabilitate and maintain South Africa's national roads.
Eskom	Electricity supply commission	Power utility. Engages in big construction projects of power generation infrastructure.
Transnet	Transnet	Developer and principal operator of national railways, seaports and fuel pipelines.
Regulatory SOEs		
CIDB	Construction industry development board	Systematically regulate, monitor and promote the performance of the industry for sustainable growth, delivery and empowerment.
CBE	Council for the built environment	To ensure sound governance of the built environment professions, in order to ensure the protection of public interest.
ASA	Agrément South Africa	Centre for the assessment and certification of innovative non-standardised construction products, systems, materials, components and processes.
NHBRC	National home builders regulatory council	Regulatory body of the home building industry. Protects housing consumers against substandard practices in design, workmanship and use of poor quality material in building.

Source: The Presidency 2013

How does the public sector intervene in the construction sector? To answer this question, each element of the 3 spheres of government as illustrated in Figure 5.1 and Figure 5.2 is described in detail to establish the microeconomic phenomena that explains how the public sector functions relative to the construction sector.

(a) The State

The SA constitution outlines that the most important role of the state is to be the trustee of the nation and to properly administer and to account for the monies it receives and to spend it effectively according to an agreed programme within its line function.

(b) National departments

The 34 national departments have cabinet ministers as political heads and directors general as administrative heads.[5] The SA constitution provides that members of the cabinet are collectively and individually accountable to parliament for the way in which they exercise their duties and perform their functions.

(c) Provincial government

In each of the 9 provinces the legislative authority is vested in the provincial legislature, while executive authority is vested in the premier. In the execution of his/her duties, the premier is assisted by an executive council composed of members of the provincial legislature.[4]

(d) Local government

The municipal council has to pass a budget for its municipality each year. They must also decide on development plans and infrastructure delivery for their municipal area.[6]

(e) SOEs

Apart from the 3 spheres of government, the SA public sector consists of a number of state owned enterprises (SOEs) that undertake specialised delivery of infrastructure and services

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[6] Department of provincial affairs and constitutional development (1998)

(see Figure 5.1 and Figure 5.2). A significant number of the SOEs exist to complement state departments that deal with infrastructure delivery (Table 5.6).

An important aspect of public sector intervention in the construction sector is how the different government spheres fund infrastructure projects. In the absence of the necessary funding it is difficult to see how each government sphere can be able to deliver on their mandate. How are infrastructure projects funded?

According to the NDP, the main challenge is to maintain and grow infrastructure to address the demands of the economy effectively and efficiently. The NDP identified that the public sector of SA is dominated by SOEs. It observed that there were no clear funding models for key infrastructure. The NDP argued that inadequate investment, alongside ineffective operation and maintenance of existing infrastructure was posing constrains to the economy. Therefore, although the public sector may have ambitious plans for upgrading the infrastructure, lack of funding for projects undermines such innovations.

The NDP also observed that poor investment decisions commit the state to continuing costs and subsidies that hinder other priority investments. The NDP noted that public sector investment levels were insufficient and maintenance programmes were seriously lagging. It provided that the public sector can achieve better outcomes by improving coordination of integrated development approaches. This means that the public sector alone cannot shoulder the level of investment required to address the infrastructure requirements of the economy.

The structure of the public sector has undergone several reconfigurations since 1994, in an attempt to make it effective and efficient. However, it would appear that it was not the public sector structure *per se* that was a major problem. Whilst there may have been problems with cooperation and good relations between the different spheres of the public sector, lack of funding seems to be the main problem (National Treasury 2011). According to the DPSA (2003), SA's inter-governmental fiscal system is based on a revenue-sharing model, with provinces largely dependent on transfers from the national government, while municipalities are only partially dependent on such transfers. Infrastructure projects that get delayed from time to time during construction as a result of funding shortages are common in the SA construction sector. This has a negative impact on the cashflows of construction firms involved.

The SA constitution provided that revenue generation is, by and large, reserved for the national government. Infrastructure development at provincial and local government spheres is funded through special grants from the national government. These grants may be conditional. This means that they need not be available to cover all provinces and could be dependent on the provinces receiving them adopting certain policies or doing certain things. Therefore, in order to receive these grants provinces may have to comply with certain directives from national government. Conditions attached to such grants could include monitoring provisions, specifications relating to the purpose for which the grants are to be used and time clauses.[4]

How does national government allocate funds for infrastructure developments? The presidential infrastructure coordinating commission (PICC) noted that although the national departments are responsible to implement some infrastructure projects, provincial and local governments perform major roles in the process.[7] A province or municipality with more people has more pressure on their budgets to spend in order to provide necessary infrastructure. Such province or municipality is likely to be allocated a bigger portion of the funds. According to the NDP, provincial governments are responsible for the implementation of major social infrastructure, such as schools, health facilities, housing and provincial roads. Since these functions have limited or no cost recovery potential, provinces are largely dependent on allocations from national government.

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[7] Presidential infrastructure coordinating commission (2011)

The DPSA also observed that local governments generally have more fiscal capacity than the provinces. It provided that although there are big variances among municipalities, they raise on aggregate about 90% of their own revenue. Municipalities can raise property tax and turnover/payroll regional levies on businesses, as well as user charges on the provision of electricity and water. However, although budgeting on the expectation of collecting all their revenue, many municipalities do not collect a significant portion of revenue due. This results in deficits at the end of the financial year, which can affect their capacity to roll out infrastructure projects.

5.4.3 Inception of infrastructure projects

The way the public sector of SA operates is underpinned by the fact that its work impacts on the lives of all its citizens. Nowhere is this phenomenon given a sharper focus than in the delivery of infrastructure. Infrastructure improves society's quality of life. Its provision yields social costs and benefits with spillover effects.

How do infrastructure projects originate in SA? The three spheres of the public sector are all responsible for the determination of priority infrastructure projects within their sphere of control.[3] What informs the identification of infrastructure projects in the different spheres of government? The national planning framework (NPF) provided that the priorities at each and every sphere of the SA government were informed by the electoral mandate.[8] How is the electoral mandate established in the different spheres of the government? According to the NPF, the electoral mandate comes from the national, provincial and local government elections that take place every 5 years. Each political party goes to the elections with a manifesto. If a political party wins the elections by a two-thirds majority, it is then said to have been given a mandate by the voters to go into government and implement their own policies as outlined in their election manifesto. Where no political party gets a two-thirds

[8] The Presidency (2001)

majority, government policies must be supported by a majority of the elected members of parliament, provincial legislature or local council.[1]

Based on the electoral mandate given in the polls, the cabinet at national government and the executive councils in provincial and local government set project priorities and take responsibility for their implementation.[8] Do they have the capacity to do that? Not necessarily. Their main focus is on winning votes in their constituencies. This results in white elephant projects. They are supported in this regard by managers and the public service at large.

The NPF also provided that the planning process for infrastructure projects must also take into account how global and domestic conditions may change over time. According to the DPSA this planning process is outlined in detail in the medium term strategic framework (MTSF). What is the MTSF? The MTSF is a statement of intent identifying the development challenges facing SA and outlining the medium term strategy for improvements in the conditions of life of South Africans and for the enhanced contribution to the course of building a better world.[8]

The MTSF provides that the national and provincial spheres of government need to develop their five-year strategic plans and budget requirements taking into account the medium term imperatives. The strategic plans are reviewed annually to ensure that all priorities remain relevant. In the same vein, municipalities are expected to generate their integrated development plans (IDPs) in line with the national medium term priorities. What are IDPs? IDPs are the development plans that all local governments are required to make through an integrated system of planning and service delivery involving all stakeholders.[5] They contain short, medium and long-term development objectives and strategies for each municipal area. The planning process is meant to arrive at decisions on key issues such as municipal budgets, land management, promotion of local economic development and institutional transformation in a consultative, systematic and strategic manner. According to the department of cooperative governance and traditional affairs (DCGTA), the process not only informs municipal management of key issues, but also guides the activities of other spheres of government.[9]

The public sector of SA has since 1994 been involved in the racial and spatial integration of its 3 spheres in accordance with the new constitutional requirements. It intervened in the construction sector through various investments in infrastructure. Central to such intervention was to correct the imbalances in the allocation of resources caused by apartheid. What has been the impact of such intervention? The picture that emerges is not a pleasant one. There are still major challenges of poverty, unemployment and inequality.[10]

5.4.4 Infrastructure delivery

To place the infrastructure delivery dynamic in perspective, the research also seeks to understand the context of the infrastructure delivery process through the public sector and the role of SOEs in this process. These dimensions present particular challenges for infrastructure delivery. Does the public sector have the capacity to deliver infrastructure? A coherent understanding of the SA economic and development policies in the short, medium and long-term as well as their strategic implications for the construction sector is crucial. The utilisation of SA's strategic sectors such as construction to deliver infrastructure is important. The complexity that characterises infrastructure projects means that it is not possible for the public sector to have all the necessary expertise in-house.[11]

Apart from the SA infrastructure departments (SAIDs), the public sector of SA also undertakes specialised delivery of some major infrastructure projects such as energy generation plants through SOEs. A significant number of these SOEs exist to complement

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[9] Department of cooperative governance and traditional affairs (2011)
[10] The Presidency (2012)
[11] African National Congress (2012)

the SAIDs. For example, Figure 5.2 illustrate that the independent development trust (IDT) exists to complement the department of public works. The IDT acts as implementation agent for infrastructure projects belonging to departments such as education, health and social development (CIDB 2004). The SOEs operate more as extensions of the SAIDs as they also engage private construction firms to execute the actual work from design to construction. So why are the SOEs necessary? It is not quite clear. However, there is an element of the SOEs being a duplication of the SAID's functions.

As illustrated in Figure 5.1 and Figure 5.2, SOEs form part of the public sector landscape in SA. They were created, in part, as a result of market failures (Turok 2011). What were the market failures? The infrastructure SOEs identified in Table 5.5 deal mainly with the delivery of public goods such power generation (Eskom) and transport networks (Transnet). As argued in the literature review the nature of public goods is such that they cannot be confined to those who have the ability to pay for the infrastructure. The use of such infrastructure by one household will not reduce its availability to others. If left to the free market mechanism, such goods would not be provided equitably, resulting in market failure. SOEs serve to significantly advance the levels of economic transformation in SA.[12]

What mitigated the formation of the SOEs in SA? According to the ANC strategy and tactics document, the 1994 democratic breakthrough provided the new government with the opportunity to pursue economic policies, which hold inclusive development and wealth distribution at its core in order to bridge the inexorable gap between the rich and the poor.[12] It was thus identified that within that context, that there existed a definite need to amplify the role of SOEs as instruments for significantly advancing the levels of transformation that the country needed. The ANC strategy and tactics document stated that SOEs were not created to maximise profits nor incur losses. It is argued in the document that their existence was for the purpose of driving the development agenda. Central to the development agenda was the provision of infrastructure such as transport networks, sanitation, electricity, human settlements and health facilities. The dual mandate of the SOEs as defined in the ANC policy document was to achieve a balance between the required level of self-funding and undertaking developmental projects that the private sector would ordinarily not have incentive to pursue. The SOEs are tasked with the implementation of costly developmental mandates on the understanding that they are strategically better positioned to source funding and steer projects.

According to statistics on fixed capital formation, the SARB (2009) reported that while the central government created fixed capital of R600 billion in 2008, SOEs created R465 billion of fixed capital. Therefore, the total fixed capital created by the public sector in 2008 was R1.07 trillion. In the same year, the private sector created fixed capital of R1.4 trillion. While the private sector is clearly more dominant, SOEs also appear to play a phenomenal role in capital formation in the SA economy.

Is there a comprehensive portrait outlining the key roles of SOEs? The SOEs that were created pre-1994 appear to have been formed for different reasons (Turok 2008). The apartheid government's drive was to enhance the self sufficiency of the country and this required the development of in-house capabilities to manage several strategic economic growth drivers. However post-1994, several of these enterprises continued to be managed as SOEs in an economic and political climate very different from that of the apartheid era. Over time, the definition and reference of these institutions gradually evolved. Some inherent tension between the interests of the public and those of SOEs developed (Turok 2011). According to Turok, the existent level of tension was more conspicuous when individual communities took to the streets in protest over poor service delivery. There are many reasons underlying the problem of infrastructure delivery through SOEs. The ANC view that SOEs were not created to maximise profit contradicts its view that they were also not created to incur losses. Short-term commercial objectives are driven by capital market returns that may supersede developmental objectives.

5.4.5 Infrastructure funding

Public sector investment provides the infrastructure through which goods are transported, the economy is powered, and households and business are connected to services and markets. Who funds public sector projects in SA? According to Gordhan, minister of finance, infrastructure projects steered by the public sector are financed through the fiscus, SOEs' balance sheets, taxes, private sector investors, and by raising funding from multilateral finance institutions and foreign investors.[13] The fiscus is used mainly to finance infrastructure such as schools, courtrooms, hospitals and rural roads. SOEs such as Eskom and Transnet finance their respective infrastructure projects from their own surpluses and by borrowing from the capital market by issuing long-term bonds. This means that they have to generate sufficient revenue from tariffs and charges to repay debt over time, and cover operating and maintenance costs. In some cases a mix of tax finance and cost recovery is appropriate. The SA public sector minimises the impact of cost recovery on poor communities by subsidising the provision of public goods and services such as commuter transport, electricity and water services.[12]

Gordhan noted that local and foreign investors were also key players in funding infrastructure projects. He provided that over 1 200MW of renewable energy projects were in 2011 tendered to independent power producers. Gordhan pointed out that the use of construction and operating concessions was another way the public sector utilizes to attract private investors. These concessions include the construction and management of industrial development zones, port operations and toll routes. According to Gordhan, SA has deep and liquid capital markets through which long-term capital can be raised at competitive rates by the public sector including SOEs. He said the country's development finance institutions were capable of raising capital and co-financing infrastructure projects. These are considerable strengths that mean the public sector of SA does not have to rely on expensive

[12] South African National Treasury (2012)

external finance to fund infrastructure projects. If it is indeed that simple to fund infrastructure projects in SA, why are there still significant backlogs in infrastructure delivery as identified in the NDP? The NDP cited funding problems as the major issue that cause infrastructure backlogs (Presidential infrastructure coordinating commission 2011).

Many infrastructure projects have a social and commercial component, and therefore cannot rely on a single source of funding. According to Nene, deputy finance minister, this requires a hybrid financing approach. The optimal financing structure needs to be tailored on a case-by-case basis to fit the specific nature of the infrastructure project. Nene stated that although infrastructure projects would remain heavily reliant on public sector funding, government had limited capacity to pay for everything. This means that the role of the private sector in financing infrastructure projects cannot be under-estimated. Are there any constraints to public sector funding of infrastructure projects? Public sector expenditure is limited by how much tax revenue government can collect without hurting the economy and how much debt it can borrow. According to Nene, these abilities are from time to time constrained by the weak global economic conditions that frequently prevail.[13]

How are allocated project funds spent? In his 2009 budget speech, Gordhan stressed that the government would improve the delivery of infrastructure through a range of measures. He said that the government would crack down on departments and municipalities with a poor record for spending funds made available to them to improve infrastructure.[13] According to National Treasury (2013), between R25-30 billion of the SA public sector procurement budget was lost annually to corruption, negligence and incompetence by public officials in the different spheres of government. The report revealed that about 86% of such cases related to procurement to do with infrastructure delivery, where project requirements were overstated or tailored to fit specific bidders. This suggests that some funds are not used as intended.

What are the underlying causes for failure to use allocated funds? Manuel, national planning minister, identified government's lack of capacity to implement projects as a challenge that needs to be overcome.[13] He indicated that the SA economy was constrained by inadequate capacity of the public sector to implement infrastructure projects. Why? The national planning commission, NPC 2012) identified major constraints to include poor coordination and integration, multiple priorities and an unidentified hierarchy of authority among the plethora of government departments and SOEs involved in infrastructure projects.

Corruption in the public sector of SA affects infrastructure delivery in many ways. According to the NPC (2012), corruption critically undermined infrastructure delivery. The NPC argued that in a democracy it was crucial for political leaders and public officials to account to the citizens for their actions. The SA Constitution (1996) stipulated that a system of institutional checks and balances including parliament, oversight institutions and the judiciary were important to combat corruption and facilitate improved outcomes in infrastructure delivery. Sohail and Cavill (2006) also attested to this, in that institutional channels of accountability such as, an independent judiciary, parliamentary oversight and anticorruption commissions had the potential to combat corruption.

According to the SA Constitution (1996), political leaders and public servants are required to maintain a high standard of professional ethics. However, the observation by National Treasury (2013) that between R25-30 billion of the SA public sector procurement budget was lost annually to corruption, negligence and incompetence by public officials in the different spheres of government is evidence that a large number of public officials fail to live up to the constitutional standard. The diagnostic report of the NPC (2012) revealed that the SA public sector suffers from high levels of corruption that undermine the rule of law and hinder infrastructure delivery. The costs of corrupt practices fall most heavily on the poor because they degrade the quality and accessibility of public services.

[13] The Presidency (2009)

Is the constitutional provision of having institutional checks and balance in force? Apparently not. The NPC (2012) found that public sector systems of accountability were uneven. Why? The NPC argued that there was no political will. As a result, corruption was exacerbated to thrive. While institutions such as the office of the public protector may be doing sterling work in exposing corruption in the public sector, without the political will of the executive to implement recommendations, their work is stifled.

5.5 Discussion

The public sector of SA intervenes in the construction sector mainly through investment in infrastructure. Does this enhance or impede the way the construction sector operates? The picture that emerges is a mixed one. The data shows that public sector intervention in SA has implications on private investment, resource allocation and overall construction output. These aspects affect the way the construction sector functions in several ways. Focus of this discussion has been based mainly on issues that directly affect the construction sector in order to answer the research question: What is the impact of public sector investment on the construction sector? The picture that emerges is a mixed one. There are problems and benefits that exist (see Table 5.7 and Table 5.8).

It would be of interest to understand if it is necessary for the government to be involved in the construction sector. The literature reviewed in chapter 3 dealt with this question at length in the context of market and government failures. The neoclassical school of thought believed that the market can work on their own, with competition as the driving force (Wolf 1989). This view reduces the public sector role to only ensuring law and order and providing public goods. The neoclassical school of thought believed that any intervention by government in any sector of the economy would result in severe shocks, frustrate the workings of the market and distort growth.

Table 5.7 and Table 5.8 summarize the problems and benefits respectively, of public sector investment in the SA construction sector that this economic analysis has found. These are related mainly to the reconfiguration of the SA government that has occurred 3 times since 1994, the investment flows and the implementation of infrastructure projects. Most of the investment that goes into the construction sector of SA is done by the public sector, since there is no incentive to private investors to finance infrastructure projects such as roads and schools.

Table 5.7: Identified problems of public sector investment

Issues related to structure		
Problems	Evidence	Justification
Big government structure costs more. High administrative costs compromise infrastructure delivery since money for projects gets diverted to cover overheads.	The South African Reserve Bank (2006) found that increasing the number of national departments increases the resource requirements in the public sector.	Since public sector administration costs are funded from the fiscus, other government priorities such as the delivery of infrastructure are negatively affected.
Big structure has long supply chains, which delay project decisions.	The construction industry development board (CIDB 2008) observed the existence of red tape associated with long supply chains.	The bureaucracy that comes with a big structure mean that it takes long to make decisions, which affects the delivey of projects on time.
Infrastructure backlogs in local government areas lead to service delivery protests.	A research conducted by Alexander (2010) in five municipalities that frequently experience service delivery protests revealed that such protests were predominantly about backlogs in infrastructure delivery.	Policy makers use promises such as job creation and better infrastructure to win votes. When such promises are unfulfilled, the electorate feel deprived and resort to service delivery protests.
Infrastructure imbalances caused by apartheid still persist.	Wenzel (2007) found that economic inefficiency in major sectors, including construction mean that limited progress has been achieved in achieving balanced delivery of infrastructure. According to the World Bank (2013), 25% of the SA population still lack basic infrastructure and live in informal settlements.	The SA government has changed the structure of the public sector from one administration to the other, on the understanding that it wants to improve among other things infrastructure delivery. The evidence show that infrastructure imbalances have actually increased by 4% since 1994.

Fragmentation of construction work in various departments.	Ten national departments and five SOEs are key to the delivery of construction related infrastructure (Rwelamila 2007). According to Alexander (2010), the creation of 7 new departments by president Jacob Zuma in 2009 was done to address backlogs mainly in infrastructure delivery.	The fragmentation of construction activity over so many departments complicates the delivery of projects. Rwelamila (2007) found that this leads to departments competing among each other for work and deliberately stifling the release of approved project funds.
Issues related to investment flows		
Problems	Evidence	Justification
Inadequate funding. Most projects are financed through the fiscus, SOEs' balance sheets, rates and taxes.	The NDP cited funding problems as the major issue that cause infrastructure backlogs (Presidential infrastructure coordinating commission, PICC 2011). The department of public service and administration (DPSA 2003) identified that infrastructure projects are delayed during implementation due to funding shortages. The PICC (2011) also found that funding problems caused infrastructure backlogs.	Funding shortages not only derails infrastructure delivery but also has a negative impact on the cashflows of construction firms that get involved. This suggests that public sector investment can frustrate the functioning of the construction sector.
Large sums of money involved attract government failure through public officials manipulating procurement systems for personal gain.	According to National Treasury (2013), between R25-30 billion of the SA public sector procurement budget was lost annually to corruption, negligence and incompetence by public officials in the different spheres of government.	Gordhan, minister of finance, outlined measures that the government was going to take to deal with corrupt public officials who manipulate public sector procurement rules (The Presidency 2013). This confirms that all is not well in the way that project funds are spent.
Some government departments do not have capacity to spend allocated budgets.	According to National Treasury (2013), the SA government undertook strict steps to crack down on departments and municipalities with poor records for spending funds made available to them to improve infrastructure.	The evidence show that while the SA government does make funds available for infrastructure projects through the fiscus, some departments and municipalities fail to utilize such funds. This points to capacity problems.
GSCI is dominated by SOEs.	In 2005, SOEs constututed 28% of total	Table 5.6 show that a

	public sector expenditure (see Table 5.3). This was the second highest expenditure after national government, which was at 30% in the same year. According to National Treasury (2012), construction related infrastructure constitute approximately 80% of total expenditure of SOEs.	significant number of SOEs exist to complement state departments that deal with infrastructure delivery. The problem is that there is too many of these SOEs. Some have no clear funding models for infrastructure (National planning commission, NPC 2012).
SOEs sometimes tend to compete with construction firms for jobs from non-SAIDs.	Figure 5.2 on page 132 shows SOEs such as IDT and SANRAL as middle-entities between the government departments and construction firms. Some departments engage construction firms directly. This then creates a situation where infrastructure SOEs tend to compete for jobs with private construction firms. This was confirmed by the NPC (2012).	SOEs form part of the public sector. For them to compete with private construction firms for public sector jobs presents an unfair advantage to construction firms.
No clear funding models. Projects are delayed and construction firms are not paid on time.	The NPC (2012) observed that some infrastructure SOEs had no clear funding models.	Having SOEs in the middle of the supply chain between departments and construction firms increases administration costs and payment delays.
Poor investment decisions result in white elephant infrastructure.	The NPC (2012) observed that poor investment decisions commit the state to continuing costs and subsidies that hinder priority.	The influence of self-serving public officials results in the development of infrastructure that is not fully utilized upon completion. This suggests that there are incidences of misguded investments.
Issues related to implementation of infrastructure projects		
Problems	Evidence	Justification
SOEs make public sector supply chain longer for construction firms, which delays payments and frustrates decision making processes.	The CIDB (2004) found that long supply chains hamper the possibility of improving value on projects. The problem of delayed payments affects the contractor's ability to buy building material and pay workers. It can cause small contractors to go out of business.	The evidence show that even where the SOE is involved on a project, payments and key decisions must still be made by the client department. The client department pays the SOE, and the SOE pays the

	Delays in getting key decisions leads to programme overruns, which can distort project budgets.	contractor. The same process goes for decision making.
Electoral mandate raises the risk of GSCI being used for political point scoring.	Based on the electoral mandate given in the polls, the cabinet at national government and the executive councils in provincial and local government set project priorities and take responsibility for their implementation (The Presidency 2001).	According to the national planning framework, the planning process for infrastructure projects must also take into account how global and domestic conditions may change over time. There is no evidence to prove that such considerations are made when initiating projects.
The public sector lacks project management expertise which frustrates project implementation.	According the African National Congress (2012), it is not possible for the public sector to have all the necessary expertise in-house.	It is argued that critical project implementation skills are in the private sector (construction firms). Therefore, implementing projects through SOEs frustrates the process.

Table 5.8: Identified benefits of public sector investment

Issues related to structure		
Benefits	Evidence	Justification
Big government structure mean that there is adequate capacity and more focus.	It was necessary to transform the public sector from what it used to be under the apartheid government so that it becomes responsive to the needs of the majority (Wenzel 2007).	Three structural changes implemented between 1994 and 2012 as outlined in Table 5.1 were done to strengthen public sector capacity and improve infrastructure delivery.
Correction of construction sector imbalances created by apartheid.	The black economic empowerment policy advocated for the corrrection of imbalances in the construction sector that were created by apartheid (CIDB 2004).	This was to be achieved by seeking to substantially and equitably transfer ownership, management and proportionate control of SA’s financial and economic resources to the majority of citizens.

Infrastructure spending has increased significantly since 2009. This means more work for the construction sector.	Table 5.2 show that public sector construction investment increased from R172 billion in 2008 to R209 billion in 2010.	Construction is labour intensive. Therefore, an increase in construction investment will lead to more people being employed in the sector.
Issues related to investment flows		
Benefits	Evidence	Justification
GSCI is 79% of TCI. This is likely to increase the productivity of capital and the construction sector will benefit through PSCI.	The public sector of SA is shown to be a major investor in construction activity. According to Erenburg (2006) public sector spending increases the productivity of private capital.	The public sector invest in the development of infrastructure such as roads. Good infrastructure attracts investment into other sectors of the economy.
GSCI enables the construction sector to contribute to enhancing the quality of lives of beneficiaries of construction products.	The department of human settlements exists to create sustainable human settlements and improved quality of household life (National Treasury 2013).	Infrastructure such as housing, water, and sanitation enhance the quality of life of society. Therefore, public sector investment in this regard is vital to providing a better life for all.
GSCI leads to growth of construction sector.	Erenburg (2006) found that an increase or decrease in public sector spending in construction causes an increase or decrease in construction activity.	Increased construction activity yields increased construction output. Increase in annual change of construction output mean that there is growth in the construction sector.
GSCI boosts job creation in construction.	The department of public works exists to growth, job creation and transformation in the construction sector (National Treasury 2013).	Through initiatives such as the expanded public works programme, public sector investment play an important role in job creation in the construction sector (see page 124).
SOEs have capacity to bring in private capital through borrowing.	SA has deep and liquid capital markets through which long-term capital can be raised at competitive rates by the public sector including SOEs (National Treasury 2012).	SOEs are able to raise funding for infrastructure projects from private investors and multilateral finance institutions, using government gaurantees as security.

GSCI keeps the construction sector active.	Construction activity is labour intensive (CIDB 2008).	An increase in public sector investment creates more jobs.
Issues related to implementation of infratructure projects		
Benefits	Evidence	Justification
Construction sector complements skills that the public sector does not possess.	The SOEs operate more as extensions of the SAIDs as they also engage private construction firms to execute the actual work from design to construction (Rwelamila 2007).	The public sector relies on construction firms for critical skills required to roll out infrastructure projects.

These findings suggest that the involvement of the public sector in construction activity in SA is clouded with more problems than benefits. To what extent should the public sector role be limited? Edwards (1992) argued that successful economies benefited from policies that gave markets leeway through limiting the role of the state in economic decision making. The public sector can provide the necessary infrastructure but leave key aspects of decision-making, such as production decisions to the construction sector.

What should be the limits of infrastructure provision by the state? The neo-classical approach generally advocates that forces of demand and supply are sufficient to determine the levels of infrastructure provision. The underlying assumption is that individuals will make rational choices based on knowledge acquired through widely available information. North (2010) presented a counter argument in that, individuals do not always make rational choices. They may not take into account the social costs of their choices. They may also have insufficient relevant information and limited mental abilities to process that information especially in developing economies.

Williamson (1971) stated that another objection to the neo-classical perspective comes from the international arena, where the interests of a nation can only be articulated by the state and not markets. The findings of this case study have shown that the public sector of SA intervenes in the construction sector mainly to correct the inequalities caused by apartheid. It is therefore hard to see how such inequalities may be addressed by the market mechanism alone. What is the impact of the SA public sector intervention in the construction sector since the dawn of democracy in 1994? While policy documents such as the RDP articulated ambitious public sector plans to make significant investments in infrastructure, most of the government reports studied here, such as those of the SA National Treasury show little evidence of phenomenal progress in addressing the inequalities caused by apartheid.

Like market failures, the inequalities caused by apartheid in SA present particular challenges for the public sector. Whilst these inequalities justify public sector intervention, the existence of government failures reduces the significance of such intervention. For example, frontline corruption is not seen as important in the larger context of corrupt transactions relating to construction activity (Hollands and Sohail 2007). An important finding by Hollands and Sohail was that corruption in SA was seen as more rampant at the executive (political) level than at the administrative level. They also found that corruption that occurs at this level was very difficult to trace because it often left no paper trail.

Recently, the NDP reiterated the SA government's resolve to eradicate rampant corruption and rent seeking from all spheres of the public sector. Government failures such as rent seeking occur when public sector decisions are made leading to resource allocation that maximises the benefit to the decision maker at the expense of other parties. This is particularly destructive to construction firms who must make profit to remain in business. It also significantly compromises the delivery of public goods to poor communities.

Does the prevailance of corruption in an interventionist economy make the market system better? No. Neoclassical thinking fails to show how an economy may be cushioned against market failures if governments do not intervene in economic decisions. Neoclassicists assume that the market failures will correct themselves in the long run, but empirical evidence from Africa's experience with structural adjustment programmes reinforces the belief that government intervention is necessary (Turok 2011).

The public sector of SA exerts a lot of influence in the construction sector through its role as a client. This manifests itself in all 3 spheres of the public sector, including the SOEs. Public sector construction investment accounts for a large proportion of total construction investment in the SA economy (see Table 5.2). The responsibility for the implementation of key construction projects is diffused through the SAIDs and selected SOEs (refer to Figure 5.1 and Figure 5.2).

The variations in the structure of departments differ widely at provincial level, since each province can only have a maximum of 10 departments and they have the autonomy to structure their departments in the best way that meets the provincial conditions. So, related departments are clustered together, in line with the services demands of each province. For example, public works and transport falls under one department in Mpumalanga province. It is also not abnormal, for instance, to find the department of health in KwaZulu Natal province running its own construction programmes. This creates a lot of fragmentation. Local government authorities (municipalities) also run some construction programmes on their own.

To what extent is the public sector involved in construction? The SA public sector exercises a considerable amount of control over the type, location, standard, technology and procurement methods used in the execution of its construction projects. Such involvement is prevalent even if the public sector commissions private construction firms to execute the actual construction programmes. What is the process of implementation? There is no clear cut-line in terms of how public sector construction projects are done. For instance, in certain projects the national public works department may exercise an even greater degree of control by assuming direct responsibility for the design. In such instances, they will have their own in-house design teams. It is however not clear as to the criterion that is used to determine which projects must be executed in this manner.

The ANC strategy and tactics document identified that the delivery of public sector projects is very often hampered by the public sector's lack of capacity and the consequent inability to spend budgets.[16] Does the creation and use of SOEs to deliver construction projects assist in addressing inefficiencies in the public sector of SA? Apparently not. According to the presidential review commission on SOEs, a majority of the over 500 SOEs operating in all sectors of the SA economy are inefficient and wasteful.[14] Administrative capacity and accountability of most SOEs is a serious challenge. In its economic policy document, strategy and tactics, the ANC initiated a reform programme of the SOEs as part of the overall transformation process of the public sector.[15] This means that although so many SOEs have been formed since 1994, they have not necessarily assisted in correcting inefficiencies of the public sector. This affects the construction sector.

Gupta (2006), in his study of privatisation, found that SOEs are extremely inefficient due to rent-seeking by politicians and workers, protection from competitive forces, and the absence of market-based incentives for workers. As a result they are a significant drain on government resources. Gupta argued that privatising SOEs could attract foreign investment, increase domestic investment, develop financial markets, and release scarce public funds for other uses, such as investment in infrastructure.

SOEs have been, and to some degree continue to be the primary vehicle for public sector infrastructure investment in SA. This gives construction firms an unfair competition for work. What is the effect of infrastructure delivery through SOEs? Kahle (2007) provided that political and social objectives sometimes outweighed business objectives, which caused poor performance. SOEs are often formed for political reasons as opposed to objective

[14] The Presidency (2013)
[15] African National Congress (2012)

business reasons.[16] The construction sector is particularly affected by this as most of the big construction contracts are implemented through SOEs.

Turok (2011) argued that there is a natural conflict between the commercial interests of SOEs and the government developmental interests. This suggests that there is a lot of political interference in the way the public sector of SA gets involved in construction. While, a majority of the public sector construction projects may have good commercial and social intentions, this is undermined by personal interest of decision makers.

5.6 Overview of public sector intervention in construction

The inability of the market system to provide infrastructure has been used as justification by most governments around the world to intervene in construction activity. The inequalities created by decades of apartheid rule in SA are predominantly used as justification for public sector intervention in the construction sector. However, the existence of government failure counters any usefulness of public sector intervention in construction.

Some problems arise when the public sector intervenes in the construction sector through its investments in economic infrastructure and public goods. Whilst such intervention is done with positive purposes, such as correcting market failures and stabilizing demand in the construction sector, the consequent government failures undermine the intervention. Government failures make it difficult for construction firms to thrive in the mist of corruption, rent seeking and inefficiency of the public sector.

Where public sector investment in the construction sector is professionally handled, such investments have a potential of positively influencing the productivity of private capital. This helps to create more job opportunities for the construction sector as private investors are inspired by good economic infrastructure to invest in other economic activities, such as

[16] National planning commission (2012)

factories. When this happens, an increase or decrease in public spending is likely to cause an increase or decrease in private investments. This has a positive impact on construction investment and growth of the sector. Increased or decreased total construction investment will influence total construction output and job creation.

The opportunity exists for the public sector to use its involvement in the construction sector to eliminate any inequalities of market failure and to correct the counter forces of government failure within its ranks. Its involvement should seek to create a more stable and secure environment for sustainable investment in the construction sector. The public sector can also ensure that the institutions of accountable governance are strengthened. These institutions will provide the necessary checks and balances against government failure.

Chapter 6: SA construction and growth

This chapter employs the time series statistical method to answer the first question of what the relationship of the construction sector is to economic growth. As reflected in the literature, the construction sector is considered as an investment sector. Investment influences economic growth. Given such arguments, it is of interest to understand why LDCs like SA are not using the construction sector to stimulate growth in their economies. It would appear that current understanding of the relationship of the construction sector to economic growth is insufficient.

6.1 Policy background to SA construction sector analysis

Growth in the construction sector of SA in the period before 1994 was constrained by economic isolation and internal structural inadequacies due to apartheid. Investment in infrastructure dwindled. Marginalization of black people undermined infrastructure development in the areas where they lived. Under the apartheid system, black people were designated and forced to live in townships and rural areas (Du Plessis and Smit 2006).

The apartheid system of governance affected the functioning of most sectors of the SA economy including construction. By 1990, the apartheid government had become very unstable. This led to dismal economic performance and an inability to create new jobs as illustrated in Figure 6.1 to Figure 6.3. Between 1990 and 1992, economic growth and employment recorded negative movements.

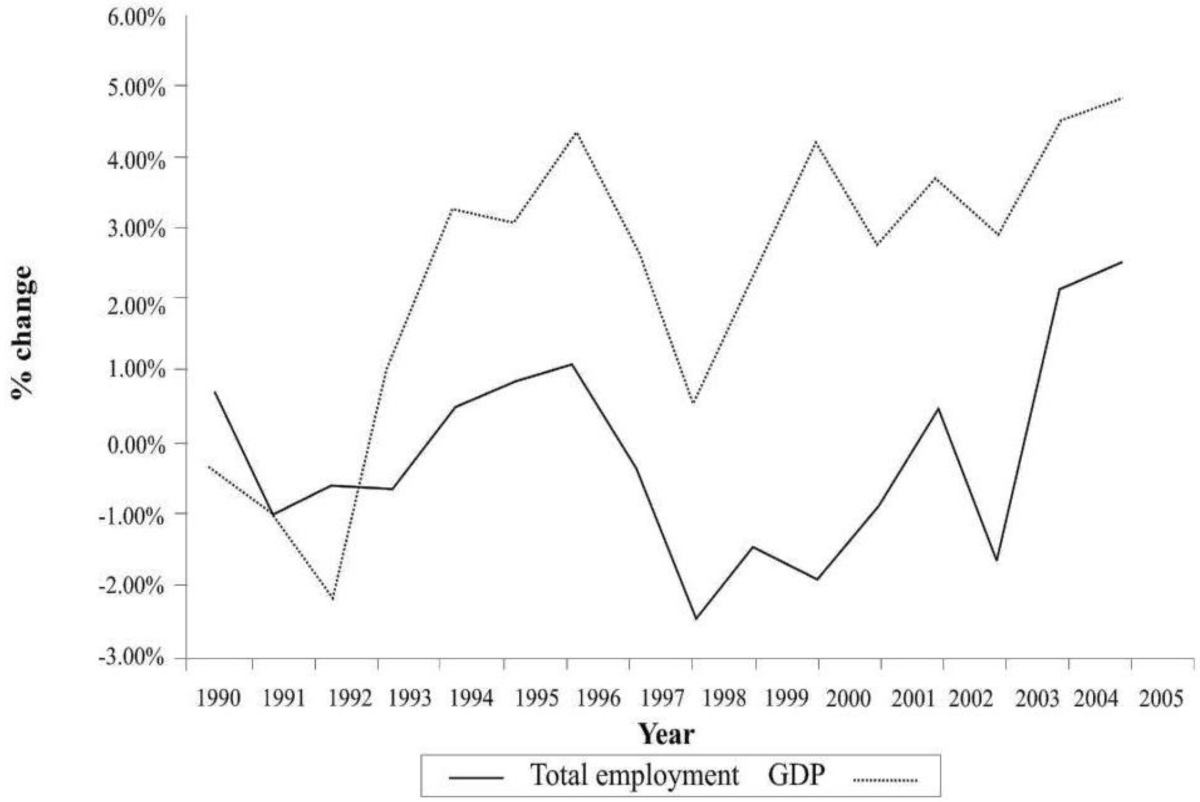


Figure 6.1: Economic growth and employment, non-agricultural sector, 1990-2005 (constant)
Source: South African Reserve Bank, Quarterly Bulletin

Unemployment reached epidemic aggregates with an average rate of -3.6% recorded between 1990 and 1993 (Figure 6.1). Inflation aggregates reached alarming levels of more than 15% by 1991. Balance of payments instability due to economic sanctions and a lack of foreign direct investment reached chaotic proportions, with the level of gross foreign reserves dwindling to less than $2 billion (Rodrik 2006).

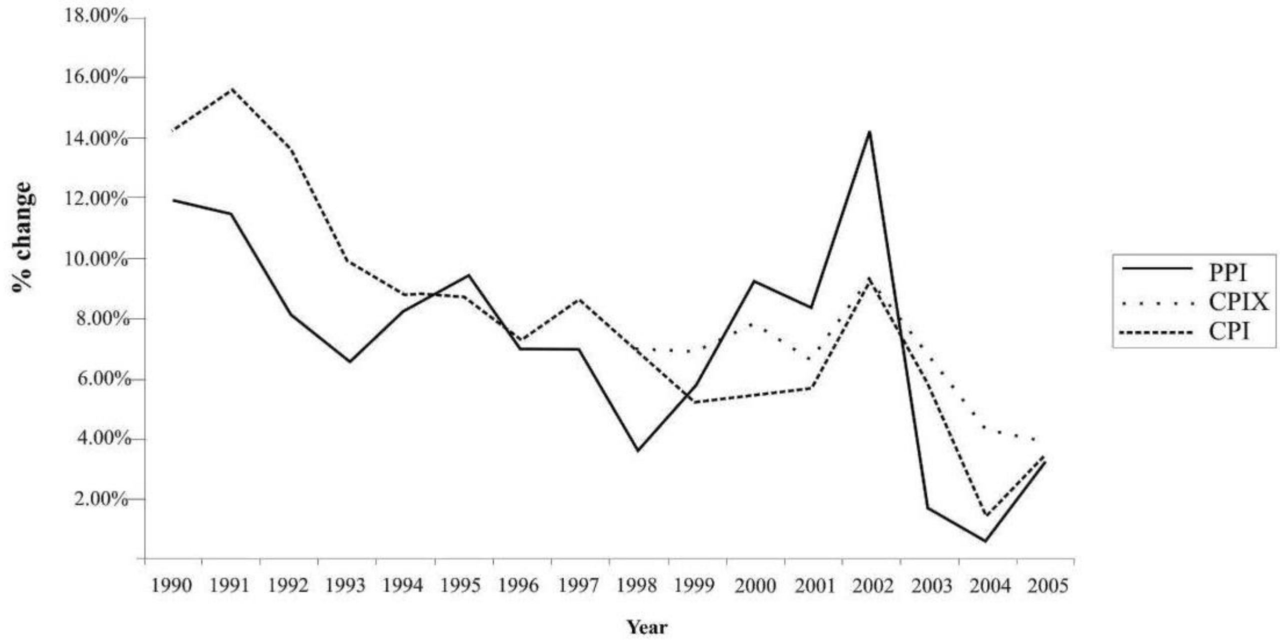


Figure 6.2: Inflation numbers, 1990 -2005 (constant)
Data source: South African Reserve Bank, Quarterly Bulletin

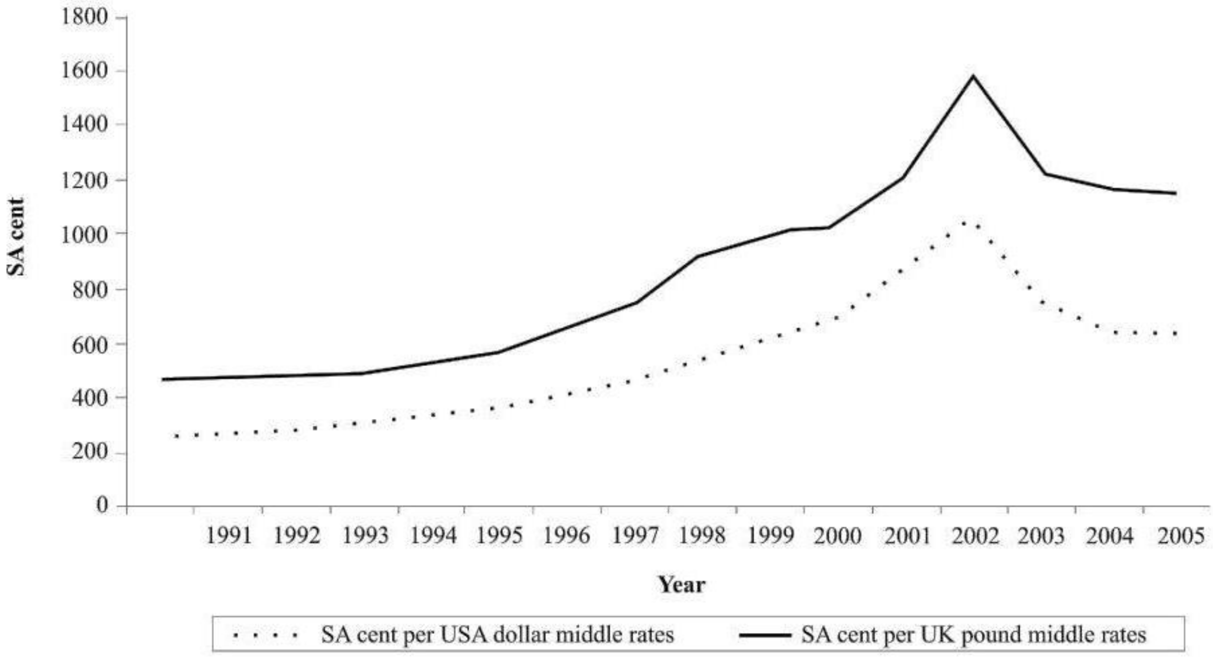


Figure 6.3: Exchange Rates, 1990 -2005 (constant)
Data source: South African Reserve Bank, Quarterly Bulletin

The dismal economic performance before 1994, as reflected in Figure 6.1 to Figure 6.3, forced the apartheid government to reconsider its stance and institute political reform. They began to realise that the structure of the economy was fundamentally unsustainable. As a result of the international isolation and aggression, the local economic performance deteriorated to levels where the government could no longer continue to function.

To continue remaining isolated from the global economy would mean further decline in the performance of the economy, increase in unemployment, infrastructure backlog and more political unrest. Top of the agenda of political reforms was the unbanning of political parties and the opening of dialogue with all stake holders on how to create a new SA that respects the rights of all who live in it. Major policy challenges existed on how best to manage the re-integration of SA into the global economy and the sequencing of reforms of major economic sectors including construction that were on the verge of collapse (South African Reserve Bank 2006).

The apartheid government was compelled to start implementing political reforms in 1990. This commenced with the release from prison of Dr Nelson Mandela. The construction sector, like the political change, took a turn for the better. The government started to show interest in addressing neglected economic conditions and infrastructure in the areas where black people lived. The dismantling of apartheid ended years of the countries isolation and local political instability. The birth of democracy opened up the country to the global economic stage as economic sanctions were lifted. This had a substantial effect not only on the everyday life of the citizens but also on the business and financial investment climate.

The challenge for the new SA was to create an economic and socio-political environment where citizens would have access to jobs and enterprise opportunities. It became necessary to build new infrastructure and develop skills to take advantage of the opportunities that were emerging. Provision of major infrastructure such as roads, rail and factories was in high demand (Du Plessis and Smit 2006).

In 1994, the African National Congress (ANC) came into power in the midst of a powerful shift in thinking about development, both in SA and globally. Amongst other factors, this influenced the formulation of a government strategy document called the reconstruction and development programme (RDP), which was published in 1994. The RDP was an integrated, coherent socio-economic policy framework that was seeking to mobilise all South African people and the country's resources towards the final eradication of apartheid and the building of a democratic, non-racial and non-sexist future (ANC 1994).

Turok (2008) argued that prior to the 1994 democratic elections, the ANC preparations for economic transformation were inadequate. Turok observed that as the ANC government started to implement the RDP, some IMF and World Bank officials influenced the government against the implementation of the RDP. Consequently, in 1996 the RDP was set aside. It was replaced with the growth, employment and redistribution (GEAR) strategy. The GEAR strategy was viewed by its critics to be furthering neoliberal market policies in response to IMF and World Bank pressure. As a result of its ill-preparedness to govern, the ANC was misled into adopting GEAR, which did not conform to the ANC vision of reducing poverty, unemployment and inequalities (Turok 2008).

What was the impact of neoliberal market policies? Neoliberalism is an ideology that emerged as a critique of the ideas of John Maynard Keynes. It argued that removing obstacles to markets will ensure growth. Amongst the obstacles that neoliberal policies advocate against is tariffs, state investment, state interference and state regulation. The neoliberal agenda in SA was defined by conservative neoliberal principles that emphasised containing government expenditure, low fiscal deficits, low inflation, privatisation, deregulation, minimal state intervention, and a stress on the importance of foreign capital inflows for development (Habib 2008).

Turok (2011) provided that the SA public sector was reduced to be lean and mean, on the guise that these were necessary interventions to make the economy competitive globally. He argued that neoliberal market policies stalled economic growth in SA and did not put emphasis on investment in strategic sectors such as construction. Turok charged that this was as a result of foreign influence. He perceived that the 1994 transition to democracy provoked all sorts of international forces to take interest in the SA economy, which put huge pressure on the ANC government. According to Turok, the neoliberal market policies were intended to open up the SA markets to global capitalism. He continued to argue that during the apartheid era, trade between the colonial powers and the colonies was marked by unequal exchange.

How do these economic developments in SA link to this research? In a time series analysis to explain the relationship between infrastructure investment and long-run economic growth in SA in the period 1875 to 2001, Fedderke *et al.* (2006) found that there was much stronger evidence that infrastructure investment might have led economic growth in SA. From 1994 onwards, the construction sector, as an investment sector became an important factor in the agenda of the ANC government. It set out to rebuild infrastructure that had deteriorated for decades under the apartheid government, especially in rural areas.

While Fedderke *et al.* found a direct impact for infrastructure on economic growth, Du Plessis and Smit (2007) reached a different conclusion. In a study of SA's growth revival after 1994, Du Plessis and Smit used growth accounting to distinguish the relative contributions of capital, labour and total factor productivity to post-apartheid growth at aggregate, sectoral and sub-sectoral levels. Infrastructure, as a type of capital financed by the public sector was considered. Du Plessis and Smit found that openness to capital flows and a stable macroeconomic environment had been leading causes of SA's growth recovery after 1994. They also found that an indirect channel via higher private sector investment in productive capital supported the growth recovery.

For much of the first decade of SA's democratic transition, its macroeconomic agenda, conceived in the policy programme of the GEAR strategy was defined by neoliberal principles. The neoliberal economic agenda came under attack from the ANC alliance partners (the congress of SA trade unions and the SA communist party), which from 2003 forced shifts in economic policy in a more developmental direction (Habib 2008). This research tracks the relationship of the construction sector to economic growth in the various stages of the democratic transition that SA has gone through. It starts by tracking how the construction sector performed during the apartheid era.

6.2 Context of SA construction statistics

The research results presented and described in this section outline the time series statistical construction output and GDP data gathered for SA. Since this research is an empirical study, the statistical data gathered is comprehensively described to determine possible interpretations that are then discussed in the data analysis. Secondary data is used and most of it was sourced from Stats SA, the South African Reserve Bank (SARB), the United Nations and the World Bank.

The developmental trajectory that the SA economy has undergone is linked to the democratic process and institutional transformation that the country went through. The performance of the construction sector is explained based on what was happening in the main stream economy to establish the relationship of the construction sector to economic growth. The findings described trace the multi-layered arenas and key government policies and plays of power and meaning that have shaped the SA developmental trajectory.

During the apartheid era, the SA construction sector was dominated by white professionals and predominantly white-owned firms (South African Reserve Bank 2006). Remarkable transformation has occurred in this regard since the country's first democratic transition in 1994. However, economic growth and employment generation have been disappointing. Economic growth between 1994 and 2012 averaged 3%, whilst unemployment is currently among the highest in the world at 25% (Stats SA 2013). Since 1994, the ANC government has adopted a number of policy positions to address these concerns. The government's fiscal policy seeks to support structural reforms of the SA economy consistent with long-run growth, employment creation and an equitable distribution of income. This study tracks growth in the SA construction sector to ascertain whether it leads or follows economic growth.

6.3 Patterns of TCO and GDP in SA 1986-2012

This section scrutinizes the trends in both total construction output (TCO) and GDP to establish the existence of a relationship between the construction sector and economic growth. The graphs of the original time series data and the trend lines illustrate the general direction in which the variables are going, that is, whether they are increasing or decreasing over time. Analysis of the trends in peaks and troughs of both TCO and GDP is undertaken to ascertain whether construction follows growth or *vice versa*.

TCO measures the volume of construction activity over time. The volume series is intended to measure the level of TCO, adjusting for price inflation, and allowing comparisons of activity to be made between periods. Annual change in TCO measures the year on year growth in the construction sector. The following is an analysis of the graphs shown in Figure 6.4 and Figure 6.5.

(a) TCO between 1986 and 1990 was sluggish, however, a small increase was observed from 1988 to 2012 as illustrated in Figure 6.4. Growth in TCO declined from 1.2% in 1986 to 0.9% in 1988 as shown in Figure 6.5. It then grew from 0.9% in 1988 to 2.9% in 1994.

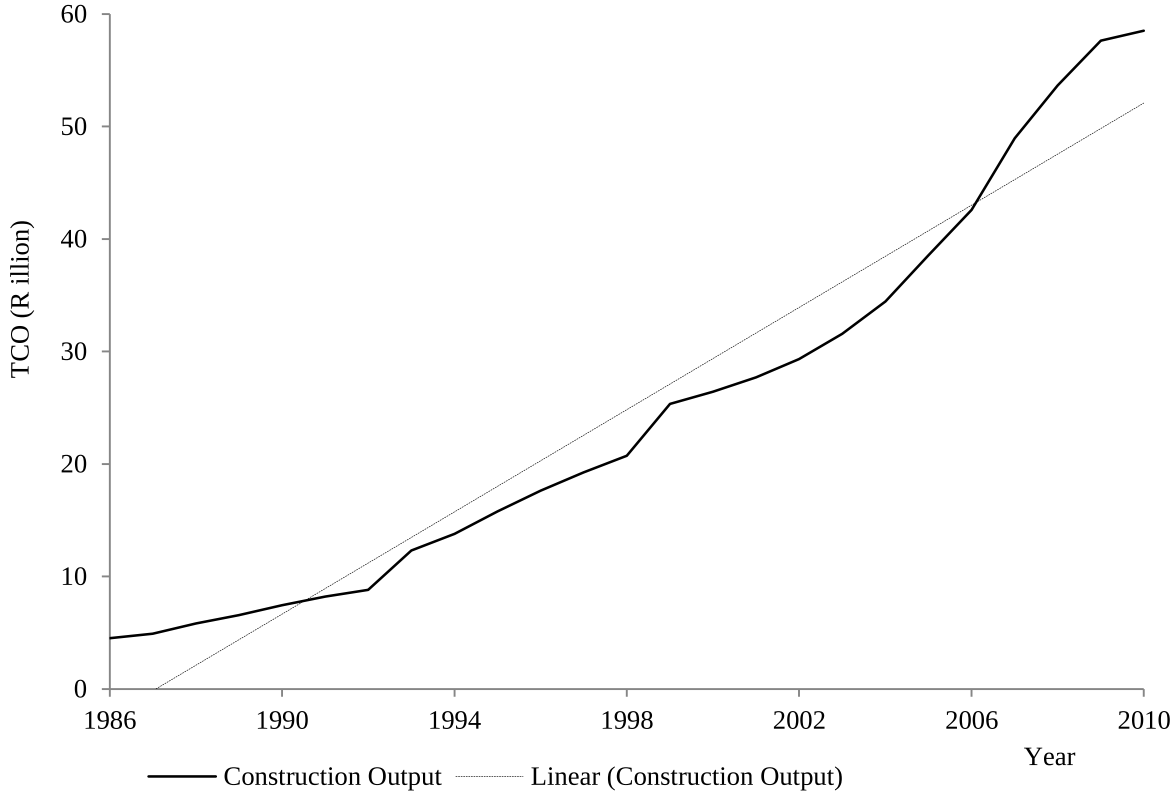


Figure 6.4: Total construction output 1986-2012 (constant)
Data source: Statistics South Africa

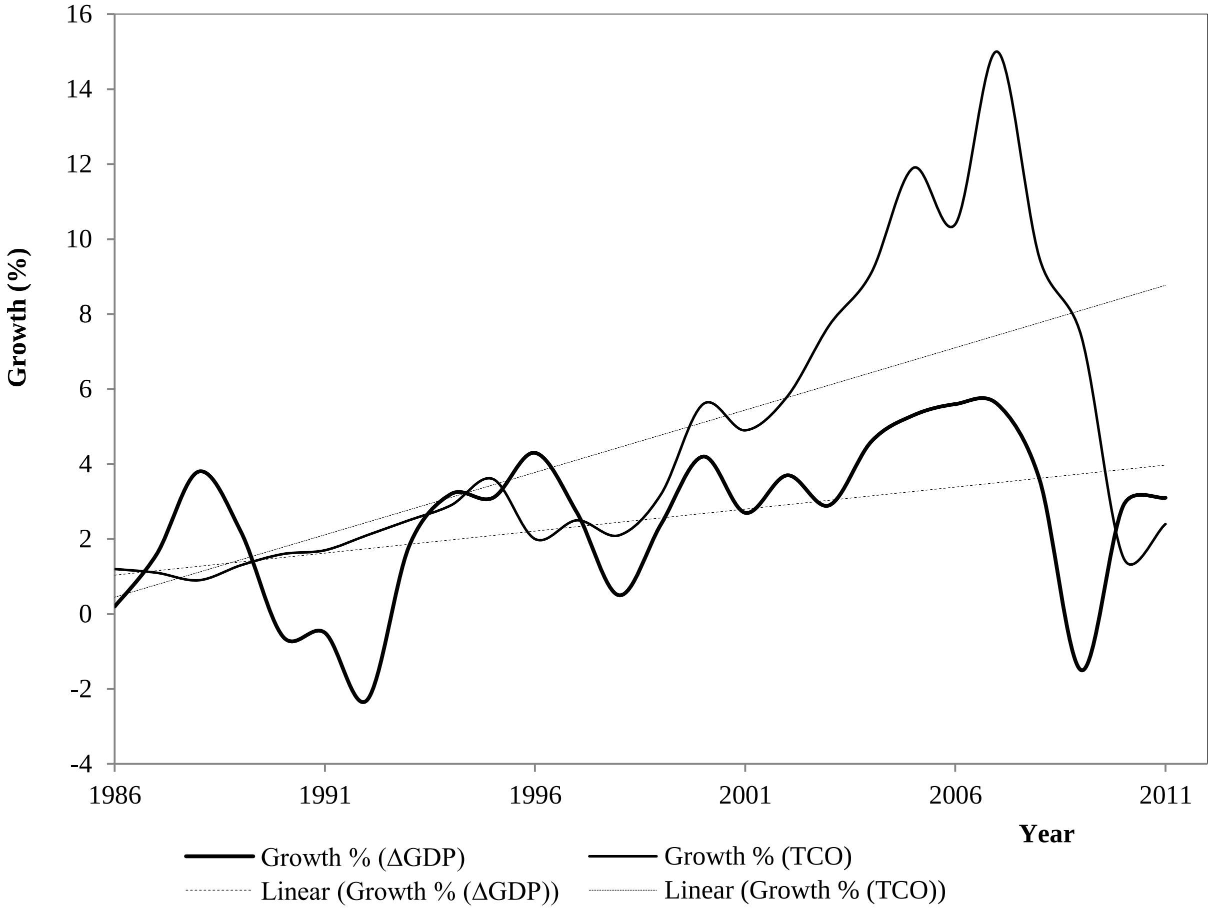


Figure 6.5: Annual change in GDP and TCO, 1986-2012 (constant)
Data source: Statistics South Africa

(b) From 1994, annual change in TCO continued to grow by a further 0.7% in 1995. However, it plummeted by 1.6% in 1996 as it declined from 3.6% in 1995 to only 2% in 1996 as shown in Figure 6.5.

(c) Year on year growth in TCO increased from 2% in 1996 to 2.5% in 1997. The growth was however bumpy, as it declined again to 2.1% in 1998 as illustrated in Figure 6.5. The growth in TCO went up from 2.1% in 1998 through 3.2% in 1999 to 5.6% in 2000 (see Figure 6.5). In 2001 there was a slight decline from 5.6% in 2000 to 4.9% in 2001. Further growth in construction output occurred between 2001 and 2003, where it increased from 4.9% to 7.7% respectively.

(d) From 2003 to 2007, growth in the construction sector was on the upswing, with annual change in TCO increasing from 7.7% in 2003 to 15% in 2007 as illustrated in Figure 6.5. An insignificant trough occurred in 2006, when year on year growth in TCO went down from 11.9% in 2005 to 10.4% in 2006. Year on year growth in TCO reached an all time high of 15% in 2007.

(e) A declining trend started in 2008, as year on year growth in TCO went down from 15% in 2007 to 8.5% in 2008. It continued to drop in 2009 and 2010 to 7.8% and 0.7% respectively. The lowest of all time was reached in 2011 as it recorded 0.5%. The growth in TCO increased from 0.5% in 2011 to 2.3% in 2012.

The pattern that emerges is a mixed one. Between 1992 and 1995, GDP growth increased from -2.3% to 3.1% respectively. Over the same period, TCO growth increased from 2.1% to 3.6%. In 1998, GDP growth increased from 0.5% to 4.2% by the year 2000. Similarly, TCO growth increased from 2.1% to 5.6% over the same period. A similar pattern repeated itself between 2001 and 2007, where GDP growth went up from 2.7% to 5.6% respectively. TCO growth followed suite, increasing from a low of 4.9% in 2001 to a peak of 15% in 2007.

Therefore, the patterns of the two graphs illustrated in Figure 6.5 suggest that growth in GDP is accompanied by faster growth in TCO.

However, there are some points in the two graphs (Figure 6.5) where TCO growth does not seem to follow GDP growth. For example, between 1988 and 1991, GDP growth decreased from 3.8% to -0.5% respectively. Over the same period, TCO growth increased from 0.9% to 1.7%. This happened again between 1996 and 1997. GDP growth decreased from 4.3% to 2.7%, while TCO growth increased from 2% to 2.5%. Again in 2002, GDP growth dropped from 3.7% to 2.9% in 2003. The opposite happened with TCO growth. It increased from 5.6% in 2002 to 7.7% in 2003. Therefore, it can be argued that while construction work does create activity in the economy, growth in TCO does not lead to growth in GDP.

The mixed picture that emerges suggests that there is no obvious link between the construction sector and economic growth. While growth in the construction sector is shown to follow growth in the economy at some points in the time series, growth in the construction sector also happens despite a decrease in economic growth at certain points in the time series. Therefore, further statistical analysis is undertaken to ascertain the relationship of the construction sector to economic growth.

6.4 Analysis of moving averages for SA TCO and GDP

This sub-section analyses the common trends in the movement of construction output and GDP figures for SA over time. Table 6.1 illustrate the 3 year, 5 year and 8 year moving averages that are used to smooth out fluctuations in the data and to highlight the important trends in the behaviour of construction output and economic growth. The 8 year moving average is preferred over the 3 year and 5 year moving averages because the higher the number of periods (years) used in the calculation of the moving average, the more smooth and clearer the trend estimate is. The movement of TCO and GDP over the years is examined to ascertain if there is a relationship between TCO and GDP.

(a) TCO/GDP

TCO/GDP is the ratio that shows the contribution of the construction sector to economic growth. The data, as presented in Table 6.1 shows that between 1987 and 1992, the construction share of GDP in SA was 3%. It then dropped to 2% in 1993. It remained at 2% until 2005. It again increased to 3% in 2006. Between 2006 and 2011, it remained at 3%. Therefore, there has been minimal change in the share of total construction output in the SA economy over the time series under consideration.

Table 6.1: Trends in TCO and GDP in SA 1986-2011 (constant)

Year	GDP (Rb)	ΔGDP (%)	TCO (Rb)	ΔTCO (%)	TCO/GDP	GDP MA (Rb)			GDP growth MA (%)			TCO MA (Rb)			TCO growth MA (%)		
						3yr	5yr	8yr	3yr	5yr	8yr	3yr	5yr	8yr	3yr	5yr	8yr
1986	129	0,2	12	1,2	0,09												
1987	465	1,6	13	1,1	0,03												
1988	553	3,8	15	0,9	0,03	382			1,87			13			1,07		
1989	645	2,2	17	1,3	0,03	554			2,53			15			1,10		
1990	735	-0,6	19	1,6	0,03	644	505		1,80	1,44		17	15		1,27	1,22	
1991	831	-0,5	21	1,7	0,03	737	645		0,37	1,30		19	17		1,53	1,32	
1992	916	-2,3	23	2,1	0,03	827	736		-1,13	0,52		21	19		1,80	1,52	
1993	1 081	1,2	25	1,1	0,02	943	842	669	-0,33	0,12	0,78	23	21	18	2,10	1,84	1,55
1994	1 116	3,2	26	2,9	0,02	1 038	936	793	0,90	0,32	1,15	24	23	20	2,50	2,16	1,76
1995	1 125	3,1	27	3,6	0,02	1 108	1 014	875	2,70	1,06	1,34	26	24	22	3,00	2,56	2,08
1996	1 174	4,3	27	2	0,02	1 138	1 083	953	3,53	2,02	1,40	26	25	23	2,83	2,62	2,21
1997	1 205	2,7	28	2,5	0,02	1 168	1 140	1 023	3,37	3,02	1,46	27	26	24	2,70	2,7	2,36
1998	1 221	0,5	26	2,1	0,02	1 200	1 168	1 084	2,50	2,76	1,60	27	27	25	2,20	2,62	2,43
1999	1 250	2,4	26	3,2	0,02	1 225	1 195	1 136	1,87	2,60	1,96	27	27	26	2,60	2,68	2,61
2000	1 302	4,2	27	5,6	0,02	1 258	1 230	1 184	2,37	2,82	2,78	27	27	26	3,63	3,08	3,05
2001	1 337	2,7	29	4,9	0,02	1 296	1 263	1 216	3,10	2,50	2,89	27	27	27	4,57	3,66	3,35
2002	1 386	3,7	30	5,8	0,02	1 342	1 299	1 250	3,53	2,70	2,95	29	28	28	5,43	4,32	3,71
2003	1 427	2,9	32	7,7	0,02	1 384	1 340	1 288	3,10	3,18	2,93	30	29	28	6,13	5,44	4,23
2004	1 492	4,6	34	9,1	0,02	1 435	1 389	1 328	3,73	3,62	2,96	32	31	29	7,53	6,62	5,11
2005	1 571	5,3	39	11,9	0,02	1 497	1 443	1 373	4,27	3,84	3,29	35	33	30	9,57	7,88	6,29
2006	1 659	5,6	43	10,4	0,03	1 574	1 507	1 428	5,17	4,42	3,93	39	36	32	10,47	8,98	7,33
2007	1 751	5,6	49	15	0,03	1 660	1 580	1 491	5,50	4,80	4,33	43	39	35	12,43	10,82	8,80
2008	1 815	3,6	53	8,5	0,03	1 742	1 658	1 555	4,93	4,94	4,25	48	44	39	11,30	10,98	9,16
2009	1 787	-1,5	57	7,8	0,03	1 784	1 717	1 611	2,57	3,72	3,73	53	48	42	10,43	10,72	9,53
2010	1 838	2,9	58	0,9	0,03	1 813	1 770	1 668	1,67	3,24	3,63	56	52	46	5,73	8,52	8,91
2011	1 896	3,1	58	0,8	0,03	1 840	1 817	1 726	1,50	2,74	3,65	58	55	49	3,17	6,6	8,05
Correl. coefficient (growth)			0,28	0.53	-0,25	0,35	0,49	0,08	0,70	0,51	0,27	0,20	0,28	-0,06	0,43	0,40	0,08
Correl. coefficient (GDP)			0,93	0.60	-0,41	0,99	0,99	0,97	0,51	0,79	0,93	0,94	0,95	0,96	0,79	0,91	0,98

(b) GDP: 8yr MA

The GDP figures are increasing with time. The 8 period moving average is smoother than the 3 and 5 period moving averages, although all of them show a positive relationship between time and the GDP. Therefore the notable trend is that GDP values increase over time. This positive trend in the GDP figures can be attributed to influences such as population growth, price inflation, technological advances or general economic changes. These influences are changing over time.

(c) GDP Growth: 8yr MA

The data shows that GDP is growing at an increasing rate over the years. The GDP growth figures show an increasing trend, similar to that shown by the original GDP figures. Therefore, the GDP growth data can be used to determine intermediate and long-term possibilities for the series.

(d) TCO: 8yr MA

The TCO figures are increasing with time. The 8 period moving average is smoother than the 3 and 5 period moving averages, although all of them show a positive relationship between time and the TCO, that is, TCO values increase over time. The TCO for SA shows an increasing trend over the years. This positive trend can be attributed to influences such as population growth, price inflation, technological advances or general economic changes. These influences are changing over time.

(e) TCO Growth: 8yr MA

The data shows that TCO is growing at an increasing rate over the years. The TCO growth figures show an increasing trend, similar to that shown by the original TCO figures.

Therefore, the TCO growth data can be used to determine intermediate and long-term possibilities for the series.

The moving averages for GDP, GDP growth, TCO and TCO growth reflect an increasing trend over time. This suggests that as economic growth increases, so does TCO. Also, as the construction sector grows, the overall economy also grows. However, these growth trends as depicted by the moving averages do not indicate whether growth in the construction sector follows growth in the economy or *vice versa*. Thus, further statistical analysis is undertaken to scrutinize the fundamental dynamics of the relationship.

6.5 Analysis of correlations

From the data presented in Table 6.1, the correlation coefficients for all variables are individually analysed in this section. The correlation coefficients are presented in a table comprising 4 parameters, to determine the strength of the relationships. Correlation is expressed on a range from -1 to +1. The middle point of the scale is 0, which represents a situation where there is no discernible relationship between fluctuations of the variables. The parameter ranges are:

- Perfect negative correlation: -1 to -0.5

This denotes a relationship where an increase in one variable reliably predicts a decrease in the other one.

- Negative correlation: -0.5 to 0

This denotes a lower degree of the relationship where if the value of one variable increases, the other decreases.

- Positive correlation: 0 to 0.5

This denotes a relationship where the individual values of variables are insignificantly likely to either increase or decrease together.

- Perfect positive correlation: 0.5 to 1

This denotes a relationship where the individual values of variables are most likely to either increase or decrease together.

When one series y_t is related to past lags of the *x*-series or has a delayed response to a common stumulus that affects both series, the simple correlation coefficient between the two series is inadequate to characterise the relationship. The estimated cross-correlation coefficients will be spurious. Sample cross-correlation function (CCF) can be used to identify lags of the x-variable that might be useful predictors of y_t. The CCF is defined as the set of sample correlations between x_t+h and y_t for h=0, ±1, ±2, ±3, and son on. If the individual series are autocorrelated, the estimated cross-correlation function may be distorted and misleading as a measure of the lagged relationship. One measure is to prewhiten the two series to put them on "equal footing" before cross correlation estimation or the use of "impulse response function".

For valid results, the following assumptions must be satisfied:

(a) The processes generating y and x must be uncorrelated.

(b) The processes must not be autocorrelated.

(c) The populations should be normally distributed.

(d) The sample size must be large.

These assumptions have been considered in the interpretation of the cross-correlation coefficients. When a CCF estimate is statistically significant, the null hypothesis that the true CCF at that lag is zero must be rejected against the alternative hypothesis that the true CCF is non-zero. Table 6.2 illustrates the correlation coefficient (CC) with growth. In all variables, the correlation coefficient with growth ranges between -0.7 and 0.64. This represents a sliding scale between negative correlation and significant positive relationship.

Table 6.2: Analysis of correlation coefficients with GDP growth for SA

Variable	CC	P value	Linear dependence			
			-1 to -0.5	-0.5 to 0	0 to 0.5	0.5 to 1
TCO	0.28	0.15			x	
TCO growth	0.53	0.01				x
TCO/GDP	-0.25	0.12		x		
TCO 3yr MA	0.46	0.03			x	
TCO 5yr MA	0.48	0.02			x	
TCO 8yr MA	-0.07	0.79		x		
TCO growth 3yr MA	0.30	0.22			x	
TCO growth 5yr MA	0.16	0.52			x	
TCO growth 8yr MA	0.08	0.75			x	

Of all 9 variables in Table 6.2, only 2 reflect negative correlation. These are TCO/GDP and TCO 8yr MA. Although negative, the correlation coefficients are, but in the lower degree category and are not statistically significant. This implies that there is no linear relationship between TCO and GDP growth and no linear relationship between TCO 8 yr MA and GDP growth; and that the correlation figures that were obtained were generated purely by the chance mechanism. 78% of the variables are in the positive correlation category. Therefore, it can be inferred that, in the main, a positive relationship exists between TCO and GDP growth.

Table 6.3 illustrate the correlation coefficient with GDP. Of all 9 variables, only 1 reflects significant negative correlation (P value < 0.05). Although negative, the correlation coefficient for TCO/GDP is, but in the lower degree category. 89% of the variables are in the perfect positive correlation category. Therefore, this suggests that a significantly positive relationship exists between GDP and the TCO.

The correlation coefficient with GDP for TCO is 0.93 (Table 6.3), which can be construed to suggest that there is a very strong relationship between TCO and GDP. However, the correlation coefficient for TCO with GDP growth is 0.28 and is not significant (Table 6.2). This suggests that, while there is a positive relationship between the two variables, TCO does not necessarily influence economic growth in SA.

Table 6.3: Analysis of correlation coefficients with GDP for SA

Variable	CC	P value	Linear dependence			
			-1 to -0.5	-0.5 to 0	0 to 0.5	0.5 to 1
TCO	0.93	0.00				x
TCO growth	0.60	0.00				x
TCO/GDP	-0.47	0.02		x		
TCO 3yr MA	0.96	0.00				x
TCO 5yr MA	0.96	0.00				x
TCO 8yr MA	0.95	0.00				x
TCO growth 3yr MA	0.73	0.00				x
TCO growth 5yr MA	0.92	0.00				x
TCO growth 8yr MA	0.98	0.00				x

The correlation coefficients with GDP in all variables of 3, 5 and 8 year moving averages range between 0.51 and 0.99 (Table 6.3). This represents a strong relationship where the individual values of variables are most likely to be influenced by the GDP figures. Therefore, this suggests that GDP influences TCO in the SA economy, as represented by the strong positive correlation coefficients that are very close to 1.

The corrrelation coefficients analyzed here again present a mixed picture about the relationship of the construction sector to economic growth. Unlike the moving averages, which simple reflected growth in all variables over time, the correlation coefficients of a majority of the variables with GDP indicate that there is an existence of a very strong relationship between economic growth and TCO growth. Although the correlation coefficients of most variables with TCO are also positive, they are not very strong compared to those of GDP. Therefore, this suggests that there is a greater possibility that when economic growth increases, TCO will also follow suit. However, this should not be construed to mean that TCO does not influence economic growth. Thus, further analysis of the results continues.

6.6 Trend analysis of TCO and GDP in SA

The previous 3 subsections examined the collected TCO and GDP data in detail to establish whether the construction sector follows economic growth or *vice versa*. The main research question is: What is the relationship of the construction sector to economic growth? The construction sector has been shown to accompany economic growth at some points in the time series. However, some instances were observed at certain points in the time series where growth in the construction sector occurred despite a decrease in economic growth. Therefore, the regression analysis is undertaken to fit a trend line to the data (Pellicer *et al.* 2009).

It is intended that the regression analysis will help estimate the quantitative influence of construction output and economic growth upon each other over time. The literature review revealed that a majority of writers in construction economics argued based on the assumption that the construction sector drives economic growth. Therefore, the hypothesis for this regression analysis is that construction drives growth, other things being equal. As mentioned in the research design in Chapter 4, national statistics data on TCO and GDP, sourced from Stats SA is used in this investigation. First, an overview description of the model is given.

(a) Description of regression analysis

The regression technique is applied to TCO and GDP data in order to model the relationship between the two variables. The results of the model may also be used as a forecasting tool to determine future trends in TCO and GDP figures. Wong *et al.* (2008) and Dikmen *et al.* (2008) examined the complexities of the Hong Kong and Turkish construction industries respectively, utilising time series data and causal relationship analysis.

TCO and GDP data is used to explain the relationship of the construction sector to economic growth over time. The collected time series data for both TCO and GDP from 1986 to 2011 is examined. The relationship is estimated using the regression model. The data is computed into the statistical package for social scientists (SPSS) software, version 14.1. The regression is run and the results obtained are presented in a table form. The analysis is run mainly to establish the goodness of fit of the model, and the significance of the variables (Yung 2010).

Reference to the adjusted R^2 is done to see the percentage of variations in the dependent variable that has been explained by the independent variables. The value of adjusted R^2 is limited to the region from 0 to 1. The higher the value, that is, the closer it is to 1, the better fit the model is (Pellicer *et al.* 2009).

The second issue is about the significance of variables. In statistics, a result is statistically significant if it is unlikely to have occurred by chance (Dikmen *et al.* 2009). The aim is to evaluate whether the coefficient of a variable is significantly different from zero. The t-test is used to evaluate the null hypothesis, which hypothesises that the coefficient is zero. If the coefficient is not significantly different from zero, then the null hypothesis is not rejected, which means the variable actually has no effect on the dependent variable.

The significance level of a coefficient is determined by the p-value of the t-test (Kennedy 2003). If the p-value is smaller than 0.05, then the coefficient is significant at 5% level. If the p-value is smaller than 0.01, then the coefficient is significant at the 1% level, and so on. In this analysis, the 5% significance level is accepted as the cut-off point. If the p-value is larger than 0.05, the null hypothesis will not be rejected.

If the coefficient is significant, then there is need to look at the sign of the coefficient. If it is positive, the variable will have a positive effect on the dependent variable, and *vice versa*. On the other hand, if the coefficient is not significant, the sign of it does not matter at all. In some cases the F-statistics may be reported. The F-statistics is a test on whether all the independent variables have zero coefficients (Kennedy 2003). Again, the significance level can be determined by referring to the p-value of the F-statistics. The next subsections apply the regression analysis described here to the TCO and GDP data collected.

(b) Analysis of TCO/GDP

The purpose here is to examine the behaviour of TCO/GDP growth figures over time in the SA economy. The SPSS software that is used to implement the regression analysis provides detailed data outputs that include graphic analysis and statistical algorithms. The results are interpreted closely, to approximate their meaning with respect to the relationship of the construction sector to economic growth.

The ratio TCO/GDP is important because it shows the percentage of TCO to the GDP. In other words it shows the percentage contribution of the construction sector to the overall output of the national economy. It also helps us to explain the relationship between TCO and

GDP over time. An increase in the ratio means that TCO is increasing at a faster rate than GDP, whilst the opposite is true for a decrease in the ratio.

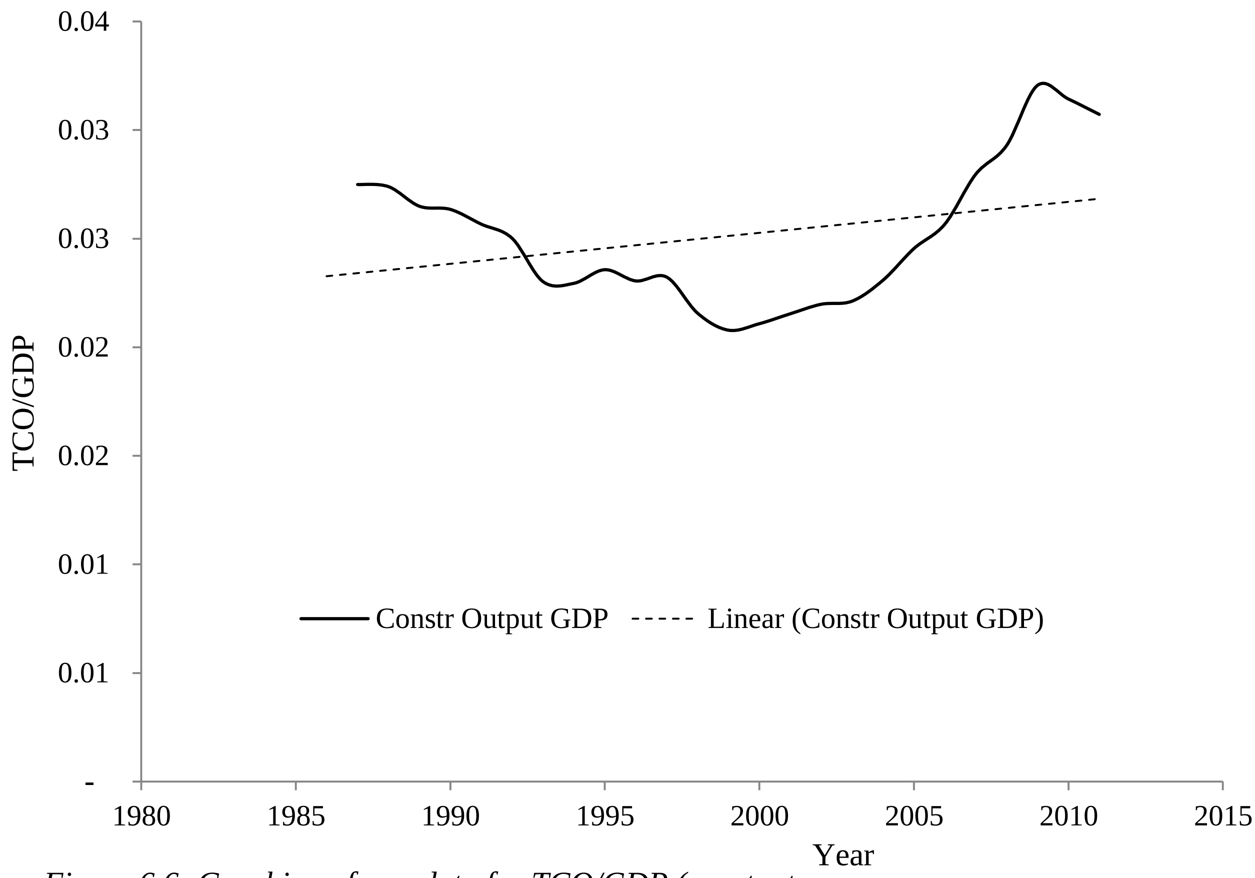


Figure 6.6: Graphing of raw data for TCO/GDP (constant)

As explained in the introduction to this subsection, the regression equation gives an indication of the actual relationship between TCO/GDP ratio and time. The trend line equation is important because it indicates the general direction of the time series after removing the short term fluctuations in the data – particularly indicating, in the long run, how the ratio linearly changes with time. The regression equation can be used to predict TCO/GDP ratios for the period under consideration and even future TCO/GDP ratios.

Figure 6.6 shows that TCO/GDP figures are increasing with time. On average TCO/GDP is increasing by about 0.00005652 per year according to the equation according to Table 6.4. However, the coefficient is not statistically significant (P value>.05), implying that there is no linear relationship between TCO/GDP and time or that TCO/GDP does not linearly change with time. This might mean that the TCO/GDP time series does not have a trend component.

Table 6.4: Regression of TCO/GDP on time

Regression coefficient	Estimate	Std. Error	Beta	T-statistic	P-value
Constant	2.376E-02	0.002		9.667	0.000
Time	5.652E-05	0.000	0.079	0.369	0.715

Table 6.4 illustrates the regression equation model for TCO/GDP. This analysis was carried out using the SPSS. The reliability of the regression analysis depends on the significance of its coefficients. If the coefficients are significant, the regression equation is reliable.

6.7 Cointegration analysis of TCO and GDP

In the previous subsection, the regression model was used to fit a trend line to the TCO and GDP data. In this section, the data is computed into the Stata version 13 software for the cointegration analysis. Created in 1985 by StataCorp, Stata is a data analysis and statistical software package that specialises in econometric analyses (Hansen and Juselius 1995).

Cointegration analysis is used in this subsection to answer the research question: what is the relationship of the construction sector to economic growth? Economic time series tend to be nonstationary and if they are, the ordinary least squares (OLS) method alone cannot be used to estimate relationships of the series because of autocorrelation and normality assumption (Greene 1993). According to Greene, where the OLS method is used in determining long run linear relationships there is the risk of spurious regression, a situation in which a statistically significant relationship between variables may appear to exist when in reality the variables are unrelated. Therefore, the technique of cointegration is used to obtain statistically and economically meaningful regression results.

Cointegration is used to indicate the existence of a long-run equilibrium among economic time series (Engle and Granger 1987). If two or more series are themselves nonstationary, but a linear combination of them is stationary, then they are said to be cointegrated (Wei 2006). Cointegration is a means for testing hypotheses concerning the relationship between two variables having unit roots (i.e. integrated of at least order one). A series is said to be "integrated of order d" if one can obtain a stationary series by "differencing" the series d times. When you are estimating a model that includes time series variables, the first thing you need to make sure of is that either all time series variables in the model are stationary or they are cointegrated – meaning that they are integrated of the same order and errors are stationary, in which case the model defines a long run equilibrium relationship among the cointegrated variables. In this study, the concept of weak stationarity is adopted. According to Wei, weak stationarity occurs when the mean, variance and covariance of a series are independent of time point, t. Nonstationarity happens when a time series does not have a constant mean, constant variance or both of these properties. This can originate from many sources but the most important one is the unit root (Ssekuma 2011).

Differencing the data set can solve the unit root problem to obtain a stationary time series (Wei, 2006). The Augmented Dickey-Fuller (ADF) test is used in this analysis to test for nonstationarity. The basic idea behind the ADF unit root test for nonstationarity is to simply regress Yt on its (one period) lagged value Yt_1 and find out if the estimated coefficient is statistically equal to 1 or not. There are two main methods used for testing for cointegration, namely, the Engle-Granger two-step method and the Johansen Procedure (Ssekuma 2011). In this study, the former is used.

(a) Autocorrelations

According to Wei (2006), this is a useful tool used to interpret a set of autocorrelation coefficients is a graph called a correlogram, and r_k is plotted against the lag(k), where r_k is the autocorrelation coefficient at lag(k). Wei provides that a correlogram can be used to get a general understanding on the following aspects of a time series:

- A random series: if a time series is completely random for large (N), then the autocorrelation coefficient will be approximately zero for all non-zero values of (k).
- Short-term correlation: stationary series often exhibit short-term correlation characterised by a fairly large value of 2 or 3 more correlation coefficients which, while significantly greater than zero, tend to get successively smaller.
- Non-stationary series: if a time series contains a trend, then the values of r_k will not come to zero except for very large values of the lag.
- Seasonal fluctuations: Common autoregressive models with seasonal fluctuations, of period s are:

$X(t) = a + b\ X(t\text{-}s) + \epsilon_t$

and

$X(t) = a + b\ X(t\text{-}s) + c\ X(t\text{-}2s) + \epsilon_t$, where ϵ_t is the random error.

(b) Partial autocorrelation

A partial autocorrelation coefficient for order k measures the strength of correlation among pairs of observations in the time series while accounting for (ie, removing the effects of) all autocorrelations below order k (Wei 2006). For example, the partial autocorrelation coefficient for order k = 5 is computed in such a manner that the effects of the k = 1, 2, 3, and 4 partial autocorrelations have been excluded. The partial autocorrelation coefficient of any particular order is the same as the autoregression coefficient of the same order.

The presence of first-order autocorrelation is tested by utilising the table of the Durbin-Watson statistic at the 5% or 1% levels of significance for n observations and k independent variables. If the calculated value of d from the equation below is smaller than the tabular value of d_L (lower limit), the hypothesis of positive first-order autocorrelation is accepted. The formula is:

$$d = \frac{\sum_{t=2}^{n}(e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^2}$$

The hypothesis is rejected if $d>d_U$ (upper limit), and the test is inconclusive if $d_L<d<d_U$. Even though negative autocorrelation is possible, most economic time series exhibit positive autocorrelation. Positive, first-order serial or autocorrelation means that $E_{u_t u_{t-1}} > 0$, thus violating the fifth OLS assumption. The value of d ranges between 0 and 4. A value in the neighbourhood of 2 indicates no autocorrelation; 0 indicates positive autocorrelation and 4 indicates negative autocorrelation.

With autocorrelation, the OLS parameter estimates are still unbiased and consistent, but the standard errors of the estimated regression parameters are biased, leading to incorrect statistical tests and biased confidence intervals. With positive first-order autocorrelation, the standard errors of the estimated regression parameters are biased downward, thus exaggerating the precision and statistical significance of the estimated regression parameters.

(c) Testing for Cointegration

Hansen and Granger (1995) provided that cointegration is a means for testing hypotheses concerning the relationship between two variables having unit roots (ie, integrated of at least order one). A series is said to be "integrated of order d" if one can obtain a stationary series by "differencing" the series d times. If two variables are individually integrated of the same order and there is at least one linear combination of these variables that is stationary, then the variables are said to be cointegrated. The cointegrated variables will never move far apart, and will be attracted to their long-run relationship (Wei 2006).

(d) Augumented Dicky-Fuller (ADF) test

The testing procedure for the ADF unit root test is applied to the following model:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{j=1}^{\rho} \delta_j \Delta y_{t-j} + \varepsilon_{ij}$$

where α is a constant, β the coefficient on a time trend series, γ the coefficient of y_{t-1} , ρ is the lag order of the autoregressive process, $\Delta y_t = y_t - y_{t-1}$ are first differences of y_t, y_{t-1} are lagged values of order one of y_t, Δy_{t-j} are changes in lagged values, and ε_{ij} it is the white noise.

The choice of the number of lags (p) in this study is based on the significant lag of the autocorrelation function (ACF) and the partial autocorrelation function (PACF) plots (Ssekuma 2011). The value of p is taken to be the number of lags at which the ACF cuts off or the number of lags of the PACF that are significant. The test procedure for unit roots is similar to statistical tests for hypothesis, that is:

(i) Set the null and alternative hypothesis as

H0 : γ = 0

H1 : γ < 0

Determine the test statistic using

$$F_\tau = \frac{\hat{\gamma}}{SE(\hat{\gamma})}$$

where SE($\hat{\gamma}$) is the standard error of $\hat{\gamma}$.

Table 6.5: Critical values for Dickey-Fuller t-distribution

	Without trend		With trend	
Sample size	1%	5%	1%	5%
25	-3.75	-3.00	-4.38	-3.60
50	-3.58	-2.93	-4.15	-3.50
100	-3.51	-2.89	-4.04	-3.45

Alternatively, Yin-Wong and Lai (1995) suggested ADF test, which tests for critical values as illustrated in Table 6.6.

Table 6.6: ADF test

Sample size	Sig. Level	Response Surface Estimates of Critical values			
		P = 0	P =4	P = 6	P = 8
50	10%	-2.891	-2.748	-2.649	-2.542
	5%	-3.195	-3.039	-2.934	-2.823

Note: P = Lag.

Compare the calculated test statistic in equation 1 with the critical value from Dickey-Fuller table to reject or not to reject the null hypothesis. The ADF test is a lower-tailed test, so if F_τ

is less than the critical value, then the null hypothesis of unit root is rejected and the conclusion is that the variable of the series does not contain a unit root and is nonstationary. In other words, if the null hypothesis cannot be rejected that $\widehat{\gamma} = 0$, then it can be concluded that a unit root is present. The unit root test tests for the existence of a unit root in two cases: with intercept only and with intercept and trend to take into account the impact of the trend on the series (Wei 2006).

Once the hypothesis of the unit root test is rejected, the long-run equilibrium relationship is estimated in the form of an OLS regression line:

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t$$

where β_0 is the y- intercept, β_1 is the slope, and ε_t is the error term.

The estimated regression line is then given in the form

$$\widehat{y}_t = \widehat{\beta}_0 + \beta_1 \widehat{x}_t$$

In order to determine if variables cointegrate, unit roots are tested on the residual sequence in the equation $y_t = \beta_0 + \beta_1 x_t + \varepsilon_t$ using the ADF test. The residual sequence, denoted by ε_t is a series of estimated values of the deviation from the long-run relationship. Testing for unit roots on residuals aims at determining whether these deviations are stationary or not. If they are stationary, then the series cointegrate. If the residuals are not stationary, there is no cointegration.

(e) Engle-Granger (EG) test

The Engle-Granger (EG) test for cointegration is a two-step residual-based test (Engle and Granger 1987). First, y is regressed on a constant and x and the residuals are calculated.

Then, the first difference of the residuals is regressed on the lagged level of the residuals without a constant. Under the null hypothesis that y and x are not cointegrated, the residual should be nonstationary, hence the resemblance of the EG test to the Dickey-Fuller test for nonstationarity. Rejection of the null hypothesis is evidence that the residual is stationary, that the series are indeed cointegrated. If the residuals are stationary, that is I(0), it means that the variables under study cointegrate and have a long-term or equilibrium relationship.

(f) Error Correction Mechanism (ECM) Model

According to the Granger representation theorem, when variables are cointegrated, there must also be an error correction model (ECM) that describes the short-run dynamics or adjustments of the cointegrated variables towards their equilibrium values (Hansen and Juselius 1995). ECM consists of one-period lagged cointegrating equation and the lagged first differences of the endogenous or dependent variables. To estimate error correction mechanism (ECM) model, the first step is identical to the first step in the EG test procedure. In the second step, the first difference of y is regressed on the lagged level of the first-step residual and the lagged first difference of x using OLS. The coefficient on the lagged residual is an estimate of the ECM “speed of correction” parameter.

(e) Results of testing the relationship between TCO and GDP using SA data

Testing the integration order of TCO

Table 6.7 shows that the significant autocorrelations are cut at lags 5 or 6, and there is at least one significant partial autocorrelation.

Table 6.7: Correlogram of TCO

Lag	AC	PAC	Q	Prob>0	-1 0 1 Autocorrelation	-1 0 1 Partial autocorrelation
1	0.8700	1.0349	22.043	0.0000	|------	|--------
2	0.7167	-0.7288	37.623	0.0000	|-----	-----|
3	0.5519	-0.3572	47.264	0.0000	|----	--|
4	0.3993	0.6716	52.54	0.0000	|---	|-----
5	0.2617	-0.0230	54.914	0.0000	|--	|
6	0.1560	0.5616	55.801	0.0000	|-	|----
7	0.0735	0.3922	56.008	0.0000	|	|---
8	0.0233	0.4780	56.03	0.0000	|	|---
9	-0.0155	0.1677	56.04	0.0000	|	|-
10	-0.0408	0.8096	56.116	0.0000	|	|------
11	-0.0636	0.7642	56.312	0.0000	|	|------

The correlogram indicates the lags with which the ADF test should be performed. At the second lag, the hypothesis is rejected as follows.

Augmented Dickey-Fuller test for unit root

Table 6.8 shows a pre-test that is done to establish the order of integration of the TCO time series using the ADF unit root test.

Table 6.8: ADF unit root test

	Estimate	Std Error	T value	Prob (>|t|)
Intercept	2.748	.696	3.95	0.001***
Trend	.420	.095	4.43	0,000***
TCO. Lag 1	-.298	.063	-4.73	0.000***
ΔTCO. Lag 1	.539	.159	3.40	0.003***
ΔTCO. Lag 2	.846	.219	3.86	0.000***

Note: sample size = 23; ***=significant at the 1% level

We are _fitting the ADF model

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{j=1}^{\rho} \delta_j \Delta y_{t-j} + \varepsilon_{ij} \qquad (1)$$

where α is a constant, β the coefficient on a time trend series, γ the coefficient of y_{t-1}, ρ is the lag order of the autoregressive process, $\Delta y_t = y_t - y_{t-1}$ are first differences of y_t, y_{t-1} are lagged values of order one of y_t, Δy_{t-j} are changes in lagged values, and ε_{ij} it is the white noise.

In terms of the coefficient estimate, the above model becomes

$$\Delta \text{TCO} = 2.748 + .420\ t\ -.298\ \text{TCO}_{t-1} + .539\ \Delta\text{TCO}_{t-1} + .846\ \Delta\text{TCO}_{t-2} \qquad (2)$$

where ΔTCO is the first difference values of the TCO series, t is the time point, ΔTCO_{t-i} are the first difference lagged values of the TCO series.

The parameter of interest in equation 2 is the estimated coefficient of ΔTCO_{t-i} which is

-.298.

The calculated test statistic

$$DF_{\tau} = \frac{\hat{\gamma}}{SE(\hat{\gamma})} = \frac{-.2977314}{.0629059}$$

= -4.73

Since the calculated test statistic value (-4.73), falls in the rejection region, that is, to the left of the 1% (tau) critical value of - 4.38, we reject the null hypothesis for presence of unit roots at the 1% level of significance. This means that the differenced TCO series does not contain a unit root. The MacKinnon approximate p-value for Z(t) = 0.001, also means that the statistic value of -4.73 is significant at the 1% level. This also implies that the ADF model is statistically significant at the 1% level.

The residuals were tested for normality and autocorrelation using respectively Shapiro-Wisk normality test and Durbin – Watson autocorretion test as illustrated in Table 6.9:

Table 6.9: Normality test - TCO

Variable	Shapiro - Wilk	P-value	Decision
Residual (ΔTCO)	0.953	0.341	Fail to reject

The results in Table 6.9 imply that the residuals follow the normal distribution. The Durbin-Watson d-statistic (5,23) of 1.995 indicates that the residuals are not autocorrelated respectively. These results suggest that the TCO series is integrated of order 1, I(1).

Correlogram of GDP

First the correlograms and partial autocorrelations of GDP are also calculated to establish the applicable lags for the tests. The following results in Table 6.10 are obtained.

Table 6.10: Correlogram of GDP

Lag	AC	PAC	Q	Prob>0	-1 0 1 Autocorrelation	-1 0 1 Partial autocorrelation
1	0.8239	0.9107	19.766	0.0000	|------	|-------
2	0.7011	-0.0915	34.674	0.0000	|-----	|
3	0.5822	0.0121	45.403	0.0000	|----	|
4	0.4583	-0.0597	52.352	0.0000	|---	|
5	0.3419	-0.0214	56.406	0.0000	|--	|
6	0.2408	0.0214	54.517	0.0000	|-	|
7	0.1495	-0.3853	59.373	0.0000	|-	--|
8	0.0920	0.1103	59.715	0.0000	|	|
9	0.0416	0.0603	59.79	0.0000	|	|
10	-0.0119	0.1260	59.796	0.0000	|	|-
11	-0.0582	0.1502	59.961	0.0000	|	|-

Table 6.10 shows that the ACF of the series cuts off at lags 5, 6 or 7, and there is one significant partial autocorrelation. So, the ADF test is performed with at least one lag.

Augmented Dickey-Fuller test for unit root

A pre-test was done to establish the order of integration of the GDP time series using the ADF unit root test. See Table 6.11.

Table 6.11: ADF Test Results - GDP

	Estimate	Std Error	T value	Prob (>|t|)
Intercept	432.890	111.328	3.89	0.002***
Trend	.38.609	10.942	3.53	0,004***
GDP. Lag 1	-.769	.213	-3.62	0.004***
ΔGDP. Lag 1	.437	.201	2.17	0.051*
ΔGDP. Lag 2	.185	.224	0.83	0.425
ΔGDP. Lag 3	.400	.249	1.60	0.135
ΔGDP. Lag 4	.339	.266	1.27	0.228
ΔGDP. Lag 5	-.134	.131	-1.02	0.327

Note: Sample size = 20; * = significant at the 10%, ** = significant at the 5%, and *** = significant at the 1% level.

The calculated test statistic

$$DF_{\tau} = \frac{\hat{\gamma}}{SE(\hat{\gamma})} = \frac{-.76932}{.2127013}$$

= -3.62

Since the calculated test statistic value (-3.62), falls in the rejection region, that is, to the left of the 5% (tau) critical value of – 3.60, we reject the null hypothesis for presence of unit roots at the 1% level of significance. The MacKinnon approximate p-value for Z(t) = 0.028, also means that the statistic value of -3.617 is significant at the 5% level. These results imply that the ADF model is statistically significant at the 5% level, and so, the differenced TCO series does not contain a unit root.

Like in the case of TCO, the residuals were tested for normality and autocorrelation. The results in Table 6.12 were obtianed.

Table 6.12: Normality test – GDP residuals

Variable	Shapiro – Wilk	P-value	Decision
Residual (ΔGDP)	0.986	0.989	Fail to reject

The results in Table 6.12 mean that the residuals follow the normal distribution. The Durbin-Watson d-statistic (8, 20) of 2.091 indicates that they are also not autocorrelated. The rejection of the hypothesis of nonstationarity means that the series is integrated of order 1, I(1). Because both TCO and GDP were found to be nonstationary series at the levels or lag zero, but integrated of the same order, I(1), this means that they are cointegrated and therefore have a long-run relationship. The cointegration can be tested using the Engle Granger cointegration method as follows.

Engle-Granger test

The Engle and Granger procedure has some defects as follows: the estimation of the long-run equilibrium regression requires that the researcher place one variable on the right-hand side as the dependent variable and use the other variable on the left-hand side as the independent variable (Wei 2006). In this study, it is possible to run the Engle-Granger method for cointegration by using the residuals from either of the following two equilibrium" regression equation.

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t$$

or

$$x_t = \beta_0' + \beta_1' y_t + \varepsilon_t'$$

For infinitely large samples, the theory indicates that the test for a unit root in the ε_t sequence becomes equivalent to the test for a unit root in the ε_t' sequence. Unfortunately, the properties of large samples on which this result is derived may not be applicable to the sample size used in this study. Hence, both equations are fitted in the study. Also, the two-step estimation procedure is based on the principle that, irrespective of which variable is chosen for normalisation, the same results will be attained if variables are interchanged. In practice, it is possible to find that one regression indicates that the variables are cointegrated, whereas reversing the order indicates no cointegration. This is a very undesirable feature of the procedure, because the test for cointegration should be invariant to the choice of variable selected for normalisation.

The following are the Engle-Granger results:

Regression of TCO on GDP

The results of the regression of TCO on GDP are shown in Table 6.13.

Table 6.13: Regression of TCO on GDP

	Estimate	Std Error	T value	Prob (>|t|)
Intercept	-2.457	3.012	-0.82	0.423
GDP	.0277	.002	11.96	0.000***

Note: Sample size = 26; ***=significant at the 1% level

Value of F(1, 24) - statistic is 143.02 and Prob>F = 0.000; R-squared: 0.856,

Adjusted R-squared: 0.850

The regression model in Table 6.13 is highly significant (P-value<0.01) with a positive coefficient estimate of 0.028 meaning that an increase in GDP of one unit results in an increase of 0.028 in TCO, holding other factors of TCO constant. Adjusted R-squared is 0.850 which implies that 85% of the variation of TCO is explained by the model. The first difference of the residual is regressed on the lagged level of the residuals without a constant to test for nonstationarity. The following results in Table 6.14 are obtained.

Table 6.14: Residual Regression - TCO

	Estimate	Std Error	T value	Prob (>|t|)
Lagged Residual	-.157	.092	-1.72	0.099*

Note: Sample size = 25; *=significant at the 10% level

F(1, 24) - statistic is 2.95 and Prob>F = 0.0988; R-squared: 0.1094, Adjusted R-squared: 0.0723.

The regression model is significant at the 10% level, which is in favour of cointegration of the two variables.

Also, the ADF test is performed on the residuals (rTCO) and the following results are obtained. See Table 6.15.

Table 6.15: Residual ADF test - TCO

	Estimate	Std Error	T value	Prob (>|t|)
rTCO. Lag 1	-.200	-.089	-2.25	0.037**
ΔrTCO. Lag 1	.428	.220	1.94	0.068*
ΔrTCO. Lag 2	.575	.237	2.43	0.026**
ΔrTCO. Lag 3	-.036	.166	-0.22	0.830

Note: rTCO = residuals of the regression model of TCO = f(GDP)

Since the calculated test statistic value (-2.25) falls in the rejection region, that is, to the left of the 5% (tau) critical value of -1.95, we reject the null hypothesis for presence of unit roots at the 5% level of significance. Also, the MacKinnon - statistic value of -2.254 is significant at the 5% level since it is less than the 5% critical value of -1.950. The results imply that the ADF model is statistically significant at the 5% level. The statistically significant ADF results confirm that there is no unit root and the residuals are stationary. Therefore, it can be concluded that TCO and GDP have a long-term positive relationship.

ECM Model

Regression of first difference of TCO on first lagged residuals from the regression model of TCO on GDP and first lagged difference of GDP yielded the results in Table 6.16.

Table 6.16: ECM - TCO

	Estimate	Std Error	T value	Prob (>|t|)
Intercept	-1.631	1.384	-1.18	0.252
rTCO. Lag 1	.081	.035	2.35	0.029**
ΔGDP. Lag 1	.013	.006	2.31	0.031**

Note: $F(2, 21)$ - statistic is 0.60 and Prob>F = 0.045; R-squared: 0.255,

Adjusted R-squared: 0.185.

The estimated ECM in table 5.15 is Δ TCO = -1.631 + 0.081 L.rTCO + 0.013 L Δ GDP.

The ECM is significant at the 5% level (Prob>F=0.045<0.005). With a positive coefficient on the lagged residuals and a value which tends to 0 the results indicate that the speed of adjustment to equilibrium is slow. Other things being equal, this implies that the TCO and GDP series converge to a long-run cointegrating equilibrium.

Regression of GDP on TCO

The results of the regression of TCO o

Table 6.17: Regression of TCO on GDP

	Estimate	Std Error	T value	Prob (>|t|)
Intercept	251.241	88.225	2.85	0.009***
TCO	30.927	2.586	11.96	0.000***

Note: Sample size = 26; ***=significant at the 1% level

F(1, 24) - statistic is 143.02 and Prob>F = 0.000; R-squared: 0.8563,

Adjusted R-squared: 0.8503

The regression model in Table 6.17 is highly significant (P-value<0.01) with a positive coefficient estimate of 30.927 meaning that an increase in TCO of one unit results in an increase of 30.927 in GDP, holding other factors of GDP constant. The adjusted R-squared is 0.850 which implies that 85% of the variation of GDP is explained by the model. The first difference of the corresponding residuals is then regressed on the lagged level of the residuals without a constant.

The following results are obtained. See Table 6.18.

Table 6.18: Residual regression

	Estimate	Std Error	T value	Prob (>|t|)
Lagged Residual	-.260	.080	-3.23	0.004**

Note: Sample size = 25; **=significant at the 5% level

F(1, 24) - statistic is 10.46 and Prob>F = 0.0035; R-squared: 0.3035,

Adjusted R-squared: 0.2744

The residual regression model in Table 6.18 is significant at the 1% level, which is in favour of cointegration of the two variables. Also, the ADF test is performed on the residuals (rGDP) and the following results in Table 6.19 are obtained.

Table 6.19: Residual ADF test - GDP

	Estimate	Std Error	T value	Prob (>|t|)
rGDP. Lag 1	-.169	.085	-1.99	0.006*
ΔrGDP. Lag 1	.334	.227	1.47	0.158
ΔrGDP. Lag 2	.422	.229	1.85	0.081*
ΔrGDP. Lag 3	-.037	.159	-0.23	0.818

Note: rGDP are residuals of the regression model of GDP = f(TCO)

In Table 6.18, since the calculated test statistic value (-1.99), falls in the rejection region, that is, to the left of the 5% (tau) critical value of –1.95 (Appendix), we reject the null hypothesis for presence of unit roots at the 5% level of significance. This is supported by the MacKinnon - statistic value of -1.991, which is also significant at the 5% level since it is less than the 5% critical value of --1.950. Because the null hypothesis that $\hat{\gamma}$ = 0 is rejected, we conclude that there is no unit root, and the series is stationary. Therefore, it can be concluded that GDP and TCO have a long-term positive relationship.

ECM Model

To fit the ECM model, first difference of GDP is regressed on first lagged residuals and first lagged difference of TCO. This produces the following results in Table 6.20.

Table 6.20: ECM - GDP

	Estimate	Std Error	T value	Prob (>|t|)
rGDP. Lag 1	.020	.074	0.27	0.791
ΔTCO. Lag 1	19.490	4.186	4.66	0.000***

Note: $F(2, 22)$ - statistic is 10.84 and Prob>F = 0.001

R-squared: 0.4964, Adjusted R-squared: 0.4506

The estimated ECM in Table 6.20 is Δ GDP = 0.020 L.rGDP + 19.490 L Δ TCO.

The small positive value which tends to 0 indicates that the speed of adjustment to equilibrium is slow. Other things being equal, this implies that the GDP and TCO series converge to a long-run cointegrating equilibrium.

(g) Reflection on results

Like any other sector of the economy, the construction sector of SA is susceptible to problems of data collection that may distort the outcome of analyses. Potential problems were highlighted earlier on in this chapter in subsection 5.1.2, where the composition of SA construction statistics was described. Many authors have stated the problems that affect the accuracy of construction output data, particularly in developing economies (Ofori 2003).

Some of these problems must be considered in order to interpret the results obtained with caution. These include unreliable data, as a result of the predominance of small companies that dominate the construction sector (South African Reserve Bank 2006). Also, the existence of the informal sector of the economy means that some construction work is not declared in the national statistics (Pearce 2003). The construction sector employs large numbers of legal and illegal migrant workers (Wells 1986). This means that the workforce statistics might be inaccurate as it is difficult to account in the national statistics for people that are not in the country's population statistics. The high degree of subcontracting that characterises the construction sector also means that a significant component of construction work may not be accounted for in the official statistics as most subcontractors operate informally (Fellini *et al.* 2007).

While Stats SA is committed to reporting credible official statistics, the identified loopholes suggest that it is still far from achieving its ambitious goal. This opinion has also been stated by some organisations that also use Stats SA data as their source for construction data (Pearce 2003). They recognised not only the additional difficulty in obtaining data from the construction sector enterprises, but also the importance of obtaining accurate data that allows for a better analysis of the construction sector.

According to Pearce (2003), data are not always consistent or reliable and there are special problems of gathering a detailed picture of the broad construction sector beyond on-site construction. Every country has its own peculiarities, not only regarding economic, financial or fiscal issues but also cultural factors. The first step of this research was to identify clearly inconsistent data and how Stats SA collected such data. Questionable data was verified with similar data reported by the SARB, which also reports on most construction statistics.

The informal sector of construction exists, even though sometimes the public sector and its agents do not like to discuss its existence, especially in developing economies. It is difficult to compile information on this issue (Pearce 2003). According to the World Bank (2010), the informal sector of the economy is growing, being approximately 40% in most developing countries. While these issues are concerning, the fact that the data is official and major global institutions such as the IMF, UN and the World Bank continue to use it in their decision making processes, the findings of this research cannot be dismissed indiscriminately.

6.8 Turning points in SA TCO and GDP

The SA construction sector has experienced a dramatic increase in TCO since the dawn of democracy in 1994. A strong assumption exists to effect that the construction sector is a major component of investment. This leads to the expectation that expansion in construction activity is related to economic growth. This section highlights the major turning points in TCO and GDP, with a view to further ascertain how TCO behaves in relation to growth in the economy. Table 6.21 illustrates the major turning points in TCO and GDP.

Table 6.21: Major turning points in TCO for SA

Year	ΔTCO (%)	ΔGDP (%)	Peak/ trough	Fundamental influence
1988	0.9	3.8	Trough	Apartheid policies and international isolation (see (a) below)
1995	3.6	3.1	Peak	Inclusive policy reforms (see (b) below)
1996	2	4.3	Trough	Institutional constraints in public sector (see (b) below)
1997	2.5	2.7	Peak	Market friendly policy reforms (see (c) below)
1998	2.1	0.5	Trough	Problems in global financial markets (see (c) below)
2000	5.6	4.2	Peak	Market friendly policies attracted investment (see (c) below)
2001	4.9	2.7	Trough	General economic cycles (see (c) below)
2005	11.9	5.3	Peak	Conducive investment climate (see (d) below)
2006	10.4	5.6	Trough	General economic cycles (see (d) below)
2007	15	5.6	Peak	Conducive investment climate (see (d) below)
2010	1.5	2.9	Trough	Spill-over effects of global financial crisis (see (e) below)
2012	3.2	2.8	Peak	Favourable policy reforms (see (e) below)
Average growth	4.6	2.5		

Average growth in TCO between 1986 and 2012 was 4.6%, whilst average growth in GDP was 2.5% (Table 6.21). At first sight, this could be construed to mean that GDP growth is accompanied by TCO growth in SA. However, the growth theories discussed in chapter 2 showed that the growth phenomenon can be complicated. A whole host of other factors need consideration before jumping into conclusions. There can be a number of influences behind the turning points in the time series. The next five points discuss the major turning points in TCO and consider the impact of different economic policies that the SA government rolled out since 1994. The discussion seeks to justify the suggested fundamental influences of peaks and troughs in TCO outlined in Table 6.21.

(a) Transition to democracy, pre-1994

The construction sector responded positively to the developments that were taking place in political circles and in the overall performance of the SA economy. From 1990, when Dr Nelson Mandela was released from prison there was some increase in year on year growth of TCO up to 1994 when the first democratic elections took place (see Figure 6.5). That increase may be associated with confidence in the overall economy and hope for the future of the country that was generated by Dr Mandela's release from prison and the political reforms. The political negotiations that took place between 1990 and 1994 to usher in a new political dispensation in SA, resulted in policy shifts that created a favourable environment for growth.

The available construction data suggest that like other sectors of the SA economy, the construction sector suffered significantly in the hands of the apartheid government in the period before 1994. The poor growth figures in TCO and GDP meant that the economy was harmed by (among other things) sanctions. In 1994, the ANC government inherited an economy that was wracked by long years of internal conflict and external sanctions. Perkins *et.al* (2005) argued that in the 2 decades before 1994, infrastructure investment was ignored by the apartheid government in SA. Although construction is a non-trade goods sector, SA's international isolation meant that there was no foreign direct investment coming. This combined with the apartheid government's reluctance to invest in infrastructure led to a remarkable decline in construction output annual growth.

Actual year on year growth in construction output was characterised by remarkable crests and troughs as illustrated in Figure 6.5. What caused the crests and troughs in total construction output? There can be a number of reasons. Construction projects have a limited time span. During the implementation of a construction project, expenditure in building materials, labour and plant fluctuates. Therefore, project expenditure goes up and down throughout the project life cycle.

What reforms influenced change in total constructin output? From 1989, apartheid laws such as the group areas act of 1950, which assigned racial groups to different residential and business areas were repealed. In 1990, Dr Nelson Mandela was released from prison, paving the way for the first democratic elections which were held in April 1994.

What was the link between the political events and construction output? According to the South African Reserve Bank (1995) economic outlook report, the political changes led to mood swings amongst investors. The report suggests that this attracted capital investment in infrastructure. Policy changes influenced more government expenditure in infrastructure, job creation and poverty alleviation schemes such as social grants. Hodge (2009), in his seminal work on growth, employment and unemployment in SA argued that the early 1990s saw a shift from apartheid policies that aimed to bolster the economic and political power of a minority to more inclusive policies that accommodated all citizens. The political changes also ended years of SA's isolation from the global economy. The international acclaim and encouragement strengthened SA's standing among international investors. The SARB reported that as sanctions were lifted, international trade led to significant investment in infrastructure such as transport networks and new factories, which boosted construction output.

(b) The RDP, 1994-1996

TCO growth increased as the ANC came into power and started to implement policy reforms including the RDP (see Figure 6.5). The RDP was a policy strategy of the ANC that was seeking to promote the advancement of the economy in a manner that would overcome the inequalities and social backlogs inherited from the apartheid government. Essential features of the inherited economy were: distorted stagnant production, gross social inequalities, enormous spatial disparities, and a misdirected and mismanaged public sector. It was against this background that the RDP document was formulated and published by the ANC in 1994. An innovative and people centred document, the RDP raised four central concerns: meeting basic needs, developing human resources, building the economy, and democratising society.

How did the RDP affect construction? The SA history was characterised by colonialism, racism, apartheid, sexism and repressive labour policies, which resulted in poverty and degradation existing side by side with modern cities and a developed mining industrial and commercial infrastructure. The economy was built on systematically enforced racial division, with underdeveloped rural Bantustans (black townships) without basic infrastructure and well developed white-owned suburbs and commercial hubs with modern infrastructure. The RDP was thus designed to correct these imbalances through the provision of basic infrastructure to upgrade the underdeveloped communities and uplift people's living standards. The construction sector was envisaged to play a significant role in the delivery of the much needed infrastructure such as roads, sanitation, electricity, schools and clinics (African National Congress 1994). The RDP was also intended to heal the deep scars of inequality and economic inefficiency that was created by segregation in education, health, welfare, transport and employment.

What were the structural difficulties that constrained the implementation of the RDP? In 1994, the RDP was formally established as government policy with the responsibility to create and implement a wide range development projects in all 9 provinces, initiate budget reprioritisation to achieve new socio-economic objectives, and introduce a performance culture in government. Major development projects that the RDP envisaged included the provision of basic infrastructure such roads, water, electricity, sanitation, schools and clinics. The fundamental problem was that institutional capacity for the implementation of the RDP was not clearly defined at national, provincial and local levels of the government. For example, reprioritising the budget to support the RDP was misinterpreted by some ministers as interfering with the direct interests of some influential ministers and senior government officials. The capacity of the minister responsible for coordinating the RDP policy was significantly compromised by the inevitable preoccupation of other ministers with internal concerns and tendencies to defend departmental autonomy. Tensions arose over the overlap of functions between the RDP office and individual departments at both national and provincial levels. Although the RDP emphasised the role of local government, the machinery for involving them was lacking. The closing down of the RDP offices amounted to a devastating setback in the implementation of most infrastructure projects, which resulted in the decline in year on year growth of construction output in 1996.

As the RDP office closed down in 1996, the implementation of RDP projects was decentralised to related departments, mainly the department of public works and the department of housing. The closure of the RDP office caused some confusion and disquiet among significant sections of the public. Some organisations were concerned that their RDP-funded projects and programmes would be disrupted. There was a concern that the closure of the RDP office meant that the RDP was going to be sidelined. Funding for the RDP projects was dependent on budget reallocations from other departments that had their own programmes. This resulted in limited amounts of financing as the room to manoeuvre within the existing budget framework was constrained by commitments already made by the other departments.

(c) The GEAR strategy, 1996-2003

From 1996, growth in TCO increased as the ANC government adopted the growth, employment and redistribution (GEAR) strategy. What was GEAR? What was its theoretical basis? The GEAR strategy entailed a shift to macro policies such as privatisation, macroeconomic stability and trade liberalisation. In June 1996, the ANC government adopted the GEAR strategy. Unlike the RDP which relied on budget reallocations to finance construction projects, the GEAR strategy was dependent more on private sector investment. The GEAR strategy created an environment conducive to market-orientated economic growth. Economic recovery would be market-led, with a view to achieving sustainable growth by attracting foreign and encouraging domestic investments. How did GEAR propose to incentivise the construction sector? According to Berry *et al*. (2002), in their paper entitled the economics of SMMEs in South Africa, provided that the GEAR strategy proposed the following interventions to facilitate activity in the construction sector:

- Government subsidies were made available to support construction firms especially those owned by black people who were disadvantaged by apartheid
- Dedicated contractor support programmes were formulated and
- Partnership programmes between government and financial institutions to finance construction projects were initiated.

Contrary to negative speculations about the consequences of the change of policy, year on year growth in construction output increased in 1997 and declined again in 1998. This bumpy growth was influenced by events that were happening in the global economy as outlined in Text box 6.1. The spill-over effects of the financial problems of Southeast Asia affected the implementation of GEAR in South Africa. This also affected construction output negatively.

In 1998 overall economic growth for South Africa dwindled to only 0.5%, as exports and foreign capital inflows decreased due to various international economic movements. For example, there was a drop in the price of gold, the weakness in the US, EU and Japanese economies, the East Asian financial crisis and the delayed effects of the stronger rand in 1997. South Africa had a low level of saving domestically, which meant that the economy had to rely on the inflow of foreign investment capital for the financing of economic growth. Investment funding was sourced from the excess saving of advanced economies such as the US.

Text box 6.1: The global financial crisis of 1998

South Africa, and many other countries of the world, experienced the adverse consequences of such sudden capital outflows back to the industrial countries of its origin. The global financial crisis of 1998 started in East Asia where a number of countries such as Japan, Korea, Thailand, the Philippines, Indonesia and Malaysia, experienced problems with their domestic economies. These problems led to a decline in the confidence of foreign investors in emerging markets which led to the large-scale withdrawal of investment funds from these countries back to the countries of origin, that is, back to the major industrial countries of the west. There was a flight from more risky investments in the emerging markets into higher quality but lower yielding financial assets of the industrial countries, in this case, mainly of the US.

Although South Africa did not experience the same economic problems as the East Asian countries, the contagion effect spilled over into the South African economy in May 1998 when foreign fund managers were withdrawing portfolio investments from all the emerging markets of the world, and not only from the East Asian countries. South Africa, with its well-developed capital markets with large turnovers and unrestricted convertibility for non-residents, provided an easy source of liquidity for the fund managers who needed to transfer funds back to their countries of origin.

During the first four months of 1998, non-residents increased their holdings of South African bonds by no less than R16 billion. From May up to December 1998, however, non-residents reduced their holdings of South African bonds again by R26 billion. It was indeed difficult for the South African economy to absorb the effect of this switch-around of R42 billion within the same calendar year of the in and outflows of non-resident portfolio investment capital. The large outflow of non-resident funds from May to December 1998 had the following adverse consequences for the South African economy:

- The yield on long-term government bonds increased from below 13% in April 1998 to over 20% in September 1998.
- Interest rates rose over the full spectrum of maturities from 14.8% in April to 21.8% in August 1998, resulting in a rand depreciation of 34%.
- The outflow of capital forced a depreciation of the rand against foreign currencies of about 20%.
- Liquidity was drained from the South African banking sector to such an extent that the banks had to borrow large amounts from the Reserve Bank on a daily basis, and also had to curtail their credit extension to the private sector.
- The shortage of funds in the markets pushed up short-term interest rates, including the prime overdraft and mortgage lending rates of the banks by about 7 full percentage points to levels of about 25%.
- The rate of inflation in South Africa increased from 5% in April 1998 to 9.3% by November of the same year.

Source: South African Reserve Bank 1999

Whilst the country was generally successful in attracting substantial foreign investment funds, a disguised problem in the capital inflows was that a majority of the total foreign funds invested came in the form of portfolio investments, which is investment in paper assets, and not in bricks and mortar. The disadvantage of this type of investment is that it can be very volatile. Funds can flow out of the country as easily as it flows into the country, and both in and outflows can at times be very disrupting for the domestic economy.

These developments in the financial markets depressed real economic activity in SA and construction, as an investment sector was also negatively affected. Year on year growth in construction output declined in 1998. Investment in infrastructure was negatively affected as the cost of borrowing was high. According the South African Reserve Bank (2005) the prime lending rate hit an all-time high of 25.5% in 1998. The high interest rates resulted in reduced investment in construction as the cost of borrowing was high.

As the government continued to steer the GEAR policies, interest rates dropped to 15.5% by the end of 1999, whilst construction output growth increased to 3.2%. The government's aim was for monetary policy to be steered towards lower interest rates, because high interest rates affect investment negatively and increase interest payments on government debt. In 1998, the increasing interest rates proved to be costly for investment and growth in SA as reflected in the decline in overall economic growth as well as the trough suffered in year on year growth in total construction output (Figure 6.5).

In response to the poor performance of the SA economy in 1998, from 1999 onwards, the SA government instituted a number of budget and financial management reforms, in line with the GEAR strategy. These were given substance by the public finance management act of 1999 (

Text box 6.2), initiating the move from an input-oriented expenditure control system towards a more performance-oriented system. The act did not prescribe numerical fiscal rules, but emphasized regular financial reporting, sound internal expenditure controls, independent audit and supervision of control systems, improved accounting standards and training of financial managers, and greater emphasis on outputs and performance monitoring. These reforms resulted in increased public sector investment in infrastructure, significant capital inflows in the form of equity and FDI, which positively influenced growth in total construction output.

Text box 6.2: Public finance management act of 1999

The Public Finance Management Act (PFMA), 1999 (Act No. 1 of 1999) (as amended by Act No. 29 of 1999) is one of the most important pieces of legislation passed by the first democratic government in South Africa. The Act promotes the objective of good financial management in order to maximise service delivery through the effective and efficient use of the limited resources.

The key objectives of the Act may be summarized as being to:

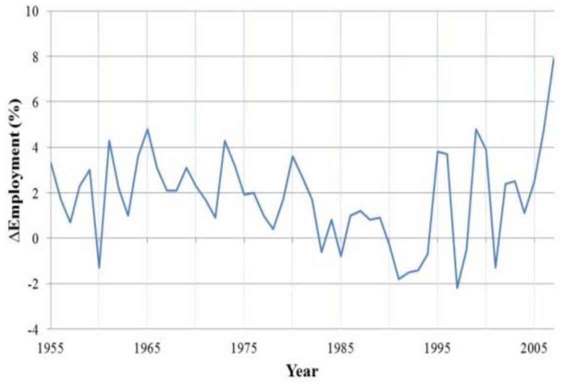
- Modernise the system of financial management in the public sector;
- Enable public sector managers to manage, but at the same time be held more accountable;
- Ensure the timely provision of quality information; and
- Eliminate the waste and corruption in the use of public assets.

Source: South African Reserve Bank 2006

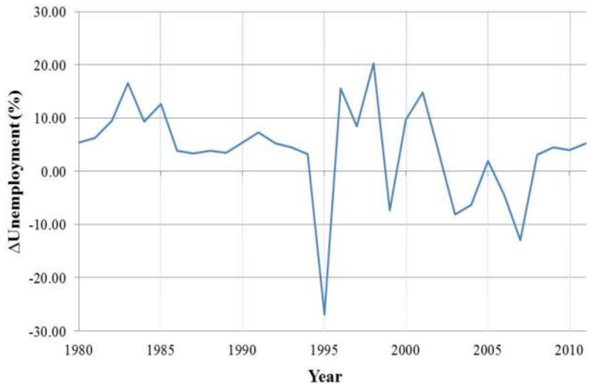
How did the GEAR strategy affect the SA construction sector? The SA government was determined to open markets and create a favourable investment climate through the GEAR strategy, but it had mixed success. It brought greater financial discipline and macroeconomic stability but failed to deliver in key areas such as curbing unemployment and reducing inflation. As discussed earlier, inflation figures were very unstable in the period 1996 to 2003 as illustrated in Figure 6.2. Growth is calculated in inflation-adjusted terms, in order to obviate the distorting effect of inflation on the prices of the goods and services produced. Inflation is, therefore, important in the construction sector since the sector generates investment goods such as roads, factories, schools, infrastructure, and office buildings that can help produce other goods in the future.

The unstable inflation figures, allied with the sharp fluctuations in formal employment levels did not augur well for GEAR as a policy. Did employment fluctuations affect TCO and vice versa? In Figure 6.5 discussed earlier, GDP growth was shown to be accompanied by faster TCO growth. Figure 6.7 indicates that employment fluctuations may affect or be affected by TCO. However, the causal effect of the two is beyond the scope of this analysis.

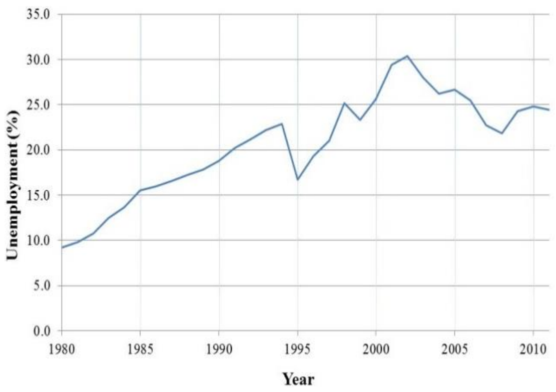
The construction sector is relatively labour intensive as it uses a large number of workers per unit of output than most other industries. Figure 6.7 shows that when employment levels in construction increased, there was also increase in overall employment levels for SA. When construction employment levels declined, the overall level of unemployment in the economy increased. Amongst other influences, the sharp cyclical levels of employment came as result of the transitory nature of construction employment. This, allied with the drift of casual employees in and out of the construction sector, makes it difficult to have great confidence in the presented levels of employment and unemployment.



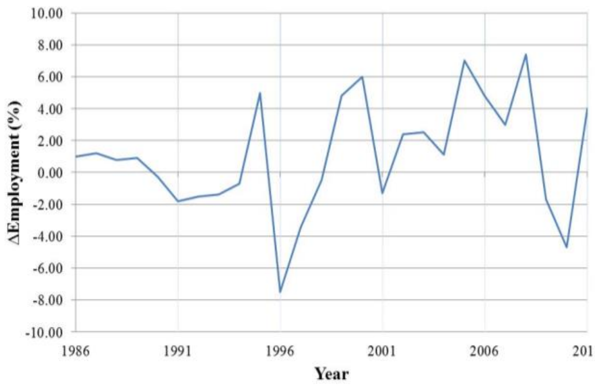
(i) Total employment levels for SA



(ii) Total unemployment levels for SA



(iii)Unemployment rate for SA



(iv)Construction employment levels for SA

Figure 6.7: Employment statistics for SA (constant)

Data source: Stats SA, Quarterly Bulletin

What were the implications of employment fluctuations on growth? The creation of employment opportunities is one way in which the benefits of growth can trickle down. As growth in the economy rose to 4.2% in the year 2000 as shown in Figure 6.5, construction employment grew even faster from -0.5% in 1998 to 6% in the year 2000 as illustrated in Figure 6.7(iv). From 2001 to 2003, GDP growth increased from 2.7% to 2.9%, while TCO growth increased from 4.9% to 7.7% over the same period. Therefore, it can be inferred that growth in the economy leads to growth in construction output and employment.

(d) The NSDP, 2003-2007

Annual growth in TCO continued to increase in 2003. This was the year the SA government enacted the national spatial development perspective (NSDP), which was a strategic framework for increasing economic growth and promoting social inclusion. The NSDP advocated for a new approach to infrastructure investment, other than government intervention. It envisaged that bringing in private sector infrastructure investors and operators would bring about greater efficiency.

According to Fourie (2006), infrastructure sectors in SA were traditionally monopolies that were owned and managed by the public sector. The NSDP legislated changes in how infrastructure should be owned, operated and regulated. Fourie stated that this policy change occurred because the SA government realized that their own resources were insufficient to meet the growing infrastructure demands. He argued that the government was under pressure to use its scarce resources for other government services such as welfare.

How did the NSDP affect the performance of the construction sector? Robust growth in construction output was achieved between 2003 and 2007 as illustrated in Figure 6.5. Emphasis on private investment attracted foreign capital inflows. The on-going policy reforms served as incentive to local and foreign investors. The resultant economic policies built up a rock-solid macroeconomic structure. Taxes were reduced, which put more money in peoples' pockets, to spend in the economy. The housing market was booming, driven by the factors as outlined in Text box 6.3.

Text box 6.3: Drivers for the housing market in South Africa 2000-06

- The emergence of a financially stable black middle class had a tremendous impact on housing demand, encouraged by tax reliefs for individuals, in the context of a growing economy.
- South Africans who had parked money offshore during the apartheid era were allowed (and required) to bring it back by September 2004. Much of this money went into property.

- Better stability and security helped. During apartheid and its sequel, property prices badly lagged the economy, as the security situation went from bad to worse.
- Lastly, the Financial Sector Charter in 2003 boosted mortgage loan growth. Financial institutions committed to provide ZAR 42 billion (US$5.45 million) of housing finance to the low income market. Then in 2006, the capital gains tax (CGT) exemption on primary residences was raised from ZAR1 million (US$127,129) to ZAR1.5 million (US$190,694). Transfer duties on properties were lowered too. For example, no transfer duty was payable on properties valued at ZAR500, 000 (US$63,565) or less.

Source: South African Reserve Bank 2009

From 2003, the SA economy grew consistently until 2007. Figure 6.7(iii) shows that overall unemployment was reduced from 30.4% in 2002 to 21.9% in 2008. Employment levels in the construction sector increased from 2.4% in 2002 to 7.4% in 2008 as illustrated in Figure 6.7(iv). The growth in construction employment experienced was however bumpy, due to the casual nature of construction work. Investment in various sectors of the economy including construction increased as policy reforms continued. The new policies led to good governance, which attracted investment. Inflation and real interest rates declined as illustrated in Figure 6.2 and Figure 6.3 respectively.

What was the stimulus for the growth in construction output? According to Hodge (2009), this growth can be explained primarily by the fiscal discipline that was required by the macroeconomic stabilization measures called for in the GEAR policy framework. Investment spending, especially in infrastructure improved sharply. Du Plessis and Smit (2005) also observed that the growth could also be associated with the impact of business cycle type fluctuations on the factors determining the long run growth trajectory. For example, the investment rate and the quality of that investment. The upswing in economic activity experienced in the period 2003-7 was a time of steady, as opposed to spectacular growth, as can be seen in Figure 6.5.

The SARB (2009) suggested that the growth can be broadly associated with the cumulative effect of the policy reforms since 1994. Figure 6.5 shows that the average growth between

1994 and 2007 was 3.6%. According to the endogenous growth theory, economic growth is a function of investment, labour and technology. Construction influences investment. It is a labour-intensive activity, with the capacity to provide extensive employment. To explain the relationship of the construction sector to economic growth, it is important to understand the part played by construction as a generator of capital stock.

What was the impact of the 2010 FIFA world cup infrastructure projects? SA was awarded the bid to host the 2010 FIFA World Cup on 15 May 2004, becoming the first African nation to serve as host for the international football competition (National Treasury 2011). The decision to award SA the bid to host an international event of this magnitude reinforced the confidence of global investors that SA was becoming a stable democracy and an attractive investment destination. The bid award meant that SA had to engage in a massive infrastructure development programme to cater for the international event. Huge infrastructure investments were made by the government and the private sector, mainly in the construction of stadia, transport networks, ports of entry and hospitality infrastructure. The major impacts of these investments included enhanced infrastructure base, gains in welfare and employment as well as increases in tourists and local business prospects.

How much was the investment? According to National Treasury (2011), the total infrastructure investment that went into hosting the 2010 FIFA world cup were approximately R35 billion. This was almost double the amount initially estimated as per Table 6.22. What percentage of total investment is SA was this investment? The SARB (2011) estimated that these investments represented approximately 12% of all investment that went into the SA economy over the period 2003-7. Employment might have increased over this period as a result of construction activities, but overall unemployment levels in the subsequent years showed an increasing trend as shown in Figure 6.7(ii). Similarly, annual change in both TCO and GDP increased between 2003-7 but then declined from 2008 to 2010 (Figure 6.5). Therefore, while growth may have increased over the four years (2003-7), it is hard to imagine that SA's hosting of the 2010FIFA world cup would have had a significant impact on long run economic growth. However, a more robust impact study may be conducted in the near future as more accurate estimates of inputs become available.

How were the investments funded? Major funding for the infrastructure projects came from government through budget allocations. According to the South African Reserve Bank quarterly reports, actual government expenditure on the projects was estimated to be R17.4 billion as at September 2007. However, some projects, such as tourism infrastructure were funded by the private sector. It is important to note that irrespective of which sector funds the investment, the impact on growth is likely to be there.

summarises the major investments that went into the hosting of the 2010 FIFA World Cup, which were borne by the state. What comes out clearly from the table is the commitment of substantial resources by government, not only to capital expenditure for the construction of stadia and related transport infrastructure, but also for improving other auxiliary services. These include the modernization of the information and communication technology, enhancing the efficiency of monitoring at ports of entry and the financing of various specific and general legacy effects.

Table 6.22: Breakdown of costs borne by the state for hosting 2010 FIFA world cup

Project	**Ex ante cost**
Stadia	R8.4 billion
Transport	R9.0 billion
Broadcasting	R400 million
ICT	R2.5 billion
Safety and security	R666 million

FIFA	R3.1 billion
Ports of entry	R1.573 billion
Training on volunteers	R25 million
Community mobilisation	R17 million
Legacy projects	R337 million
Arts and culture	R150 million
Organising committee	R3.2 billion
Total	**R17.4 billion**

Source: South African Reserve Bank 2006

As indicated earlier, a robust impact study of the 2010 FIFA world cup infrastructure projects would need to be undertaken in the near future, as more data becomes available. For instance, it would be of interest to understand the how investment from the private sector, as well as FDI was affected by the projects. The construction sector was active for several years as a result of a myriad of new infrastructure that had to be built and existing infrastructure that had to be upgraded.

In its economic outlook report, the South African Reserve Bank (2009) reported growth in FDI from just under US$1 billion in 2005 to US$3 billion in 2007. Globalisation places great emphasis on the importance of FDI to developing countries (Krugman and Wells 2006). The problem is that its effects concerns long-term prospective benefits. Their consequences on the economy may only be determined long after the games. It is also not easy to predict if SA would continue attracting FDI after the hosting of the games. However, the year on year growth in construction output that the economy experienced between 2003 and 2007 can also be associated with an increase in FDI as SA's image as an investment destination was enhanced. The construction sector was particularly boosted as perceived demand for various products increased considerably. Improved infrastructural networks such as roads and freight increased the productivity of investments and stimulated more FDI flows.

(e) The NGP, 2008-2012

In 2008, the consistent year on year growth in construction output that SA had experienced since 2002 came to a halt. This was the time when the global financial crisis started to affect most of the developed world. Spill-over effects from the crisis started to affect developing countries such as SA. The consequent domestic recession reversed many of the country's gains in employment creation and investment levels. The unemployment rate increased from 21.9% in 2008 to 25.5% in 2012 as shown in Figure 6.7(iii). Figure 6.7(iv) shows that annual change in construction employment went down to -4.7% in 2010, the lowest in 14 years.

Why did the global economic downturn affect year on year growth in construction output? There are no obvious answers to this question. The 2008-2012 global financial crisis is considered by many commentators to be the worst since the great depression of the 1930s. It was a marked global economic decline that had negative spill-over impacts on several sectors of the economy around the world. The SA construction sector was no exception to such negative effects. What happens in the main stream economy affects the functioning and growth of construction output. As argued in subsection 5.1.4 earlier, the data presented in Figure 6.5 suggests that GDP growth is accompanied by TCO growth.

As the global financial crisis hit the SA economy in 2008, both GDP growth and TCO growth started to decline. This happened despite the fact that the construction sector was heavily occupied with significant infrastructure projects in preparation for SA's hosting of the 2010 FIFA world cup. It would have been expected that the TCO growth experienced between 2003 and 2007 would have continued at least until 2010 when most of the infrastructure projects were complete. However, in response to the global economic crisis, most investors became cautious. Some investments that were in the pipeline were deferred. FDIs related to the construction sector were affected negatively. This is reflected in the decline in GDP growth from 5.6% in 2007 to -1.5% in 2009 as shown in Figure 6.5. The SA government reviewed its infrastructure spending from time to time. According to National Treasury (2011), some infrastructure projects that were of less priority to the hosting of the FIFA games were put aside. These events could not but had an impact on TCO as illustrated in Figure 6.5.

What was the net effect of the 2010 FIFA world cup and the global financial crisis? From 2004 when SA won the bid to host the event, both GDP growth and TCO growth increased (Figure 6.5). TCO growth increased faster than GDP growth until the 2007. The global financial crisis that started in 2008 undermined this growth and both GDP growth and TCO growth declined significantly until 2010 as illustrated in Figure 6.5. However, overall infrastructure investment related to the hosting of the FIFA games totalled approximately 12% of all investments that went into the economy.

It is worth noting that the SA construction sector managed, on the whole, to avoid some of the worst effects of the global economic crisis, as a result of the many infrastructure projects that were being implemented. So investment in the infrastructure projects had short term positive impacts on growth in construction output. Since most of these projects were funded by the government, their implementation was based on political decisions. The ability of developments that are initiated in this manner to stimulate economic growth is questionable. It can be argued for instance that the huge slump in construction activity experienced in 2010 was as a result of the infrastructure projects being completed. So how do you create further demand for more infrastructure investments, to sustain the initial growth?

In December 2010, the SA government adopted the new growth path (NGP) document drawn by the department of economic development. The document outlined an ambitious strategy to grow the economy and curb the prevailing job deficit. What was the NGP strategy? The fundamental strategy involved direct government investment in economic infrastructure that was envisaged to earn future returns and tax revenue. Infrastructure development, agriculture, mining, manufacturing, the green economy and tourism were identified as priority sectors of focus. The NGP identified investments in the construction sector to the tune of R845 billion in the medium term and R3.2 trillion to be rolled out over a 10-year period (South African National Treasury 2011). The NGP set out critical markers for employment creation and growth and identified areas where viable changes in the structure and character of production could generate a more inclusive and greener economy over the medium to long-term. A significant component of the NGP was the massive infrastructure programme aimed at maximising job creation across the economy.

The construction sector responded positively to the implementation of the NGP, as construction output growth increased from -1.5% in 2009 to 3.1% in 2011 as illustrated in Figure 6.5. The NGP suggested that significant investment in value-adding manufacturing operations and beneficiation of raw materials was necessary so that SA must export value-added products. According to the NGP policy document, the opportunities that this was intended to bring to the SA construction sector included the building of manufacturing infrastructure and transport networks. Although the SA government has made some commitments regarding investments in this line, it remains debatable if government action alone is sufficient for such bold endeavours to be realized.

The investment in infrastructure provision was envisaged to enhance efficiency across the economy, laying the foundation for stepped-up growth and employment creation in every industry, while significantly advancing social equity goals and addressing inequalities in the SA society. The suggestion that investment in infrastructure leads to economic growth and employment is questionable. The implication of such investments on social equity and addressing inequalities is also unclear. In the politicians' view, the interventions by the government would stimulate economic growth in the short and medium-term, but there is no clear evidence to support such perspectives. So, whether or not the NGP will be able to achieve its objectives remains the subject for further scrutiny.

The picture that arises suggests that when there is growth in the economy, the construction sector also experiences growth. It is also notable that construction output grows at a particularly faster rate than the growth of the economy as a whole. The employment statistics presented in Figure 6.7 suggest that growth in the economy also leads to increased construction employment and when economic growth decreases, construction employment also decreases.

Chapter 7: UK construction and growth

Chapter 6 investigated the relationship of the construction sector to economic growth in the context of the SA economy. This chapter analyzes the relationship based on the construction sector of the UK. The literature reviewed showed that major writers in construction economics such as Choy (2011), Jackman (2010), Myers (2008), Hillebrandt (2000), Tan (2002), Bon (1992), Wells (1986) and Turin (1978) all emphasized the importance of the role that the construction sector plays in economic growth. However, they seemed to base their work purely on the power of their argument. It remains unclear as to how the construction sector is considered to be of such importance. Given the growth trajectory of the UK economy, it is anticipated that this investigation will yield some more insights on the relationship of the construction sector to economic growth.

7.1 Policy background to UK construction sector analysis

The UK is among the world's most developed economies. It was the birthplace of modern democracy, the industrial revolution, and many of the financial and capital markets that are the foundation of the capitalist economic system. To understand how the construction sector of the UK has evolved over the years, it is necessary to first look back at the period since the Second World War (Strassman 1970).

There was no civilian new construction during the war except essential stop-gap repairs. In 1945, the stock of all types of buildings and works was badly depleted. There was a long period of slow reconstruction during which a system of building permits was in operation so that only essential work was given priority (Hillebrandt 1984).

The period after the Second World War saw hightened activity in the UK construction sector. An estimated 58 million ft^2 of commercial property and 475 000 housing units had been destroyed during the war. The UK government exercised rigid control over construction activity. Priority was given to the repair of infrastructure damaged during the war. This included infrastructure such as schools and local authority housing (Gruneberg 1997).

A balance of payments crisis in 1947 compelled the UK government to cut down on public sector house building by about 50% (Gruneberg 1997). Devaluation of the Sterling in 1949, caused by the balance of payment crisis meant that most reconstruction programmes had to be stalled (Barnett 2001). This led the UK government to the relaxation of building restrictions in the early 1950s, in a bid to incentivise private investment in construction.

In the 1960s, office speculation began and private sector housing expanded. Throughout the 1960s and 1970s, many urban fringe, high-density housing estates were built. Older residential houses were converted into flat dwellings. By the 1980s, fewer fringe sites were made available for development by the government. This was influenced by the policies of the government of the day, as the fundamentals of free markets were taking root in the UK. Despite this, prices of up-market properties continued to increase (Gruneberg 1997).

The construction sector of the UK experienced a property boom from the late 1960s to the early 1970s. That boom ended with the oil crisis of 1973. From the mid-1970s and throughout the 1980s, construction demand was unstable compared to the previous decades. It dropped by 30% between 1973 and 1975. Similar declines occurred in 1981 and again in 1990 (Gruneberg 1997).

Construction firms in the UK relied heavily on government spending for expansion. Therefore, the decline in public sector spending affected the size and workload of the construction sector. In 1975 and 1976, an economic crisis led to a downward shift in public sector spending in construction activity as a proportion of all spending in the economy (Hillebrandt 1984). This trend continued throughout the 1980s (Gruneberg 1997).

Does activity in the construction sector depend on the performance of the rest of the economy and government policies? Does the construction sector drive growth in the UK? The argument that the economy and employment could be stimulated through the construction sector by creating building projects came to the fore in the beginning of the 1980s in the UK. Proponents of the Keynesian school of thought argued that construction projects could be financed through government borrowing to propel activity in the economy (Wells 1986).

Keynes (2007) had argued that in recession governments need to spend more than they take in through taxes in order to create sufficient demand in the economy to reduce unemployment. The UK government in the 1980s under the leadership of Prime Minister Margaret Thatcher vehimently refused to be persuaded to pursue budget deficit policy. As a result, construction workload continued to dwindle until the late 1980s. Unemployment rates also increased (Gruneberg 1997).

Inadequate investment continued to undermine the performance of the UK economy and the the construction sector in particular. High levels of unemployment distorted national output so that the government ended up with a budget deficit anyway. It is important to note that despite government's refusal to stimulate the economy by increasing its spending on construction projects as a whole, several motorway projects were initiated during the 1980s (Hillebrandt 2000). While the government stood unfazed by the pressure to increase its spending on construction projects, it is of interest to understand if stimulating the economy in that way would have had any effect at all in boosting growth.

The late 1980s saw the construction sector slowly peaking up in its output. It recovered strongly in 1989, where construction output was similar to what it was in 1979. Despite this, building costs and prices were much higher. Construction products that were in demand included shopping malls and office accommodation. Annual housing output was still lower than in 1969 or 1972 (Gruneberg 1997).

What does the policy background of the UK teach about the prerequisites for growth in the construction sector? In an empirical study to explore the role of the natural environment in supporting and contributing to growth, Everett *et al.* (2010) stated that new ideas and their transmission, in combination with the accumulation of labour and capital, have enabled sustained growth over the past few decades. Likewise, Mokyr (2005) in a survey to establish the precise connection between the industrial revolution and the beginnings of growth argued that economists had become accustomed to associate long-term growth with technological progress. These views were embedded in the Solow growth models and more recently in the endogenous growth models.

The Solow growth models regarded technology as a mechanism that enhanced productivity increamentally each year. However, the endogenous growth models view technology as being produced within the system by the rational and purposeful application of research and development, coupled with the growth of complementary human and physical capital. What is the prerequisite for growth? Everett *et al.* (2010) indicated that to achieve growth, technology, in combination with labour and capital are necessary. Technology is often embodied in capital and labour. Mokyr (2005) provided that people are inherently innovative and that if only the circumstances were right, then technological progress would be guaranteed. What circumstances was Mokyr referring to? According to Sloman *et al.* (2012), if growth is to be sustained over the years the key is growth in investment and productivity. Therefore, the understanding of growth in the construction sector must be based on much broader considerations.

Growth remains essential to support continued improvements in factors that affect people's wellbeing, from health and employment to education and quality of life. Sloman *et al.* (2012) stated that politicians in the UK and elsewhere see growth as very important. If growth disappears and a recession looms, people get very concerned about declining incomes and rising unemployment.

The policy background of the UK since the Second World War show that the government has played a susbstantial part in the growth of the construction sector. Its interest in the sector has been driven mainly by the construction sector's contribution to GDP, investment and the part that the sector plays in employment creation. Clearly, there must be some relationship between the construction sector and economic growth. Also, government policy must be a major component of that relationship.

7.2 Context of UK construction statistics

This section describes construction output and GDP data for the UK economy from 1955 to 2012, to understand the relationship between construction activity and economic growth. The data presented ranges from graphs and tables to the use of multivariate statistical techniques. Most of the data described was sourced from the ONS, HM Treasury, United Nations, the World Bank, the IMF, and the OECD. The UK is a developed economy whilst SA is still a developing economy. As economies that are at two different developmental trajectories, it was considered prudent to use both UK and SA data. An understanding of the dynamics that influence construction output and growth in the two economies will assist in developing a coherent comprehensive view of the relationships.

Construction output in the UK construction sector is defined as the amount chargeable to customers for building and civil engineering work done in the relevant period excluding

VAT. Businesses are asked to include the value of work done on their own initiative on buildings such as dwellings or offices for eventual sale or lease, and of work done by their own operatives on the construction and maintenance of their own premises. The value of goods made by businesses themselves and used in the work is also included (ONS 2012).

In all returns, work done by sub-contractors is excluded to avoid double counting, since sub-contractors are also sampled. The results of the new orders survey are used to distribute the overall estimate of output on new work (based on business returns) between the different types of new work carried out and the location of the work. The regional classification of new work is therefore based on the location of site work, while for repair and maintenance it is based on the location of the firm (ONS 2011).

The figures collected are at current values (ONS 2012). These are re-valued at constant prices and then seasonally adjusted and converted into index form. The estimates of the value of output no longer include estimates of unrecorded output of firms and individuals not on the statistical register. Construction output does not include payments made to architects or consultants from other firms (Myers 2008). This also covers engineers and surveyors. It would include wages paid to such people if they were directly employed by the business.

Like in other economies, construction output in the UK makes a significant contribution to the GDP of the economy (HM Treasury 2012). Recent ONS data shows that the UK construction sector accounts for about 10% of GDP (ONS 2013). The time series annual output behaviour of the UK construction sector from 1955 to 2012 is examined so as to compare the dynamics involved with those of the SA construction sector. The underlying stochastic process that characterize construction output over this period is then investigated further using other statistical methods, including regression analysis.

7.3 Patterns of TCO and GDP in the UK 1955-2012

This section investigates the trends in both TCO and GDP, with a view to establish the existence of a relationship between the construction sector and economic growth in the UK economy. The graphs of the original time series data and the trend lines illustrate the general direction in which the variables are going, that is, whether they are increasing or decreasing over time. Analysis of the trends in peaks and troughs of both TCO and GDP is undertaken to ascertain whether construction follows growth or *vice versa*.

TCO measures the volume of construction activity in the UK economy over time. The volume series is intended to measure the level of TCO, adjusting for price inflation, and allowing comparisons of activity to be made between periods. Annual change in TCO gives an indication of the year on year growth in the construction sector. The following is an analysis of the graphs shown in Figure 7.1 and Figure 7.2.

(a) Figure 7.1 shows TCO figures, whilst Figure 7.2 illustrates the annual change in GDP and annual change in TCO over the period 1955 to 2012. In Figure 7.2 the pattern of change for TCO is presented. The TCO including repairs and maintenance (R&M) increased from £39.9 billion in 1955 to £82.1 billion in 1973. Construction output excluding R&M increased from £27 billion to £59.6 billion over the same period.

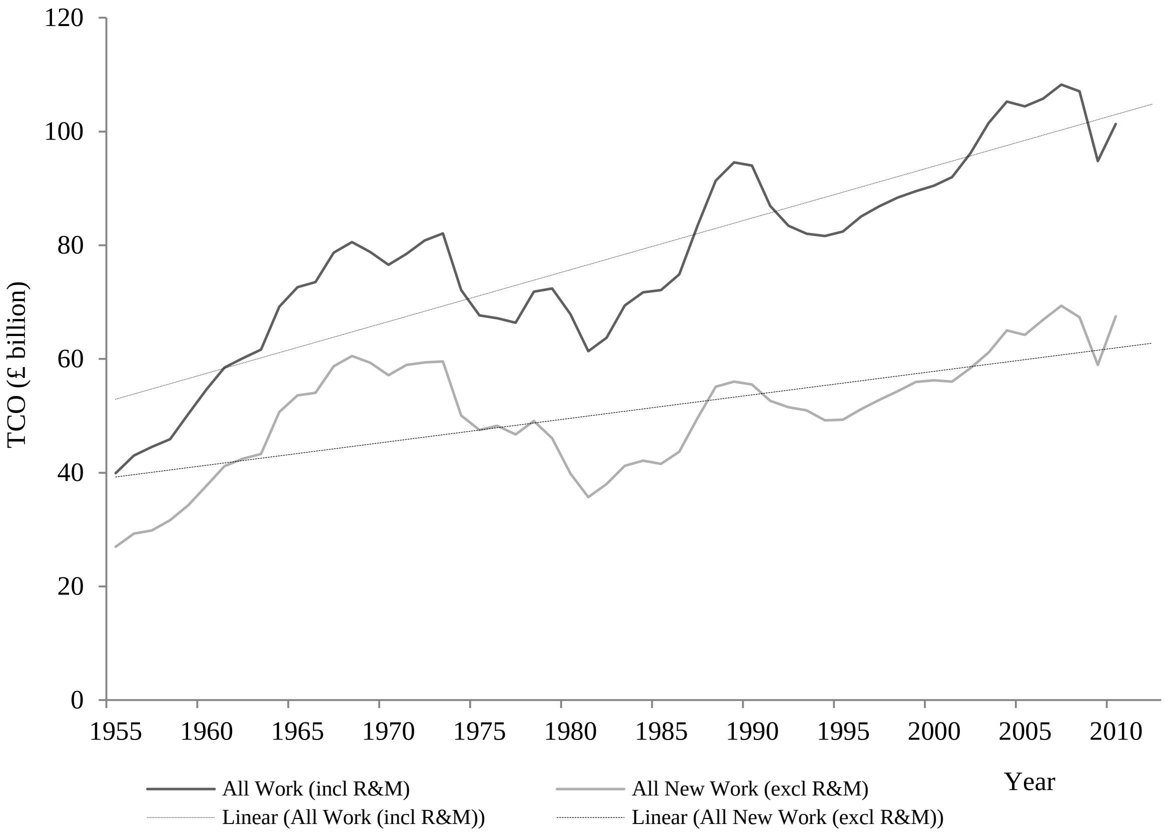


Figure 7.1: Total Construction Output, 1955-2012 (constant)
Data Source: Office for National Statistics, 2012

Figure 7.2: Annual change in GDP and TCO, 1955-2012 (constant)
Data Source: Office for National Statistics, 2012

Of interest to note on the graphs is that construction output including R&M and construction output excluding R&M tend to follow the same pattern, that is, when TCO including R&M goes up, construction output excluding R&M also goes up and vice versa (see Figure 7.1). However, the gap between the two variables has increased over the time series. It was smaller in 1955 than in 2011. Rapid boom-bust cycles of construction characterised the year on year growth in TCO in the period 1955-73 as shown in Figure 7.2. Annual growth in TCO ditched to an all-time low of -12.1% in 1974.

(b) From 1980 to 1982, growth in TCO increased from -6.1% to 3.9% respectively (see Figure 7.2). It continued to grow as it went up to 8.9% in 1983 and then started to decline again in the following year. In 1985, growth in TCO hit a low of 0.6%. The bumpy growth in TCO continued up to 2007 where it recorded 2.7%.

(c) In 2008, annual change in TCO went down to -1.1%. The downward trend continued in 2009 as change in TCO crumbled to -11.5%, the lowest in 3 decades. In 2010, growth in TCO increased to 7.2%. This growth was short-lived as it again dropped to 4.8%.

Growth in GDP is followed by faster growth in TCO. While construction activity does create activity in the economy, growth in TCO does not lead to growth in GDP. Therefore, growth in the economy is accompanied by growth in the construction sector.

The patterns that emerge resemble a mixed picture in the movement of TCO and GDP over the period 1955 to 2012. Between 1955 and 1956, GDP increased from 4.2% to 5.6%. Over the same period, TCO increased from 5.6% to 7.7%. Again, between 1959 and 1964, GDP increased from 1.2% to 3.6%. Similarly, TCO increased from 9.7% to12.3%. From 1977, GDP went up from 3.6% to 5.7% by 1988. TCO also followed suite, increasing from a low of -1.2% to a high of 11.4% over the same period. Between 2008 and 2010, GDP increased from -0.1% to 1.4%, while TCO also increased from -1.1% to 7.2%. Therefore, the patterns of the two graphs illustrated in Figure 7.2 suggest that growth in GDP is accompanied by faster growth in TCO.

However, it is important to note that some exceptions exist. There are some points in the two graphs (Figure 7.2) where TCO growth does not seem to follow GDP growth. For example, between 1957 and 1959, GDP went down from 3.7% to 1.2%, while TCO increased from 3.6% to 9.7% (Table 7.1). From 1966 t0 1967, GDP declined from 4.1% to 2.6%, in contrast to TCO, which increased from 1.2% to 7.1%. This also occurred between 1977 and 1978 where GDP dropped from 3.6% to -1.5%, while TCO increased from -1.2% to 8.3%. Again in 1982, GDP went down from 7.5% to 5.3% in 1983, against an increase in TCO from 3.9% to 8.9%. Similarly, GDP growth declined from 3.9% in the year 2000 to 2.8% in 2003, while TCO growth increased from 1.1% to 5.6% over the same period. These figures suggest that although investment in construction work does create necessary activity in the economy, increased construction activity does not necessarily lead to economic growth.

This mixed picture suggests that there is no obvious link between the construction sector and economic growth. While growth in the construction sector is shown to follow growth in the economy at some points in the time series, growth in the construction sector also happens despite a decrease in economic growth at certain points in the time series. Therefore, further statistical analysis is undertaken to explore the relationship further.

7.4 Analysis of moving averages for UK TCO and GDP

This sub-section analyses the common trends in the construction output and GDP data for the UK. Table 7.1 shows the 3, 5 and 8 year moving averages for different variables. These moving averages are used to smooth out fluctuations in the data and to highlight the important trends. The 8 year moving average is preferred over the 3 year and 5 year moving averages because the higher the number of periods (years) used in the calculation of the moving average the more smooth and clearer the trend estimate is. The movement of TCO and GDP over the years is examined to ascertain the relationship between TCO and GDP.

(a) GDP: 8yr MA

The 8 year moving average for the GDP is smoother than the 3 and 5 year moving averages. However, all of them show a positive relationship between time and the GDP figures. Therefore, the GDP values reflect an increase over time. This observed positive trend in the GDP figures can be attributed to influences such as population growth, price inflation, technological advances or general economic changes.

Table 7.1: Trends in construction output & GDP in the UK 1955-2011 (constant)

Year	**GDP (£b)**	**ΔGDP (%)**	**TCO (£b)**	**ΔTCO (%)**	**TCO / GDP**	**GDP MA (£b)**			**GDP growth MA (%)**			**TCO MA (£b)**			**TCO growth MA (%)**		
						3yr	**5yr**	**8yr**	**3yr**	**5yr**	**8yr**	**3yr**	**5yr**	**8yr**	**3yr**	**5yr**	**8yr**
1955	385	4,2	27		0,07												
1956	389	5.6	29	7.7	0.08												
1957	395	3.7	30	3.6	0.08	390			4.5			29					
1958	397	3.1	32	2.9	0.08	394			4.1			30			5		
1959	414	1.2	34	9.7	0.08	402	396		2.7	3.6		32	30		5		
1960	436	1.5	38	8.5	0.09	415	406		1.9	3.0		35	33		7	6	
1961	446	2.8	41	7.1	0.09	432	417		1.8	2.5		38	35		8	6	
1962	451	3.4	42	2.8	0.09	444	429	414	2.6	2.4	3.2	40	37	34	6	6	
1963	470	2.0	43	2.5	0.09	456	443	425	2.7	2.2	2.9	42	40	36	4	6	6
1964	496	3.6	51	12.3	0.10	472	460	438	3.0	2.7	2.7	45	43	39	6	7	6
1965	507	5.5	54	4.9	0.11	491	474	452	3.7	3.5	2.9	49	46	42	7	6	6
1966	517	4.1	54	1.2	0.10	506	488	467	4.4	3.7	3.0	53	49	45	6	5	6
1967	529	2.6	59	7.1	0.11	518	504	481	4.1	3.6	3.2	55	52	48	4	6	6
1968	552	4.6	61	2.4	0.11	533	520	496	3.8	4.1	3.6	58	56	51	4	6	5
1969	563	4.2	59	-2.1	0.11	548	534	511	3.8	4.2	3.8	60	57	53	2	3	4
1970	576	2.7	57	-2.9	0.10	563	547	526	3.8	3.6	3.7	59	58	55	-1	1	3
1971	588	3.7	59	2.5	0.10	576	562	541	3.5	3.6	3.9	58	59	57	-1	1	3
1972	609	2.9	59	3.1	0.10	591	578	555	3.1	3.6	3.8	58	59	58	1	1	2
1973	653	4.6	60	1.5	0.09	617	598	573	3.7	3.6	3.7	59	59	58	2	0	2
1974	645	5.3	50	-12.1	0.08	636	614	589	4.3	3.8	3.8	56	57	58	-3	-2	0
1975	641	5.6	48	-6.1	0.07	646	627	603	5.2	4.4	4.2	52	55	57	-6	-2	-2
1976	657	5.6	48	-0.8	0.07	647	641	616	5.5	4.8	4.3	49	53	55	-6	-3	-2
1977	673	3.6	47	-1.2	0.07	657	654	630	4.9	4.9	4.3	48	50	53	-3	-4	-2
1978	695	-1.5	49	8.3	0.07	675	662	645	2.6	3.7	3.7	48	48	52	2	-2	-1
1979	713	2.9	46	0.8	0.06	694	676	661	1.7	3.2	3.6	47	48	51	3	0	-1
1980	699	3.1	40	-6.1	0.06	702	687	672	1.5	2.7	3.7	45	46	48	1	0	-2
1981	689	6.2	36	-9.7	0.05	700	694	676	4.1	2.86	3.9	41	43	45	-5	-2	-3
1982	704	7.5	38	3.9	0.05	697	670	684	5.6	3.6	4.1	38	42	44	-4	-1	-1
1983	729	5.3	41	8.9	0.06	707	707	695	6.3	5.0	4.1	38	40	43	1	0	1

Year	GDP (£b)	ΔGDP (%)	TCO (£b)	ΔTCO (%)	TCO / GDP	GDP MA (£b)			GDP growth MA (%)			TCO MA (£b)			TCO growth MA (%)		
						3yr	5yr	8yr	3yr	5yr	8yr	3yr	5yr	8yr	3yr	5yr	8yr
1984	749	4.9	42	3.3	0.06	727	714	706	5.9	5.4	4.0	40	39	42	5	0	1
1985	776	5.5	42	0.6	0.05	751	729	719	5.2	5.9	4.2	42	40	42	4	1	1
1986	807	4.5	44	3.8	0.05	777	753	733	5.0	5.5	5.0	42	41	41	3	4	1
1987	844	5.2	50	11.4	0.06	809	781	749	5.1	5.1	5.3	45	44	41	5	6	2
1988	886	5.7	55	9.5	0.06	845	812	773	5.1	5.2	5.6	49	46	43	8	6	4
1989	906	6.9	56	3.5	0.06	879	844	800	5.9	5.6	5.7	54	49	46	8	6	6
1990	913	0.8	56	-0.6	0.06	902	871	826	4.5	4.6	4.9	56	52	48	4	6	5
1991	901	-1.4	53	-7.5	0.06	907	890	848	2.1	3.4	4.0	55	54	50	-2	3	3
1992	902	0.1	52	-4.0	0.06	905	902	867	-0.2	2.4	3.4	53	54	51	-4	0	2
1993	922	2.2	51	-1.7	0.06	908	909	885	0.3	1.7	3.0	52	53	52	-4	-2	2
1994	961	4.3	49	-0.5	0.05	928	920	904	2.2	1.2	3.0	51	52	53	-2	-3	1
1995	991	3.1	49	5.2	0.05	958	935	923	3.2	1.7	2.7	50	51	53	1	-2	0
1996	1 019	2.9	51	3.2	0.05	990	959	939	3.4	2.5	2.4	50	50	52	3	0	0
1997	1 054	3.3	53	3.2	0.05	1 021	990	958	3.1	3.2	1.9	51	51	52	4	2	0
1998	1 095	3.6	54	1.2	0.05	1 056	1 024	981	3.3	3.4	2.3	53	51	52	3	2	0
1999	1 135	3.5	56	0.8	0.05	1 095	1 059	1 010	3.5	3.3	2.9	54	53	52	2	3	1
2000	1 185	3.9	56	1.3	0.05	1 138	1 098	1 045	3.7	3.4	3.4	56	54	53	1	2	2
2001	1 223	2.5	56	1.8	0.05	1 181	1 138	1 083	3.3	3.4	3.4	56	55	53	1	2	2
2002	1 255	2.1	58	3.8	0.05	1 221	1 179	1 120	2.8	3.1	3.1	57	56	54	2	2	3
2003	1 299	2.8	61	5.2	0.05	1 259	1 219	1 158	2.5	3.0	3.1	59	58	56	4	3	3
2004	1 338	3.0	65	3.4	0.05	1 297	1 260	1 198	2.6	2.9	3.1	62	59	57	4	3	3
2005	1 366	2.2	64	1.1	0.05	1 334	1 296	1 237	2.7	2.5	3.0	63	61	59	3	3	2
2006	1 401	2.8	67	1.0	0.05	1 368	1 332	1 275	2.7	2.6	2.9	65	63	60	2	3	2
2007	1 450	2.7	69	2.7	0.05	1 406	1 371	1 315	2.6	2.7	2.8	67	65	62	2	3	3
2008	1 434	-0.1	67	-0.7	0.05	1 428	1 398	1 346	1.8	2.1	2.3	68	67	64	1	2	2
2009	1 371	-4.9	59	-10.7	0.04	1 418	1 404	1 364	-0.8	0.5	1.3	65	65	64	-3	-1	1
2010	1 400	1.4	67	6.0	0.05	1 402	1 411	1 382	-1.2	0.4	1.2	65	66	65	-2	0	1
2011	1 409	0.7	71	4.8	0.05	1 393	1 413	1 396	-0.9	-0.04	0.98	63	66	66	-2	-1	0
Correl. coefficient (growth)			-0.28	0.18	0.18	-0.36	-0.38	-0.46	0.74	0.51	0.27	0.20	0.28	-0.06	0.43	0.40	0.08
Correl. coefficient (GDP)			0.70	-0.16	-0.78	0.99	0.99	0.99	-0.41	0.79	0.93	0.94	0.95	0.96	0.79	0.91	0.98

(f) GDP Growth: 8yr MA

The data show that GDP is growing at a decreasing rate over the years. This suggests that the rate of growth has decreased over the time series. The GDP growth overall shows a decreasing trend.

(g) TCO: 8yr MA

The TCO figures are increasing with time. It is notable that the 8 period moving average for TCO is smoother than the 3 and 5 period moving averages. However, all of them show a positive relationship between time and the TCO. Therefore, annual TCO shows an increasing trend over the years. This positive trend in the TCO figures can be attributed to influences such as population growth, price inflation, technological advances or general economic changes.

(h) TCO Growth: 8yr MA

The data shows that TCO is growing at a decreasing rate over the years. The average decrease in the growth rate for the 8 year moving average is 0.0386 per year. The TCO growth overall shows a decreasing trend.

(i) CO/GDP: 8yr MA

The share of total construction output in the GDP has decreased over the years. It has decreased by an average of 0.001 per year. The construction share of GDP shows a decreasing trend for all the moving averages for the period under consideration.

The moving averages for GDP and TCO reflect an increasing trend over time. However, GDP growth and TCO growth reflect a mixed picture. While some increase may be observed at certain points in the time series, the overall trend reflects a decreasing trend. This suggests that growth in GDP and TCO in the UK is increasing at a decreasing rate over time. It is important to note that the growth trends suggested by the moving averages do not indicate whether growth in the construction sector follows growth in the economy or *vice versa*. Therefore, further statistical analysis is undertaken to ascertain this.

7.5 Analysis of correlations

Based on the data presented in Table 7.1, the correlation coefficients for all variables are individually analysed in this section. The correlation coefficients are presented in a table comprising 4 parameters, to determine the strength of the relationships. Correlation is expressed on a range from -1 to +1. The middle point of the scale is 0, which represents a situation where there is no discernible relationship between fluctuations of the variables.

Table 7.2 illustrates the correlation coefficient (CC) with growth. The correlation coefficient with growth in all variables ranges between -0.44 and 0.72. This represents a sliding scale between negative correlation and significant positive relationship.

Table 7.2: Analysis of correlation coefficients with GDP growth

Variable	CC	P value	Linear dependence			
			-1 to -0.5	-0.5 to 0	0 to 0.5	0.5 to 1
TCO	-0.32	0.015		x		
TCO growth	0.04	0.788			x	
TCO/GDP	0.15	0.285			x	
TCO 3yr MA	-0.11	0.430		x		
TCO 5yr MA	-0.21	0.141		x		
TCO 8yr MA	-0.44	0.001		x		
TCO growth 3yr MA	0.11	0.430			x	
TCO growth 5yr MA	0.01	0.937			x	
TCO growth 8yr MA	-0.10	0.503		x		

The correlation of TCO 8yr MA with GDP growth is highly significant at the 1% level and is -0.44. TCO is also significant at 5% and is -0.32. However, the CC of TCO/GDP, TCO 3yr

MA, TCO 5yr MA, TCO growth 3yr MA, TCO growth 5yr MA and the TCO growth 8yr MA are all not significant at 5%.

Table 7.3 illustrates the CC with GDP. The CC in all variables ranges between -0.77 and 0.71. This represents a sliding scale between perfect negative correlation and perfect positive correlation.

Table 7.3: Analysis of correlation coefficients with GDP

Variable	CC	P value	Linear dependence			
			-1 to -0.5	-0.5 to 0	0 to 0.5	0.5 to 1
TCO	0.71	0.000				x
TCO growth	-0.12	0.365		x		
TCO/GDP	-0.77	0.000	x			
TCO 3yr MA	0.61	0.000				x
TCO 5yr MA	0.60	0.000				x
TCO 8yr MA	0.63	0.000				x
TCO growth 3yr MA	-0.08	0.580		x		
TCO growth 5yr MA	-0.10	0.483		x		
TCO growth 8yr MA	-0.12	0.397		x		

The correlation coefficient for TCO, TCO/GDP, TCO 3yr MA, TCO 5yr MA and TCO 8yr MA are all highly significant at the 1% level. TCO growth, TCO growth 3yr MA, TCO 5yr MA and TCO growth 8yr MA are not significant at 5%.

The correlation coefficient for TCO with GDP is 0.7 and the P value is 0.000. This suggests that there is a very strong and statistically significant relationship between GDP and TCO. However, the correlation coefficient for TCO with GDP growth is -0.32 (P value = 0.015). This suggests that TCO does not influence GDP growth in the UK. The strong positive relationship between GDP and TCO may be interpreted to imply that economic growth does impact positively on TCO. When the economy is growing, there is a great likelihood that TCO will also increase.

7.6 Trend analysis of TCO and GDP in the UK

This section scrutinizes the trends in TCO and GDP to establish the existence of a relationship between the construction sector and economic growth in the UK. A trend analysis is a method of analysis that allows us to predict what will happen with a series in the future Dikmen *et al.* (2008). It is based on historical data and it allows analysts to forecast short, intermediate and long-term possibilities for the series. The regression analysis undertaken here is intended to fit a trend line to the data.

(a) Description of regression analysis

The collected time series data for both TCO and GDP from 1955 to 2011 is examined. The relationship is estimated using the regression model. The data is computed into the SPSS software, version 14.1. The regression is run and the results obtained are presented in a table form. The analysis is run mainly to establish the goodness of fit of the model, and the significance of the variables (Yung 2010).

(b) Analysis of TCO/GDP

The ratio TCO/GDP is important because it shows the percentage contribution of TCO to national GDP. In other words it shows how much the construction sector is contributing to the national economy. It also helps to explain the relationship between TCO and GDP over time. An increase in the ratio means that TCO is increasing at a faster rate than GDP, whilst the opposite is true for a decrease in the ratio.

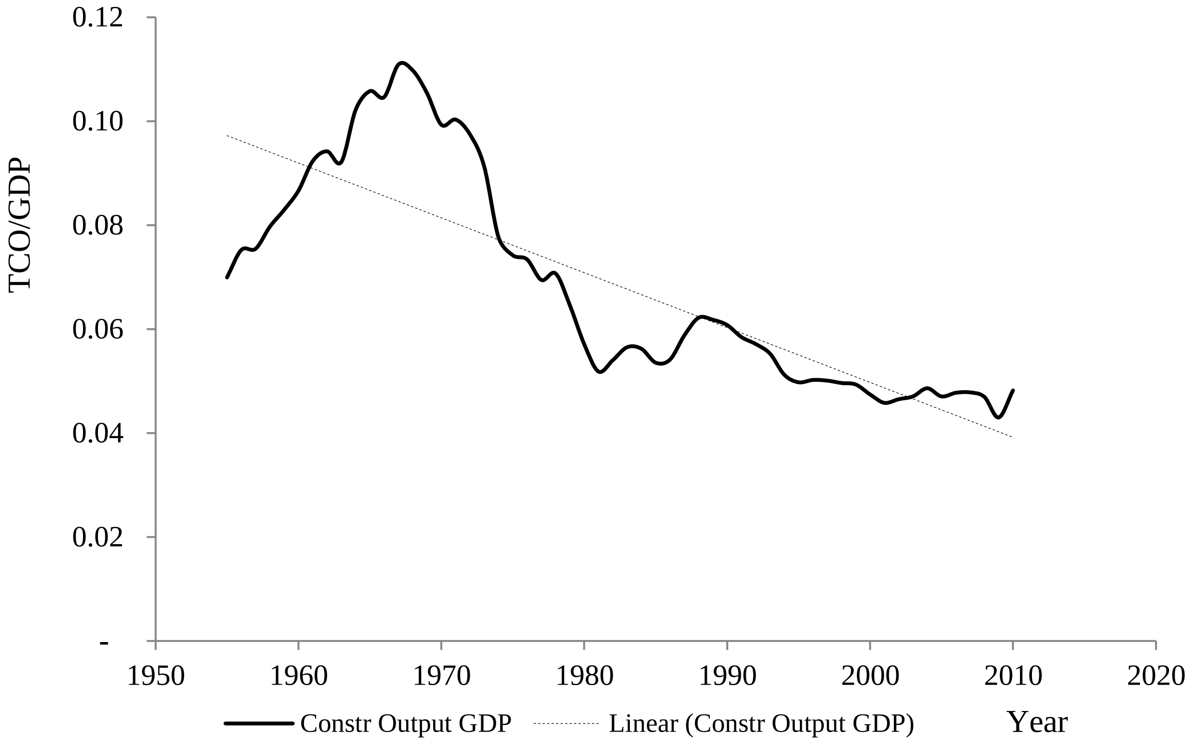


Figure 7.3: TCO/GDP graph and trend line 1955-2012 (constant)

Figure 7.3 shows that the share of total construction output in the GDP has decreased over the years. It has decreased by an average of 0.001177 per year. The trendline equation is TCO/GDP = - 0.001177T + 0.136. The R^2 value of 0.68 shows that the data fit the trendline quite well, that is, about 68% of TCO/GDP is explained by time.

Table 7.4: Regression of TCO/GDP on time

Regression coefficient	Estimate	Std. error	Beta	T-statistic	P-value
Constant	0.136	0.003		42.158	0.000
Time	-1.177	0.000	-0.853	-12.144	0.000

Table 7.4 illustrates the regression equation model for TCO/GDP. This analysis was carried out using the SPSS. Table 7.4 is the computer output for the analysis of the data. The reliability of the regression analysis depends on the significance of its coefficients. If the coefficients are significant, the regression equation is reliable.

Table 7.4 show that the slope coefficient, b= -0.001177 is significant at 1% level of significance, that is, p= 0.000 <0.01. Therefore, the regression model for TCO/GDP is significant and valid estimates of TCO/GDP can be made from the equation.

7.7 Cointegration analysis of TCO and GDP

The regression analysis done in the previous subsection only served to fit a trend line to the data. As a result of autocorrelation and the normality assumption (Hansen and Juselius 199%), ordinary regression analysis alone does not help to answer the research question of what the relationship of the construction sector is to economic growth. Therefore, the cointegration analysis is used to try and answer the question.

(a) Results of testing the relationship between TCO and GDP using UK data

Testing the integration order of TCO

The correlogram of TCO (Table 7.5) shows that the ACF cuts off at some lags, and there is at least one significant partial autocorrelations.

Table 7.5: Correlogram of TCO

<table>
<tr><th>Lag</th><th>AC</th><th>PAC</th><th>Q</th><th>Prob>0</th><th>-1 0 1
Autocorrelation</th><th>-1 0 1
Partial autocorrelation</th></tr>
<tr><td>1</td><td>0.8707</td><td>0.9337</td><td>45.523</td><td>0.0000</td><td>|------</td><td>|-------</td></tr>
<tr><td>2</td><td>0.7340</td><td>-0.2646</td><td>78.469</td><td>0.0000</td><td>|-----</td><td>--|</td></tr>
<tr><td>3</td><td>0.6297</td><td>0.1193</td><td>103.16</td><td>0.0000</td><td>|-----</td><td>|</td></tr>
<tr><td>4</td><td>0.4993</td><td>-0.1773</td><td>118.98</td><td>0.0000</td><td>|---</td><td>-|</td></tr>
<tr><td>5</td><td>0.3506</td><td>-0.2472</td><td>126.93</td><td>0.0000</td><td>|--</td><td>-|</td></tr>
<tr><td>6</td><td>0.2131</td><td>-0.0596</td><td>129.92</td><td>0.0000</td><td>|-</td><td>|</td></tr>
<tr><td>7</td><td>0.0900</td><td>-0.1465</td><td>130.47</td><td>0.0000</td><td>|</td><td>-|</td></tr>
<tr><td>8</td><td>-0.0321</td><td>0.0007</td><td>130.54</td><td>0.0000</td><td>|</td><td>|</td></tr>
<tr><td>9</td><td>-0.1321</td><td>0.0402</td><td>131.76</td><td>0.0000</td><td>-|</td><td>|</td></tr>
<tr><td>10</td><td>-0.1829</td><td>0.1073</td><td>134.15</td><td>0.0000</td><td>-|</td><td>|</td></tr>
<tr><td>11</td><td>-0.2039</td><td>0.1503</td><td>137.19</td><td>0.0000</td><td>-|</td><td>|-</td></tr>
<tr><td>12</td><td>-0.2315</td><td>-0.2620</td><td>141.2</td><td>0.0000</td><td>-|</td><td>--|</td></tr>
<tr><td>13</td><td>-0.2314</td><td>0.2488</td><td>145.29</td><td>0.0000</td><td>-|</td><td>|-</td></tr>
<tr><td>14</td><td>-0.1952</td><td>0.2190</td><td>148.27</td><td>0.0000</td><td>-|</td><td>|-</td></tr>
<tr><td>15</td><td>-0.1565</td><td>-0.1046</td><td>150.23</td><td>0.0000</td><td>-|</td><td>|</td></tr>
<tr><td>16</td><td>-0.1193</td><td>0.1541</td><td>151.4</td><td>0.0000</td><td>|</td><td>|-</td></tr>
<tr><td>17</td><td>-0.0613</td><td>0.2837</td><td>151.72</td><td>0.0000</td><td>|</td><td>|--</td></tr>
</table>

Lag	AC	PAC	Q	Prob>0	-1 0 1 Autocorrelation	-1 0 1 Partial autocorrelation
18	-0.0026	-0.0742	151.72	0.0000	|	|
19	0.0534	0.1081	151.97	0.0000	|	|
20	0.0662	0.0114	152.37	0.0000	|	|
21	0.0641	-0.1553	152.37	0.0000	|	-|
22	0.0557	0.6998	153.05	0.0000	|	|-----
23	0.0443	0.8624	153.25	0.0000	|	|-----
24	0.0315	0.7893	153.37	0.0000	|	|-----
25	0.0209	0.0449	153.41	0.0000	|	|
26	0.0047	0.7886	153.41	0.0000	|	|-----

So, the ADF test is performed with 1 to 5 lags. The following are the results in Table 7.6.

Table 7.6: ADF unit root test

Lag 1

	Estimate	Std Error	T value	Prob (>|t|)
Intercept	5.481	2.414	2.27	0.027**
Trend	.0457	.035	1.31	0,195
TCO. Lag 1	-.123	.057	-2.16	0.036**
ΔTCO. Lag 1	.292	.133	2.20	0.033**

Lag 2

Intercept	5.7273	2.585	2.22	0.031**
Trend	.040	.036	1.11	0.273
TCO. Lag 1	-.123	.060	-2.04	0.047**
ΔTCO. Lag 1	.311	.138	2.26	0.028**
ΔTCO. Lag 2	-.081	.147	-0.55	0.586

Lag 3

Intercept	6.442	2.778	2.32	0.025**
Trend	.048	.037	1.29	0.203
TCO. Lag 1	-.144	.064	-2.24	0.030**
ΔTCO. Lag 1	.337	.140	2.42	0.020**
ΔTCO. Lag 2	-.148	.158	-0.94	0.354
ΔTCO. Lag 3	.213	.169	1.26	0.214

Lag 4

Intercept	7.865	2.963	2.65	0.011**
Trend	.060	.037	1.61	0.114
TCO. Lag 1	-.181	.068	-2.67	0.011**
ΔTCO. Lag 1	.328	.139	2.37	0.022**
ΔTCO. Lag 2	-.096	.159	-0.60	0.549

ΔTCO. Lag 3	.117	.178	0.66	0.514
ΔTCO. Lag 4	.300	.170	1.77	0.084
Lag 5				
Intercept	8.276	3.319	2.49	0.017**
Trend	.067	.039	1.73	0.092*
TCO. Lag 1	-.195	.076	-2.57	0.014**
ΔTCO. Lag 1	.315	.142	2.22	0.032**
ΔTCO. Lag 2	-.097	.162	-0.60	0.553
ΔTCO. Lag 3	.138	.183	0.75	0.455
ΔTCO. Lag 4	.255	.182	1.40	0.168
ΔTCO. Lag 5	.133	.179	0.75	0.460
Lag 6				
Intercept	9.748	3.658	2.66	0.011**
Trend	.081	.040	2.00	0.052*
TCO. Lag 1	-.234	.084	-2.81	0.008***
ΔTCO. Lag 1	.332	.145	2.29	0.027**
ΔTCO. Lag 2	-.108	.163	-0.66	0.510
ΔTCO. Lag 3	.142	.185	0.77	0.447
ΔTCO. Lag 4	.296	.185	1.60	0.117
ΔTCO. Lag 5	.070	.186	0.38	0.709
ΔTCO. Lag 6	.239	.180	1.33	0.192
Lag 7				
Intercept	11.315	4.191	2.70	0.010**
Trend	.088	.043	2.03	0.049**
TCO. Lag 1	-.270	.096	-2.81	0.008***
ΔTCO. Lag 1	.346	.149	2.33	0.025**
ΔTCO. Lag 2	-.088	.167	-0.53	0.600
ΔTCO. Lag 3	.148	.188	0.79	0.437
ΔTCO. Lag 4	.311	.189	1.64	0.108
ΔTCO. Lag 5	.096	.194	0.49	0.625
ΔTCO. Lag 6	.224	.190	1.18	0.246
ΔTCO. Lag 7	.113	.190	0.60	0.555
Lag 8				
Intercept	12.770	4.776	2.67	0.011**
Trend	.093	.046	2.02	0.051*
TCO. Lag 1	-.302	.110	-2.75	0.009***

ΔTCO. Lag 1	.364	.155	2.35	0.024**
ΔTCO. Lag 2	-.071	.173	-0.41	0.684
ΔTCO. Lag 3	.163	.195	0.84	0.407
ΔTCO. Lag 4	.318	.193	1.65	0.108
ΔTCO. Lag 5	.114	.200	0.57	0.572
ΔTCO. Lag 6	.244	.199	1.23	0.228
ΔTCO. Lag 7	.107	.202	0.53	0.599
ΔTCO. Lag 8	.085	.198	0.43	0.669

Lag 9

Intercept	10.250	5.357	1.91	0.064*
Trend	.094	.049	1.93	0.061*
TCO. Lag 1	-.255	.123	-2.07	0.045**
ΔTCO. Lag 1	.339	.159	2.14	0.040**
ΔTCO. Lag 2	-.800	.176	-0.45	0.652
ΔTCO. Lag 3	.126	.197	0.64	0.527
ΔTCO. Lag 4	.265	.197	1.35	0.187
ΔTCO. Lag 5	.092	.201	0.46	0.649
ΔTCO. Lag 6	.205	.201	1.02	0.315
ΔTCO. Lag 7	.096	.208	0.46	0.648
ΔTCO. Lag 8	.042	.205	0.20	0.839
ΔTCO. Lag 9	.016	.198	0.08	0.938

Note: sample size = 55; *=significant at 10% level, **=significant at the 5% level and ***=significant at the 1% level.

Using the Cheung and Lai’s (1995) ADF Critical Values, the ADF test statistic is statistically significant since value -2.75 is less than the corresponding 10% level critical value of -2.542. This is supported by the MacKinnon - statistic value for the ADF test on the differenced TCO series with 8 lags of -2.773, which is significant at the 10% level since it is less than the 10% critical value of -2.604.

The ADF model residuals were then tested for normality and autocorrelation. Table 7.7 show the results that were obtained.

Table 7.7: Normality test

Variable	Shapiro – Wilk	P-value	Decision
Residual (ΔTCO)	0.967	0.197	Fail to reject

According to Table 7.7, Shapiro-Wilk test results indicate that the residuals are normally distributed. The Durbin-Watson d-statistic (11, 48) of 1.91 indicates that the residuals are also not autocorrelated. The results therefore indicate that the TCO series is integrated of order 1, I(1).

(b) Testing the integration order of GDP

The following correlogram (Table 7.8) indicates that the ACF of GDP cuts off between 13 and 16 lags. It is also shown that there are about 3 significant partial autocorrelations.

Table 7.8: Correlogram of GDP

Lag	AC	PAC	Q	Prob>0	-1 0 1 Autocorrelation	-1 0 1 Partial autocorrelation
1	0.9528	1.0106	54.524	0.0000	|-------	|--------
2	0.9023	-0.3950	104.31	0.0000	|-------	---|
3	0.8518	0.1780	149.49	0.0000	|------	|-
4	0.7919	-0.4292	189.28	0.0000	|------	---|
5	0.7281	0.2695	223.57	0.0000	|-----	|--
6	0.6674	-0.0836	252.95	0.0000	|-----	|
7	0.6076	0.0565	277.78	0.0000	|----	|
8	0.5480	0.2323	298.39	0.0000	|----	|-
9	0.4910	0.3503	315.29	0.0000	|---	|--
10	0.4375	-0.0865	328.98	0.0000	|---	|
11	0.3851	0.0523	339.83	0.0000	|---	|
12	0.3345	0.2528	348.19	0.0000	|--	|--
13	0.2871	0.1707	354.49	0.0000	|--	|-
14	0.2430	0.1950	359.11	0.0000	|-	|-
15	0.2016	0.3697	362.36	0.0000	|-	|--

Lag	AC	PAC	Q	Prob>0	-1 0 1 Autocorrelation	-1 0 1 Partial autocorrelation
16	0.1624	0.2604	364.52	0.0000	|-	|--
17	0.1246	-0.0281	365.83	0.0000	|	|
18	0.0887	-0.3858	366.51	0.0000	|	---|
19	0.0575	-0.1680	366.8	0.0000	|	-|
20	0.0258	0.0767	366.86	0.0000	|	|
21	-0.0077	0.1930	366.87	0.0000	|	|-
22	-0.0427	0.1319	367.04	0.0000	|	|-
23	-0.0773	0.4055	367.63	0.0000	|	|---
24	-0.1098	-0.0665	368.86	0.0000	|	|
25	-0.1381	1.4959	370.87	0.0000	|-	|--------
26	-0.1660	1.3005	373.86	0.0000	|-	|--------

So, the ADF test is tried on some lags.

(c) ADF test

Lag 1

	Estimate	Std Error	T value	Prob (>|t|)
Intercept	24.961	10.622	2.35	0.023**
Trend	1.473	.725	2.03	0.047**
GDP. Lag 1	-.069	.036	-1.88	0.065*
ΔGDP. Lag 1	.403	.126	3.19	0.002**

Lag 2

Intercept	24.147	10.763	2.24	0.029**
Trend	1.399	.761	1.84	0.072*
GDP. Lag 1	-.063	.038	-1.66	0.104
ΔGDP. Lag 1	.457	.138	3.31	0.002***
ΔGDP. Lag 2	-.142	.140	-1.02	0.314

Lag 3

Intercept	28.497	10.583	2.69	0.010**
Trend	1.641	.767	2.14	0.038**
GDP. Lag 1	.502	.217	-2.22	0.032**
ΔGDP. Lag 1	-.087	.039	4.08	0.000***
Δ2GDP. Lag 2	.600	.147	-2.25	0.029**
Δ2GDP. Lag 3	-.382	.170	2.42	0.025**

Lag 4

Intercept	26.564	11.095	2.39	0.021**
Trend	1.676	.818	2.05	0.046**
GDP. Lag 1	-.084	.043	-1.96	0.056*
∆GDP. Lag 1	.634	.152	4.17	0.000***
∆GDP. Lag 2	-.442	.191	-2.32	0.025**
∆GDP. Lag 3	.594	.245	2.43	0.019**
∆GDP. Lag 4	-.155	.231	-0.67	0.505

Lag 5

Intercept	28.846	11.523	2.50	0.016**
Trend	1.932	.873	2.21	0.032**
GDP. Lag 1	-.100	.046	-2.15	0.037**
∆GDP. Lag 1	.652	.157	4.15	0.000***
∆GDP. Lag 2	-.458	.199	-2.30	0.026**
∆GDP. Lag 3	.661	.265	2.49	0.017**
∆GDP. Lag 4	-.233	.264	-0.88	0.382
∆GDP. Lag 5	.188	.235	0.80	0.428

The test is performed without a trend to see whether significance of the model would be obtained as follows.

Lag 1

	Estimate	Std Error	T value	Prob (>|t|)
Intercept	8.28	6.938	1.19	0.238
GDP. Lag 1	0.004	0.008	0.45	0.657
∆GDP. Lag 1	.395	.130	3.04	0.004***

Lag 2

Intercept	9.098	7.151	1.27	0.209
GDP. Lag 1	.005	.008	0.62	0.538
∆GDP. Lag 1	.460	.141	3.26	0.002***
∆GDP. Lag 2	-.178	.142	-1.25	0.215

Realising that the significance of the coefficient of the lagged GDP is not forthcoming, the test is performed at lag 2 without a constant and the results are as follows:

Lag 2 without a constant

	Estimate	Std Error	T value	Prob (>|t|)
GDP. Lag 1	.014	.004	3.23	0.002
∆GDP. Lag 1	.476	.142	3.36	0.001
∆GDP. Lag 2	-.171	.143	-1.20	0.236

Since the calculated test statistic value (3.23), falls in the rejection region, that is, to the right of the 5% (tau) critical value of 2.93, the null hypothesis is rejected for presence of unit roots at the 5% level of significance. The MacKinnon - statistic value of -4.727 (P-value=0.000) is also significant at the 1% level since it is less than the 1% critical value of -3.573. This implies that the ADF model is statistically significant at the 1% level and so, the differenced GDP series does not have a unit root. Table 7.9 illustrates the normality test.

Table 7.9: Normality test

Variable	Shapiro – Wilk	P-value	Decision
Residual (∆GDP)	0.992	0.975	Fail to reject

According to the normality test results in Table 7.9 the residuals are normally distributed. The Durbin-Watson d-statistic (3, 54) of 1.87, which is close to 2, indicates that the residuals are also not autocorrelated. So, the GDP series is also integrated of order 1, I(1).

(d) Engle-Granger test

In order to test for cointegration between TCO and GDP, the Engle-Granger test is performed as illustrated in Table 7.10.

Table 7.10: Regression of TCO on GDP

	Estimate	Std Error	T value	Prob (>|t|)
Intercept	32.152	2.685	11.97	0.000***
GDP	.023	.003	7.53	0.000***

$F(1, 55) = 56.72$ (P value = 0.000), R-squared = 0.508, Adjusted R-squared = 0.50

The regression model is highly significant (P-value<0.000) with a positive coefficient estimate of 0.023 meaning that an increase in GDP of one unit results in an increase of 0.023 in TCO, holding other factors of TCO constant. Adjusted R-squared is 0.50 which implies that 50% of the variation of TCO is explained by the model.

(e) Regression of Δ*.rTCO on rTCO, no constant*

In Table 7.11 the residuals of the model is regressed on the lagged level of the residuals (D.rTCO) without a constant to test for nonstationarity. The following results are obtained.

Table 7.11: Regression of Δ*.rTCO on rTCO*

	Estimate	Std Error	T value	Prob (>|t|)
Residual (rTCO). Lag 1	-.110	.054	-2.04	0.046**

The regression model is significant at the 5% level, which is in favour of cointegration of the two variables. Also, the ADF test is performed on the residuals, that is, the differenced TCO model residual was regressed on the lagged residual to obtain the following results (Table 7.12).

Table 7.12: ADF test on residuals

	Estimate	Std Error	T value	Prob (>|t|)
Residual (rTCO). Lag 1	-.988	.138	-7.14	0.000***

The regression model is highly significant, and so the null hypothesis of nonstationarity is rejected. Because the null hypothesis that $\hat{\gamma}$ = 0, it is rejected at the 1% level. Based on this, it can be concluded that there is no unit root, and the series is stationary. Thus, TCO and GDP have a long-term positive relationship.

(f) ECM Model

Table 7.13: Regression of D.TCO on L.rTCO and LΔ.GDP

	Estimate	Std Error	T value	Prob (>|t|)
Intercept	.744	.601	1.24	0.221
Residual (rTCO). Lag 1	-.119	.062	-1.93	0.059*
Differenced GDP (Δ.GDP). Lag 1	.002	.022	0.08	0.933

The estimated ECM in Table 7.13 is Δ TCO = .744 - .119 L.rTCO + .002 LΔ GDP.

With a coefficient on the lagged residuals of -.119, other things being equal, the results imply that the TCO and GDP series converge to a long-run cointegrating equilibrium.

(g) Testing for cointegration for the Regression of GDP on TCO

Engle Granger test

The results in Table 7.14 show the regression of GDP on TCO.

Table 7.14: Regression of GDP on TCO

	Estimate	Std Error	T value	Prob (>|t|)
Intercept	-310.916	154.382	-2.01	0.049**
TCO	22.352	2.968	7.53	0.000***

F(1, 55) = 56.72 and P- value>F = 0.000); R-squared = 0.508, Adjusted R-squared = 0.50

The regression model is highly significant (P-value=0.000) with a positive coefficient estimate of 22.352 meaning that an increase in TCO of one unit results in an increase of 22.352 in GDP, holding other factors of GDP constant. Adjusted R-squared is 0.50, which implies that about 50% of the variation of GDP is explained by the model.

The residual of the model is regressed on the lagged level of the residuals without a constant to test for nonstationarity. Table 7.15 illustrates the results that are obtained.

Table 7.15: Regression of ∆.rGDP on rGDP, no constant

	Estimate	Std Error	T value	Prob (>|t|)	Decision
Residual (rGDP). Lag 1	-.036	.037	-0.98	0.332	Fail to reject
Residual (rGDP). Lag 2	-.056	.037	-1.54	0.130	Fail to reject
Residual (rGDP). Lag 3	-.060	.038	1.59	0.118	Fail to reject
Residual (rGDP). Lag 4	-.066	.038	-1.73	0.089*	Reject
Residual (rGDP). Lag 5	-.083	.038	-2.18	0.034**	Reject

At lag 4, the null hypothesis of nonstationarity is rejected at the 10% level, which is in favour of cointegration. Also for lag 5, the null hypothesis of nonstationarity is rejected and this time at a higher level of significance of 5%, which is also in favour of cointegration. The Engle-Granger test therefore indicates that GDP and TCO have a long-term positive relationship.

(h) ECM

Table 7.16: Regression of Δ.GDP on L.rGDP and LΔ.TCO

	Estimate	Std Error	T value	Prob (>|t|)
Intercept	17.440	2.624	6.65	0.000***
Residual (rGDP). Lag 1	.020	.011	1.83	0.073*
Differenced TCO (Δ.TCO). Lag 1	1.635	.794	2.06	0.044**

With a positive coefficient on the lagged residuals and a value (0.020) which tends to 0, it is indicated that the speed of adjustment of the system to equilibrium is rather slow (Table 7.16). Other things being equal, this implies that the GDP and TCO series converge to a long-run cointegrating equilibrium.

(i) Reflection on results

The cointegration analysis undertaken here was done to ascertain the nature of the relationship of the construction sector and economic growth. As alluded to at the beginning of this subsection, the cointegration analysis is a statistical tool for the investigation of relationships between variables. TCO and GDP data has been used in the analysis to estimate the quantitative effect of the causal variables upon the variable that they influence. The statistical significance of the hypothesized relationship has been assessed.

The analyses done show a positive relationship between TCO and GDP, that is, as GDP increases TCO is also increasing, other things being equal. In other words, as the economy grows, construction output increases in the UK. However, there is not enough evidence to support the hypothesized view that the construction sector is the driver of growth.

Construction output is considered an integral part of national output in the UK economy. However, the cointegration analysis of TCO and GDP undertaken here reveal that in the main, expansion of construction activity is preceded by an increase in GDP. This could be construed to mean that construction activity does not influence economic growth. This finding confirms that of Akintoye and Skitmore (1994), who tested the relationship between national output and construction demand. Their finding suggested that construction investment is a derived demand which is growth dependent.

While growth in the construction sector is shown to accompany growth in the economy in a majority of points in the time series, growth in the construction sector also happens despite a decrease in economic growth at certain points in the time series. Therefore, further analysis is undertaken to explore the relationship further. The following section examines the major turning points in TCO and GDP.

7.8 Turning points in UK TCO and GDP

This section highlights the major turning points in TCO and GDP, with a view to further ascertain how TCO behaves in relation to growth in the economy. The period after the Second World War experienced a backlog of infrastructure in the UK. The 1950s and 1960s were periods of recurrent balance of payment crises and the government intervened from time to time by increasing or decreasing public construction programmes (Hillebrandt 1984).

Table 7.17: Major turning points in TCO for the UK

Year	ΔTCO (%)	ΔGDP (%)	Peak/ trough	Fundamental influence
1956	7.7	5.6	Peak	Increased reconstruction activities after World War II (see (a) below)
1958	2.9	3.1	Trough	Puplic capital investment and credit restraints (see (a) below)
1964	12.3	3.6	Peak	Increased public sector spending and population growth (see (a) below)
1974	-12.1	5.3	Trough	Stagflation and large cuts in public expenditure (see (a) below)
1978	8.3	-1.5	Peak	Increase in public expenditure (see (a) below)
1981	-9.7	6.2	Trough	Cuts in grants to local authorities and high interest rates (see (b) below)
1987	11.4	5.2	Peak	Technological advances (see (b) below)
2009	-11.5	-4.9	Trough	Global financial crisis (see (c) below)
Average growth	2.1	3.2		

Table 7.17 shows that average growth in TCO between 1955 and 2012 was 2.1%, whilst average growth in GDP was 3.2%. At first sight, this could be construed to mean that TCO growth follows GDP growth in the UK. However, the growth theories discussed in Chapter 2 showed that the growth phenomenon can be complicated.

Growth in GDP can be attributed to influences such as population growth, price inflation, technological advances and general economic changes. Fluctuations in construction output can be a result of a myriad of unpredictable events. The construction sector is particularly vulnerable to fluctuations of activity as a result of government decisions (Ruddock 2006).

A whole host of other factors need consideration before jumping into conclusions. There can be a number of influences behind the turning points in the time series. The next three points discuss the major turning points in TCO and consider the impact of different economic policies that the UK government instituted since 1955. The discussion seeks to justify the suggested fundamental influences of peaks and troughs in TCO outlined in Table 7.17.

(a) Post World War II 1955-1979

From 1955, annual growth in TCO was very bumpy. Like with most European countries, this was the time when the UK was in a state of economic ruin after World War II, with most of the industrial infrastructure destroyed. The consequences of the war continued to manifest themselves through weak economic recovery that ensued over a number of decades. From 1955 to 1979, the UK economy was experiencing bumpy growth, whilst the construction sector appeared to follow the same trend (see Figure 7.2). The investment climate was characterised by a lot of uncertainties, which influenced construction output (Hillebrandt 1984).

It is also interesting to note that there are times when even if the overall economy is growing TCO may still be on a declining trend. The UK economy experienced growth from -1.5% in 1978 to 6.2% in 1981. Contrary to that, there was a major bust in TCO from 8.3% to -9.7% over the same period. According to Gruneberg (1997), this could have been due to lack of confidence in the UK economy. If firms fear that the rate of economic growth cannot be sustained, demand for construction products is undermined. Firms reduce their demand, not only for new buildings but also for repairs and maintenance of many of their existing buildings.

The construction sector predominantly deals with the production of investment goods rather than consumer goods. This makes the sector susceptible to all of the uncertainties that characterize investment decisions, such as cost of investment, access to funds and levels of uncertainty regarding demand for the final output. The construction sector is subject to wider swings in activity than most industries and is unable to operate an inventory policy to even out the extremes. This is mainly due to the fact that the sector produces capital goods, not for its own use but for other sectors of the economy such as factories for manufacturing.

(b) Market fundamentalism 1980-2007

TCO growth continued to be bumpy in the 1980s. From 1979 when Margaret Thatcher came into power, the UK government adopted market-oriented policies, which became known as market fundamentalism. Market fundamentalism was an exaggerated faith in the ability of the free market economy to solve economic and social problems. It was popularised in the 1980s by the idea that a society is strongest when its members pursue their own self-interest to the exclusion of everything else. They argued that private vice leads to public virtue. From this moral standpoint, selfishness was not selfishness at all but an advanced form of social work. Free of all constraints, unregulated markets and profit-maximizing entrepreneurs would increase growth, expand opportunity and allow new wealth to trickle down. Figure 7.2 show that in the period 1980 to 2007, overall growth in the UK economy and in TCO was on a downward spiral (ONS 2011).

The major policy changes that the government introduced over this period included privatization of major industries such as mining, increased ownership in housing by sale of council flats to residents and elimination of restrictions in capital flows. Table 7.17 and Figure 7.2 illustrate that TCO growth reached a peak of 11.4% 1987. The policy changes influenced technological advances in construction as firms tried to remain competitive in the midst of privatization (Ive and Gruneberg 2000).

The overall ambition of these policy reforms was to address the relative decline in economic growth. The economy responded positively to these reforms as average GDP growth between 1980 and 2007 was 5.8%, whilst growth in TCO over the same period was only 2.6% as illustrated in Figure 7.2. The policy reforms may have had a positive impact on overall economic growth but they do not seem to have had the same impact on TCO growth.

Although there were some volatility and boom-bust cycles in the year on year growth in UK construction output, the trend line shows a constant decline in growth. What does this mean? This finding is important in that it means the past performance of the construction sector may be used to predict the future. Is the trend line related to the stage of development of the economy? This will be determined later on in the section, where comparison in trends will be made with that of SA which is at a different stage of development. What are the macroeconomic forces that influence construction output? There is no obvious answer to this question. However, in the previous section that dealt with findings on the SA construction sector, it was revealed that economic growth, interest rates, inflation, private income and investment volume are some of the factors that affect construction output.

(c) Austerity policies 2008-2012

Annual growth in TCO in the UK declined from 2.4% in 2007 to -11.5% in 2009 as shown in Figure 7.2. Investment in infrastructure shrank, resulting in significant decline in construction output. In the period 2007 to 2012, the UK experienced a series of major economic and financial problems (ONS 2013). The crisis played a significant role in the failure of key businesses, declines in consumer wealth and a downturn in economic activity. Economic policy shifted from fiscal stimulus to austerity. These developments affected both public and private investment in the construction sector.

The declining trend in overall economic growth and annual growth in construction output resulted in construction companies downsizing and some going out of business, fuelling substantial unemployment not least to the construction sector. How did the financial crisis affect the construction sector? To a large extent, construction depends on public investment for infrastructure projects and as governments such as the UK tightened their fiscal spending, construction was one of the hardest hit sectors, followed by the knock on effects of reduced demands for building materials. According to the BERR (2005), private investors primarily seek returns and the risk profile of most infrastructure assets is not sufficiently attractive for investment, especially those that involve construction.

What stands out in Figure 7.2 is that the year on year growth in construction output is punctuated by steady peaks and troughs with a downward trend. During the global financial crisis, some significant downturns were experienced as the government tightened its spending. Given the fact that about 50% of construction investment comes from the public sector, the effects of spending cuts were felt more by the construction sector (Hillebrandt 2000). Throughout the crisis, businesses have been cutting investments in response to tight credit conditions, depressed demand and declining profitability. All these issues have impacted negatively on the UK construction output.

In the main, the picture that arises suggests that when there is growth in the economy, the construction sector also experiences growth. It is also notable that construction output grows at a particularly faster rate than the growth of the economy as a whole. However, at certain points in the time series, growth in construction output occurred despite a decline in GDP growth. Public sector intervention in construction activity has been shown to be responsible for such growth in construction output. This was done through investment in infrastructure. The impact of such public sector investment on the functioning of the construction sector was investigated in Chapter 5. The next chapter compares and contrasts the major findings in the UK and SA economies.

Chapter 8: Comparison of SA and UK results

The findings discussed in chapters 6 and 7 have revealed both similar and contrasting trends for certain variables. This can be associated with the fact that the two economies (SA and the UK) in which the study is based are at two different growth trajectories. This section highlights the major aspects of the relationship of the construction sector to economic growth that transpired in the SA and UK results of the study.

8.1 GDP and TCO trends

Both the UK and SA experienced an upward trend in GDP over the periods covered. The GDP growth for SA increased at an increasing rate (positive growth), whilst in the UK it increased at a decreasing rate (negative growth). This could be associated with the growth trajectories of the two economies. This suggests that the rate of growth in AIC is less than that of LDCs.

Both TCO and GDP for the U.K showed an increasing trend, but TCO growth and GDP growth increased at a decreasing rate (negative growth). This suggests that the rates of growth in both construction output and economic growth for the UK has decreased over the time series. TCO and GDP for SA showed an increasing trend over the time series. Both TCO growth and GDP growth increased at an increasing rate (positive growth). Also, the construction share of GDP for the UK decreased over the years at a faster rate than that for SA. Therefore, this suggests that GDP growth in SA influences TCO growth more than is the case in the UK.

Unlike the UK where most essential infrastructue already exists, SA still has a lot of infrastructure that needs to be put up to support economic growth given the fact that it is still a developing economy. As the SA economy experiences growth, the demand for infrastructure increases. This creates good prospects for the construction sector of SA, hence the positive growth. The higher growth rate of the SA economy also influences faster growth of construction output. While in the UK, slow economic growth negatively influences growth in the construction sector.

The regression equations of TCO on GDP for both the UK and SA reflected a positive relationship between the two variables in both economies. However, the SA data revealed a stronger positive relationship than that of the UK. Again this can be associated with the growth trajectories of the two economies and the fact that positive growth was observed in the SA economy, contrary to the negetive growth observed in the UK.

8.2 Construction share of GDP over time

The trend analysis done in subsections 6.6 helps us to understand the percentage contribution of the SA construction sector to the overall output of the national economy. The regression equation gives an indication of the actual relationship between TCO/GDP ratio and time. This explains the construction share of GDP over the time series. The analysis showed TCO/GDP figures to be increasing over the period 1986 to 2011 in SA (Figure 6.6). Since SA is still a developing country, this finding is in line with that of Bon (1992). Bon found that the share of construction in GDP grows first at an increasing rate as economies move from LDC status to NIC stage of growth.

The trend analysis undertaken in subsection 7.6 showed that the construction share of GDP in the UK was rising and falling at a decreasing rate over the period 1955 to 2011 (Figure 7.3). Given the fact that the UK is a developed economy, this finding is not quite in line with the finding by Bon (1992), which suggested that as economies move from NIC stage of growth to

AIC stage, the share of construction in GDP declines. Figure 7.3 suggests that the rising and falling trend tends to repeat itself over time. What then is the relationship of the construction sector to economic growth?

Early studies of the relationship between the construction sector and economic growth inferred that construction plays an important role in economic growth. However, the fundamental dynamics pertaining to such a role remain a subject for debate. Turin (1978) postulated an S-shaped relationship, while Bon (1992) promulgated an inverted U-shaped relationship. Choy (2011) refuted this and instead observed an inverted U-shape curve with a long-tailed end on the right hand side. These three fundamental conceptions of the growth process are summarised as illustrated in Figure 8.1. Since these fundamental contributions, there has been a significant debate about the relationship. Clarification of this relationship will go a long way in ensuring that policy is based on more detailed considerations than the mere assumption that construction drives growth.

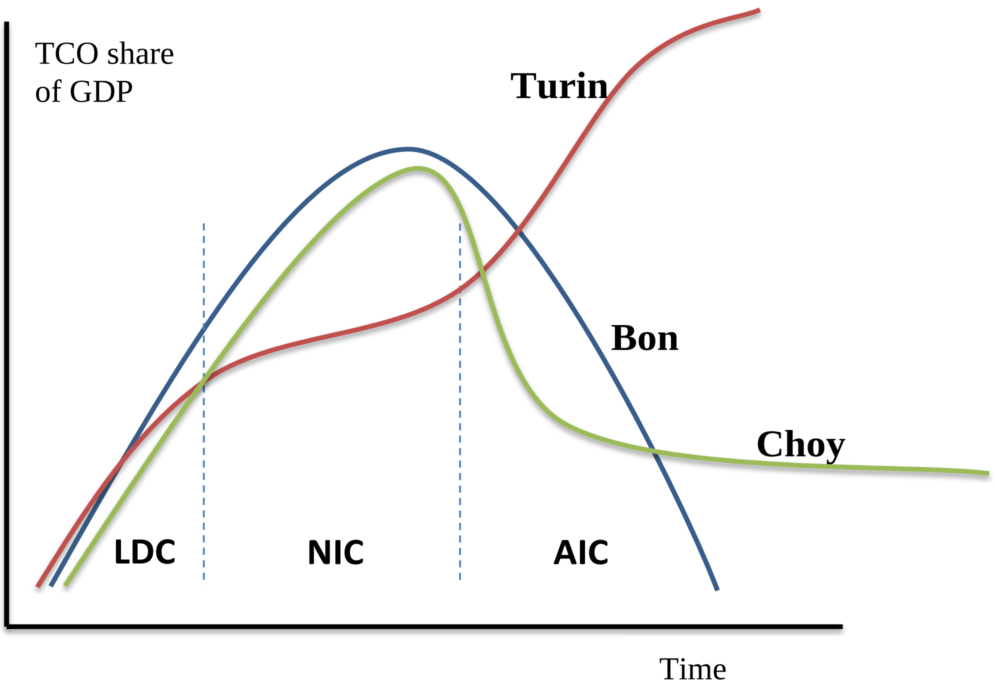


Figure 8.1: Three conceptions of the pattern of change in construction share of GDP

A lot has been said about these three curves. The classification of countries according to their stage of growth raises a number of questions, since the dynamics in growth trajectories vary from one country to the other. If countries follow the same growth path, why is it difficult for LDCs to move to the upper levels of the growth trajectory? Although there has been some significant economic progress over the years in many countries, economic growth remains a point of concern for policy makers globally.

According to Bon (1992), the construction share of GDP is higher in LDCs. As the economy develops into the NIC stage, the construction share of GDP reaches a peak. It then starts to decline as the economy approaches the AIC stage. What happens to the construction share of GDP beyond the AIC stage of growth? Neither Bon (1992) nor Turin (1978) explained this. Choy (2011) found that beyond the AIC stage of growth, the construction sector continues to play a role. However, she did not explain what the long tail in her graph mean (see Figure 8.1). It is from this point of departure that this research seeks to make contribution by explaining the behaviour of the construction share of GDP beyond AIC stage of growth.

The share of TCO in GDP is to be interpreted as explaining the variations within LDCs, NICs, and AICs over time. Since development is an on-going process, it is suggested that beyond the AIC stage, TCO will continue to play a role in the economy. Given the behaviour of TCO and GDP in SA and the UK, it is considered prudent to suggest a growth trajectory that repeats itself over time as illustrated in Figure 8.2. It is suggested that this stage of development would be referred to as the post industrial country (PIC) stage.

The proposition of a PIC stage of development puts into question the suggestion by Bon (1992) that each economy must go through three stages of growth. The comparative study of the relationship between the share of TCO and GDP shows that the share of TCO increases in the early stages of development but declines at the later stages. However, such decline is relative but not absolute as Bon purpoted.

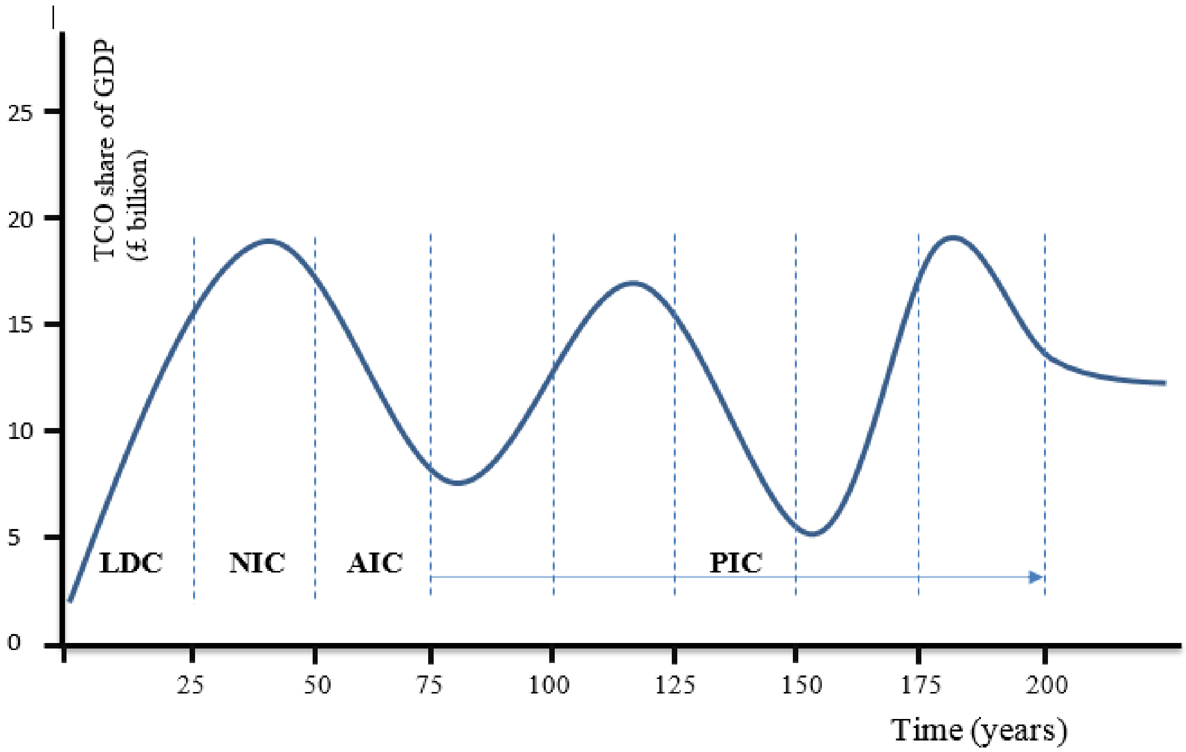


Figure 8.2: Suggested pattern of change in construction share of GDP

It can be inferred that beyond the AIC stage, the construction share of GDP continues to rise and fall as shown in Figure 8.2. The process repeats itself over time. It is argued that for as long as there is some economic activity, the growth process must continue in one way or the other. It cannot be static. It does not stop at the AIC stage as may be extrapolated from Bon's arguments.

Figure 8.2 illustrates a pattern of change that suggests 25 years between each stage of development. This is based on Bon's prediction of each stage. It is suggested that the PIC stage continues to repeat itself to infinity. The share of TCO in GDP over time for a time span of 200 years is speculated to be as shown in Figure 8.2. In the absence of external shocks, such as those experienced by the UK during World War II, the share of TCO in GDP continues to rise and fall, but never reach zero. This suggests that Bon's envisaged inverted U-shaped curve continues to repeat itself over time.

Bon argued that once most of the capital infrastructurre was in place, construction activity was less dynamic than other sectors of the economy, such as services (Bon 1992). However, the findings of this research tend to refute this. The average share of construction in GDP for the UK (1955-2011) was greater than that for SA (1986-2011), at 9% and 3% respectively. If Bon's observation was anything to go by, one would have expected that the construction share of GDP for SA would be higher than that of the UK since more infrastructure is still being developed in the SA economy. Therefore, the assumed significance of the construction sector to economic growth needs to be explored further.

8.3 Influence of economic policy

Analyses of the major turning points in TCO growth and GDP growth for both SA and the UK have shown that the implementation of different economic policies by the public sector has inherent consequences on construction output. The implementation of certain economic policies tended to work out in favour of growth, whilst others were shown to have hampered growth. The success of most economic policies that advocated for more investment in the construction sector to stimulate economic growth turned out to point to a lack of understanding of the functioning of the construction sector.

In what way is public sector investment in construction misguided? In the period after World War II, the UK government implemented a number of policies that were geared towards rebuilding most of the infrastructure that was destroyed during the war. However, massive investment in infrastructure projects did not achieve the intended growth in the overall economy. What is notable is that between 1955 and 1979, both GDP growth and TCO growth were increasing at a decreasing rate. While investment in construction creates some economic activity, construction investment does not lead to GDP growth. Analysis of the UK patterns of growth in both GDP and TCO undertaken here suggest that GDP growth is accompanied by TCO growth.

Similarly, the SA economy was at a point of collapse under the apartheid government in the late 1980s. As the ANC government came into power in 1994, the adopted RDP policy proposed massive infrastructure investment to rebuild neglected and new infrastructure in black townships that were isolated from the main stream economy under the apartheid regime. Although TCO growth increased from 3.1% to 4.3% between 1995 and 1996, GDP growth declined from 3.6% to just 2% over the same period. By 1996, the RDP showed signs of dismal failure. This forced the government to abort the RDP policy in favour of the GEAR policy. Therefore, it would appear that although investment in construction activity may influence economic activity in the short term through backwards and forwards linkages, it's impact on overall economic growth is dependent on government policy.

In the 1980s, TCO growth was bumpy in the UK. From 1979, the UK government adopted market-oriented policies. The exaggerated faith in the ability of the free market economy to solve economic and social problems tended to affect the performance of the construction sector. Both GDP growth and TCO growth was on a downward spiral in the period 1980 to 2007.

Likewise, the GEAR policy had its own ups and downs in the SA economy. Unlike the RDP, which favoured public sector intervention in the construction sector through investment, the GEAR policy was market-oriented. This meant that the SA government had to reduce its investments in infrastructure, which infuriated a majority of the population who had high expections from the young democracy. Between 1997 and 1998, GDP growth dwindled from

2.7% to 0.5%. TCO growth also followed suite, declining from 2.5% to 2.1% over the same period.

While all these arguments may associate the booms and busts with economic policy in both SA and the UK, it is equally important to note that there could be other factors that may have influenced the outcomes. The economic growth theories discussed in chapter 2, showed that the growth phenomenon can be complicated. While the theories identified certain factors that affect growth, such as human and physical capital, the theories also pointed to the existence of a whole host of other factors. Therefore, the impact of economic policy on construction output must not be considered in isolation.

8.4 Relationship of construction sector to economic growth

The findings of this research do not support the assumption that the construction sector drives economic growth. While it is closely correlated with economic growth, it does not follow that providing incentives and increased spending on projects necessarily leads to economic growth. Major authors in construction economics have been preoccupied with the significance of construction activity to economic growth. The assumption that construction drives growth is widespread. If such an assumption was true, why are so many LDCs not using the construction sector to grow their economies? The literature reviewed pointed to the significance of the construction sector in economic growth without outlining the fundamental dynamics of the relationship.

In the light of the magnitude of investments that go into construction from time to time, it may be argued that the significance of the construction sector purported is misleading. According to Hillebrandt (2000), the construction sector produces on average across the world around a tenth of all the goods and services produced. This research has shown that construction constitutes on average about 9% and 3% of GDP in the UK and SA respectively. Arguably, this is not a significant share.

The significance of the construction sector is also associated with the linkages that it has with other sectors of the economy. The existing knowledge of the linkages between the construction sector and economic growth is to a greater extent, imperfect. There is a need for a wider and better understanding of the linkages. This would help ensure that policy makers can make their investment decisions based on broader considerations than the mere assumption that construction drives growth. There must be a better explanation of the relationship of the construction sector to economic growth.

The construction sector deals mainly with the provision of capital infrastructure, which has an impact on economic growth. The delivery of such infrastructure creates significant employment opportunities for the population, which generates further investment in other sectors of the economy through the multiplier effect. As consumption spending increases through salaries earned, investment in other sectors of the economy become necessary which stimulates further growth. However there is no evidence that the construction sector can be regarded as the determinant of such growth.

According to Tan (2002), the construction sector is perceived to possess the capability of innovatively initiating and implementing projects that have a positive impact on the economy as a whole. The sheer size of some construction projects attracts attention at national scale. Attracting attention does not necessarily translate into an economic impact. Therefore, while the construction sector may be considered a factor in the growth process, there is no sufficient evidence to suggest that it is a driver.

The data analyses undertaken in this research reveal some important insights about the relationship of the construction sector to economic growth. While there is evidence of a close relationship, this cannot necessarily be construed to mean that construction drives growth. This research has shown that there are a number of reasons why people consider the construction sector to be important.

It can be deduced from the analysis of TCO growth and GDP growth done in this research that a positive relationship does exist between the construction sector and economic growth. The analyses show the relationship to be stronger for SA than for the UK. This partially confirms the finding by Bon (1992) that construction plays a bigger role in economies transforming from LDC stage to NIC stage. Although the construction share of GDP was shown to be higher for the UK than that for SA, the former was shown to grow at a decreasing rate while the latter was shown to grow at an increasing rate over the time series.

The time series construction output and GDP data analysed for both SA and the UK suggest that in the main, growth in construction output follows that of GDP. Comparison of TCO and GDP trends in both SA and the UK showed that the construction share of GDP varied from time to time. SA exhibited higher levels of growth in construction output, which was reflective of overall growth in the economy. This finding means that while the construction sector is envisaged to play a role in economic growth, construction alone cannot drive growth. Therefore, growth in the construction sector follows growth in the economy. Where significant investments are made in construction to stimulate growth, the result may be short-run growth. Economic growth theory considers this as merely a business cycle.

The findings discussed in this chapter confirm that there is a relationship between construction activity and economic growth. However, the analyses of both the SA and UK construction output and GDP time series data, fail to show that the construction sector drives growth. Also, the construction share of GDP for SA increased over the years as the economy moved from LDC stage to NIC stage of growth. The construction share of GDP for the UK declined gradually as the economy moved beyond AIC stage with developed infrastructure. These results are important for policy makers so that macroeconomic policy to stimulate growth is not misguided. The next chapter sums up the arguments of the thesis and draws a conclusion based on the major findings.

Chapter 9: Conclusion

The aim was to ascertain what is the relationship between activity in the construction sector and economic growth. A positive short run relationship was found. Evidence in this thesis provides grounds for the acceptance of the hypothesis that there is a relationship between construction activity and economic growth.

9.1 Main contributions

The contributions summarized here are based on the various analyses undertaken as part of the investigations. Each analysis in the research chapters is concluded with a summary of the major findings. Reference is drawn to these, as evidence of how the outlined contributions were reached.

9.1.1 There is a positive short run relationship between construction activity and economic growth in the context of both a developing economy and a developed economy

The graphical analysis of the patterns of TCO and GDP for SA suggested that growth in GDP was accompanied by faster growth in TCO. Similar analysis done for the UK data also suggested the same pattern. Analysis of moving averages for SA suggested that GDP growth is accompanied by TCO growth and *vice versa*. A similar trend was observed for the UK as well.

Analysis of correlation coefficients for both SA and the UK suggested a very strong positive relationship between GDP growth and TCO growth. Of all these analyses, non could confirm whether TCO growth followed or led GDP growth. The cointegration analysis was then employed. For both SA and the UK, the cointegration analysis suggested that TCO growth and GDP growth have a long run positive relationship that runs in both directions. This suggests that the construction sector can influence economic growth and *vice versa*.

9.1.2 Growth trajectories occur in repeated patterns over time

Figure 6.6 showed that over time the construction share of GDP was increasing in SA. This was shown to be associated with the fact that SA is still at LDC stage. Since more infrastructure is still being developed in SA, this leads to increases in the construction share of GDP over time.

Figure 7.3 showed that the construction share of GDP in the UK was rising and falling at a decreasing rate over time. This was shown to be as a result of the fact that the UK is categorized as an AIC. This means that most of the infrastructure required to support the economy is already in place.

The behaviour of TCO and GDP in SA and the UK suggests a growth trajectory that repeats itself over time as illustrated in Figure 8.2. This stage of development considered here to be the post industrial country (PIC) stage. It is argued that the construction sector continues to play a role in the economy beyond the AIC stage. The rising and falling trend will repeat itself over time as suggested in Figure 8.2. While the construction share of GDP declines at AIC stage, the inverted U-shaped pattern continues to repeat itself to infinity.

9.1.3 Public sector investment in construction activity has a negative impact on the functioning of the construction sector

The public sector of SA intervenes in the construction sector mainly to correct the market failure of inequalities that were created by the apartheid system of governance prior to 1994. Market failures prompt action by government and public sector agencies. When such action fails, it leads to public sector investment having a negative impact on the functioning of the construction sector.

Analysis of collected data on public sector investment in SA found that the picture that emerge is a mixed one. There are problems and benefits of such investments. These are summarized in Table 5.7 and Table 5.8. The analysis suggests that public sector investment in the construction sector of SA is clouded with more problems than benefits.

The problems identified have since 1994, significantly undermined public sector investment in construction. Policy documents such as the RDP articulated ambitious public sector plans to channel major investments into infrastructure development. Most of the government reports studied, such as those of the SA National Treasury showed little evidence of phenomenal progress in addressing the inequalities caused by apartheid.

Government failures such as rent seeking and corruption were to blame for most of the problems identified. Such government failures are particularly distructive to construction firms who must make a profit to remain in business. These failures also affect the delivery of public goods to poor communities where they are needed the most. Clearly, the existence of government failures counters the usefulness of public sector investment in construction. It becomes very difficult for construction firms to thrive and remain competitive.

9.2 Research findings

The hypothesis was that the construction sector has a relationship with economic growth. A suggested framework of the construction sector and economic growth relationship, as well as the impact of the public sector on the construction sector is illustrated in Figure 9.1. A positive short run relationship was identified between the construction sector and economic growth. This means that investment in the construction sector can stimulate growth in the short run subject to other factors being equal. The public sector invests in construction to stimulate economic activity. Such investment decisions must be made with caution, in the light of the existence of market and government failures.

Figure 9.1 postulates the relationship of the construction sector to economic growth in the context of a developing economy. In the SA ecnomy, about 80% of all construction work is funded by the public sector (see Table 5.2). In the UK, only about 15% of all construction work is funded by the public sector (ONS 2012). Therefore, a model of the relationship based on UK data would reflect the private sector as the main player.

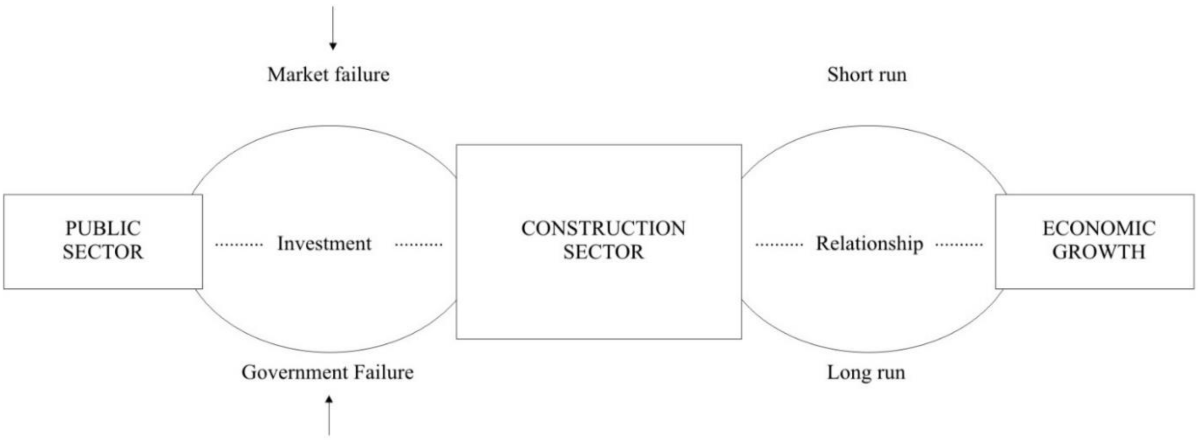


Figure 9.1: Model of construction-growth nexus

A comprehensive search of relevant literature in construction and growth was undertaken. This showed that economic growth theory was appropriate to explain the nature of the relationship. Economic growth theories from Harrod-Domar, through Solow to the endogenous growth theories all emphasized that construction influences investment, which is a major factor in determining economic growth. Therefore, this raises the expectation that the relationship of the construction sector to economic growth is positive.

From the literature reviewed, there is no obvious link between the construction sector and economic growth. As an investment sector, construction has the potential to impact positively on short run growth, hence the expectation for a positive relationship. The time series statistical results indicate that there is a positive, statistically significant relationship between TCO and GDP. This relationship was shown to be stronger in SA as a developing economy than in the UK which is a developed economy. This is explained by the higher demand for infrastructure in developing economies than it is for developed economies.

While investment in the construction sector can positively influence short run economic growth (see Figure 9.1), there was no evidence to support the assumption that the construction sector drives growth. It may be argued that over time, short run growth distorts the ‘natural’ growth path. Increasing investment in construction stimulates economic activity only for a limited period of time. When such investments decrease, a bust is likely to occur. Also, economic growth is not just about investment. The economic growth theories showed that other conditions such as technological advance are also necessary prerequisites for economic growth to occur. Construction can thus be regarded as a component of investment programmes, particularly for developing economies like SA but not a driver for economic growth.

Regression analysis of TCO and GDP showed that the construction sector is closely correlated with economic growth. Despite this, it does not follow that providing incentives and increased spending on projects necessarily leads to economic growth. In the Keynesian sense, like in any other sector, increased spending does stimulate economic activity.

The backward and forward linkages that the construction sector exhibits mean that other sectors of the economy are impacted positively. The construction sector deals mainly with the development of infrastructure. Infrastructure development creates significant employment opportunities for the population. As a result of the multiplier effect, further investment in other sectors of the economy has a positive impact on growth, other things being equal. However, such growth may not necessarily be credited to the construction sector.

As a result of the need to fill the gaps of market failure left by the private sector, public sector investment in construction is necessary. However, the existence of government failures makes such intervention questionable. The SA government has had difficulties correcting market failures and more specifically the inequalities created by apartheid. There is little evidence to suggest that monies invested in the construction sector are spent as intended. Can the public sector be relied upon to correct market failures? No. Different policies implemented in SA from the RDP in 1994 to the NDP in 2012 have not sufficiently addressed market failures in SA.

What then? Despite criticism of the GEAR strategy of 1996 in SA, apparently, it was the only government policy that improved efficiency and growth in the construction sector since 1994. Major criticism of this policy was based on the fact that it stemmed from market-oriented approaches. The existence of government failures alongside market failures in SA mean that neither public sector intervention nor market forces alone can improve performance. A balanced approach is necessary.

These conclusions fulfil the research objectives and address the hypothesis. The literature examined on growth theories showed that the three growth models discussed are best suited for explaining the growth phenomenon as it relates to the construction sector. These are the Harrod-Domar, Solow and endogenous growth theories. This finding fulfils the first objective of the research, which was to analyse current literature on the relationship of the construction sector to economic growth with a view to ascertaining the current arguments and economic theory that underpins the relationship.

The second objective of this study was to determine if there is a relationship between activity in the construction sector and economic growth. The time series statistical analysis undertaken confirmed that there is a relationship between construction activity and economic growth. The cointegration analysis and the analysis of turning points in TCO and GDP over time demonstrated that the two variables have a positive short run relationship. The analyses also showed that this relationship depends on a number of factors and conditions. This finding fulfils the objective.

The third objective was to determine how the public sector of SA is involved in construction. Using the theory of market and government failures, public sector investment in construction has been shown to negatively affect the functioning of the construction sector. Again this finding fulfils the last objective.

9.3 Policy implications

The findings on the relationship of the construction sector to economic growth in this thesis have major implications for policy makers. Two points are important: first, it is necessary to determine whether short run or long run growth is required before making any investment decision to stimulate economic activity through construction. Second, policy makers need to take cognisance of market and government failures when deciding on public investment policy for construction.

It is worth mentioning that the scope of the sectoral analysis undertaken in this research was only limited to ascertaining the impact of the public sector on the functioning of the construction sector. Market and government failures were only dealt with in the context of public sector investment in construction. Therefore, while the findings fulfil the objective of this thesis, it is insufficient to offer strong policy recommendations regarding market and government failures as they affect other sectors of the economy.

There can be a number of reasons for the importance of understanding the impact of the public sector on the construction sector. Private businesses are motivated to invest in growth initiatives depending on available infrastructure. Also, with poor understanding of the construction sector, the public sector can be misled to make investment policies that undermine economic growth. In the light of misleading information about the construction sector, the public sector can be misguided to invest in 'white elephant' infrastructure, thus wasting resources.

The discipline of developmental economics has been challenged to respond to the question of 'minimum necessary and sufficient conditions for economic growth' as a result of the plausible significance that has been placed on the role of the construction sector to economic growth. The growth theories examined in this research have shown that the economic growth phenomenon is influenced by a number of factors. A deeper understanding of all the aspects of the construction sector from obtaining the raw materials through to demolition and disposal of the facility at the end of its useful life needs to be fully comprehended. Given the sophisticated nature of the construction supply chain, it is recommended that policy should be based on more detailed considerations than the mere assumption that construction drives growth.

9.4 Areas for future research

Considering the significance that the construction sector has been purported to have, there is clearly a need to study its dynamics further. The finding that a positive relationship does exist between construction and growth, make it all the more important to push forward the frontiers. There is need to explore the causal relationships further.

The construction sector does not necessarily stop playing a role in the economy at AIC stage as purported by existing literature. The construction sector continues to play a role in economic growth beyond the AIC stage of growth. Therefore, the post industrial country (PIC) stage of growth has been proposed as a potential growth stage for further research.

This research has established that there is no sufficient evidence to support the assumption that the construction sector drives economic growth. Irrespective of the identified characteristics of the construction sector that positively support economic growth, the research could not confirm if the construction sector *per se* can be used to build our way out of the recession. Therefore, the minimum necessary and sufficient conditions for economic growth need to be investigated further. Allied to this is the investigation of the implications of construction investment on long run economic growth.

9.5 Limitations

The research used time series construction output and GDP data for the UK and SA. The idea was to study the trends in construction output over the past 100 years for two economies that are at different growth trajectories. Whilst available data for the UK dated back to 1955, SA data only dated back to 1986. Nevertheless, the available data was sufficient for a rigorous analysis to explain the nature of the relationship of the construction sector to economic growth.

The construction output data for the UK included variables such as public and private infrastructure, housing as well as repairs and maintenance. However SA data does not show these variables. It is assumed that given data incorporates all variables. Whilst the findings cannot be dismissed in the light of this limitation, they should be treated with caution. The results offer a degree of consistency with other similar studies done using data from developing economies.

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