Public service delivery and private firms in South Africa: Perceptions and possible impacts

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ABSTRACT

Since the advent of democracy in 1994, the South African Government has accomplished greater economic growth, a reduction in the fiscal deficit, lower inflation as well as tax relief for corporates and individuals. Regardless of these accomplishments, South Africa as a country is still struggling with a number of difficulties, including high unemployment, unequal income distributions as well as extreme poverty and crime. To overcome these problems, the majority of studies show that sustainable job creation is essential. It is the responsibility of the Government to take active steps that will guarantee favourable economic and social conditions through which employment opportunities can be created. Part of these steps that the government can take, and has been taking, is the provision of public goods and services, specifically the provision of infrastructure, which has been seen as key to creating an environment conducive to growth and development. The issue of service delivery in the academic literature and popular press is focussed on households and delivery of basic services, while limited research has been done on the level of firms and basic service delivery. This dissertation aims to reduce this gap in literature. By means of Principal Component Analysis, public service delivery indicators are computed, highlighting the factors that make up aggregate service delivery to the firms in the 2007 World Bank Enterprise survey data. This dissertation was successful in computing these factors and determining whether the situation differs between four metropolitan cities in South Africa (Cape Town, Durban, Port Elizabeth and the greater Gauteng area) and whether firm size play a role.

OPSOMMING

Sedert die aanvangs van demokrasie in 1994, het die Suid-Afrikaanse owerheid daarin geslaag om hoër ekonomiese groei, ’n vermindering in owerheidskuld, laer inflasie asook belastingverligting vir firmas sowel as individue te bewerkstellig. Ten spyte van hierdie welslae, is daar steeds verskeie probleme wat Suid-Afrika in die gesig staar. Hoë werkloosheid, ongelyke inkomeverdeling, armoede en misdaad neem die voortou. Studies toon dat ten einde hierdie probleme te oorkom, volhoubare werkskepping fundamenteel is. Die Owerheid is egter daarvoor verantwoordelik om ’n gunstige ekonomiese omgewing te skep waarbinne werkskepping kan plaasvind. Die voorsiening van publieke dienslewering, spesifiek infrastruktuur, is ’n stap wat die owerheid kan neem en reeds besig is om te neem ten einde werkskepping te bewerkstellig. Literatuur het reeds die effektiwiteit van beskikbare infrastruktuur tot die skepping van ekonomiese groei en -ontwikkeling bewys. Dit is egter so dat literatuur tot dusver oorwegend gefokus het op huishoudings en basiese dienslewering eerder as basiese dienslewering en die vlak van firmas. Die doel van dié verhandeling is om hierdie gaping in die literatuur in te kort. Deur middel van Principle Component Analysis is vier publieke diensleweringskomponente bepaal wat totale dienslewering daarstel vir die betrokke firmas in die datastel. Die verhandeling het daarin geslaag om die komponente vir totale dienslewering te bepaal asook om vas te stel of die situasie verskil tussen vier metropolitaanse stede in Suid-Afrika (Kaapstad, Durban, Port-Elizabeth en die Gauteng area), of firmagrootte ’n invloed het en hoe die faktore bydra tot die firmas se sukses.

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1.1 Background

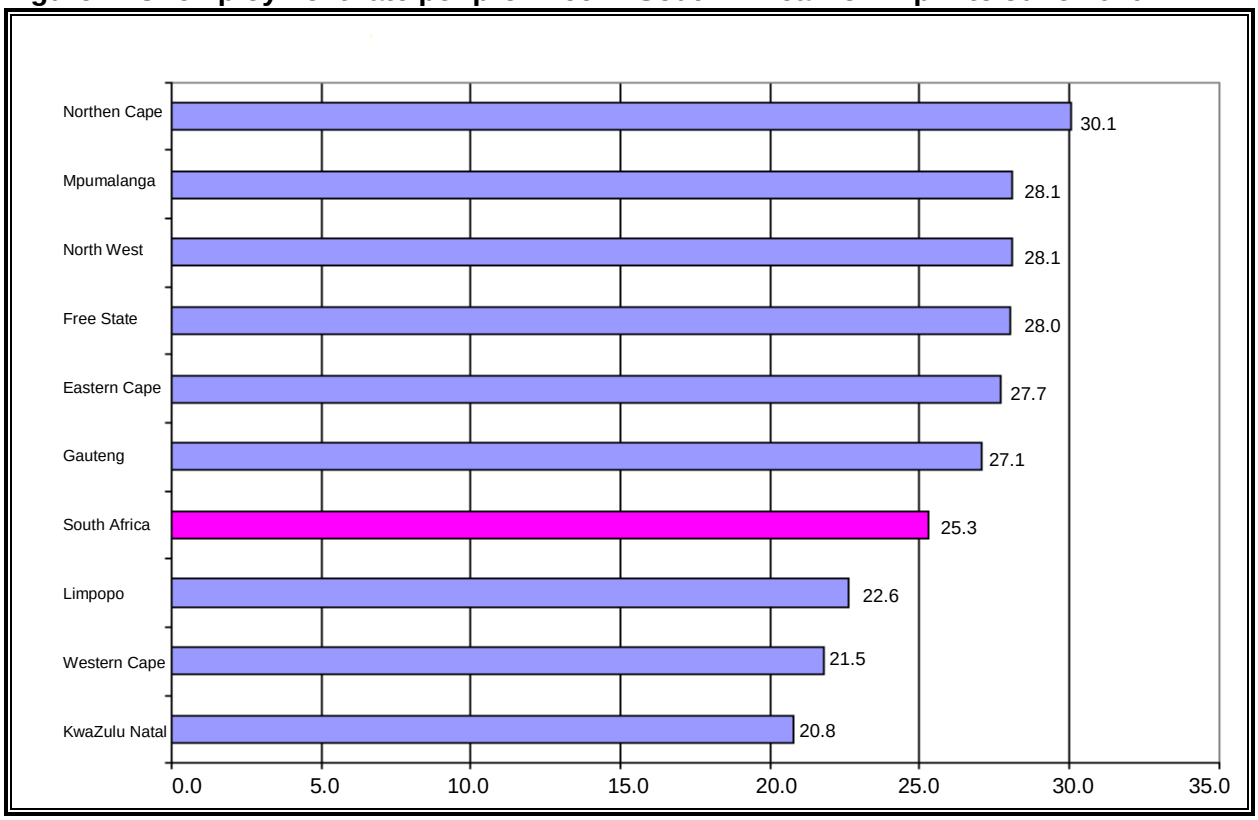
The South African economy has experienced faster economic growth since the advent of democracy in 1994. The average growth rate improved from 2.9 per cent over the period 1994 to 2003, to 4.6 per cent during the period 2005 to 2008 (StatsSA, 2009a). Factors contributing to the higher and less volatile growth rate comprise of the enhancement in the private sector fixed investment as well as capital inflows (ASGISA, 2006). A reduction in the fiscal deficit has also been accomplished along with tax relief for corporates and individuals. South Africa's government has succeeded in lowering the inflation rate from an average of 14.3 per cent over the period 1984 to 1993, to an average of 7.2 per cent over the period 1994 to 2005. During the period of August 2009 to July 2010, the average inflation rate was equal to 5.4 per cent (StatsSA, 2010a). After an extensive period in which the inflation rate was above the inflation targeted range of three to six per cent, it decreased into the target range again in October 2009 and has since declined to as low as 3.7 per cent in July 2010 (StatsSA, 2010). Despite all these improvements, South Africa is still struggling with a number of difficulties. Many believe that although South Africa has shown higher economic growth rates since democracy, the growth is not rapid enough. High unemployment, poverty, inequality and crime are some of South Africa's greatest predicaments today (Landman, Bhorat, Van dar Berg & van Aardt, 2003:1).

South Africa suffers from high unemployment. The average annual unemployment rate was measured at 23.4 per cent for the period April 2008 to June 2009 (StatsSA, 2009). For the first quarter of 2010, the unemployment rate measured 25.3 per cent or approximately 4.3 million people in South Africa that are unemployed (StatsSA, 2010). From Figure 1 it also shows that high unemployment in 2010 is present in every province in South Africa, thus it is a problem faced by all South Africans throughout the country.

This is a serious matter of concern since unemployment affects firm production, crime rates, social volatility and thus aggregate economic welfare (Kingdon & Knight, 2004:391). Kingdon and Knight (2004:391) state that the informal sector in South Africa is small, considering the high unemployment level that is most likely due to impediments to entry into the informal sector. These impediments include crime and limited access to

credit, infrastructure and services. The high unemployment rate in South Africa is also closely linked to the prevailing poverty and inequality.

Figure 1: Unemployment rate per province in South Africa from April to June 2010



Source: StatsSA, 2010b

Poverty and unequal income distribution are the two greatest challenges South Africa has faced since democracy (Landman *et al*., 2003:1). A Gini coefficient of 0.6 indicates that relative to the world, South Africa has one of the most unequal income distributions. In addition, it is estimated that approximately 40 per cent of South Africans live in poverty – that is an estimated 18 million people (Landman *et al*., 2003:1, 3). These extreme levels of poverty and inequality contribute to negative spillovers, such as the 2.1 million serious crime cases registered in South Africa between 1 April 2008 and 31 March 2009 (South African Police Service, 2009:1).

Somavia (as quoted by Landman *et al*., 2003:8) states that in order to halve poverty by 2015, global efforts should be put into job creation. Trends in poverty and inequality can only be countered by creating a greater number of sustainable jobs. Clarke *et al*. (2006:15) agree by adding that broad-based economic growth and job creation can lead to improved living standards and reduced poverty. In South Africa, the Government initiated a Medium Term Strategic Framework 2009 to 2014 to build on the success of

fifteen years of democracy. The essential mission and objectives of this framework are to expand and diversify the South African economic base, create greater equity and also social unity (Office of the Presidency, 2009:7). Furthermore, they aim to halve poverty and unemployment (compared to 26.4 per cent in 2004) by the end of the mandate period in 2014 (Office of the Presidency, 2009:7). An important fact is that job creation is not the Government's direct responsibility. However, it is the Government's direct responsibility to take active steps that will guarantee favourable economic and social conditions in general through which employment opportunities can be created.

Part of the steps that the government can take (and has been taking) is the provision of public goods and services, specifically, the provision of infrastructure that has been seen as key to creating an environment conducive for growth and development. Fedderke, Perkins and Luiz (2006:1038) provide a theoretical link between investment in public infrastructure and output when they state that the expenditure on infrastructure averts diminishing returns to scale in private-sector capital. This will raise the marginal product of capital in the private sector and thus elevate the output growth rate (Fedderke *et al*., 2006:1039). Fedderke and Garlick (2008:18) found a positive infrastructure-growth relationship, while Fedderke *et al*. (2006:1037) found that economic growth appears to be led by infrastructure investment in South Africa. They add that infrastructure influences output both directly and indirectly and in effect, creates economic growth. Increases in infrastructure stock increase economic output in general, and directly induce economic growth (Fedderke & Garlick, 2008:4). Infrastructure may otherwise be regarded to function as a complement to other inputs in the process of production (Fedderke & Garlick, 2008:4). Improved infrastructure lowers production costs and relieves firms from developing contingency plans to prevent infrastructure failure or to build infrastructure themselves (Fedderke & Garlick, 2008:4). Infrastructure may improve the accumulation of other production factors or even boost the productivity of these production factors and hence influence growth indirectly (Fedderke & Garlick, 2008:4).

This literature, however, focuses on the role of infrastructure in a growth-enabling environment at the aggregate, economy-wide level. The issues of service delivery in the academic literature and popular press are focussed on households and the delivery of basic services. Limited research has been done on the level of firms and basic service delivery. This dissertation aims to reduce this gap in literature and to link the public

goods to the private firms that have to generate the economic growth and employment for development.

1.2 Problem statement

The government supplies public goods and services, specifically infrastructure, to create an environment conducive for economic growth and job creation, but what are private firms' experiences of public service delivery, does it differ between the major cities in South Africa and does firm size matter?

1.3 Motivation

A fundamental priority in government policy and strategy has always been economic growth, with the aim of improving the living quality of all South Africans (DPLG, 2007:2). The Deputy President announced the Government's core objective, as set out in 2004, which is to halve poverty and unemployment by 2014 (DPLG, 2007:2).

Public service provision – water, electricity and transport – is fundamental to poverty reduction and economic growth (Hewett & Montgomery, 2001:1). It can play an important complementary role to private sector production, since infrastructure is characterised as a public good and private firms receive the services of most publicly-owned capital at no or little cost (McCann & Shefer, 2004:178). Hewett and Montgomery (2001:2) highlight the importance of service delivery by considering it to be a basic need of firms. With reliably supplied services, firms are able to obtain the advantages of agglomeration[1] and scale economies[2] with which growth can be accomplished. Growth will ultimately result in job creation and poverty reduction (Hewett & Montgomery, 2001:2).

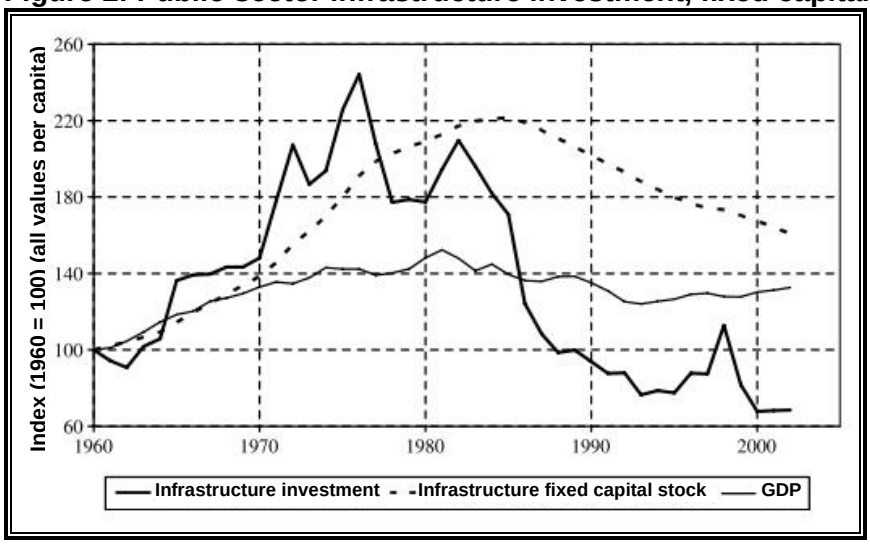
In South Africa, however, infrastructure investment declined significantly from 1976 to 2002. Investment per capita fell by 72 per cent over that period (Bogetić & Fedderke,

[1] Agglomeration economies is the term used to refer to the advantages generated through the spatial concentration of economic activity (Graham, 2007:4).

[2] Economies of scale is present when the increase in the produced output level causes a decrease in the average cost per unit of output of a firm (Brakman, Garretsen & van Marrewijk, 2001:26).

2006:4). Investment, as a percentage of GDP, decreased from 8.1 per cent to 2.4 per cent over this period, falling below the international benchmark of approximately three to six per cent (Bogetić & Fedderke, 2006:4). Figure 2 illustrates this fall of the investment in infrastructure in South Africa from 1976 to 2002. The brief recovery in the 1990s was due to development programmes by Telkom and ESKOM in order to extend telephone lines and available electricity (Fedderke *et al*., 2006:1041).

Figure 2: Public-sector infrastructure investment, fixed capital stock and real GDP



Source: Fedderke *et al*. (2006:1041)

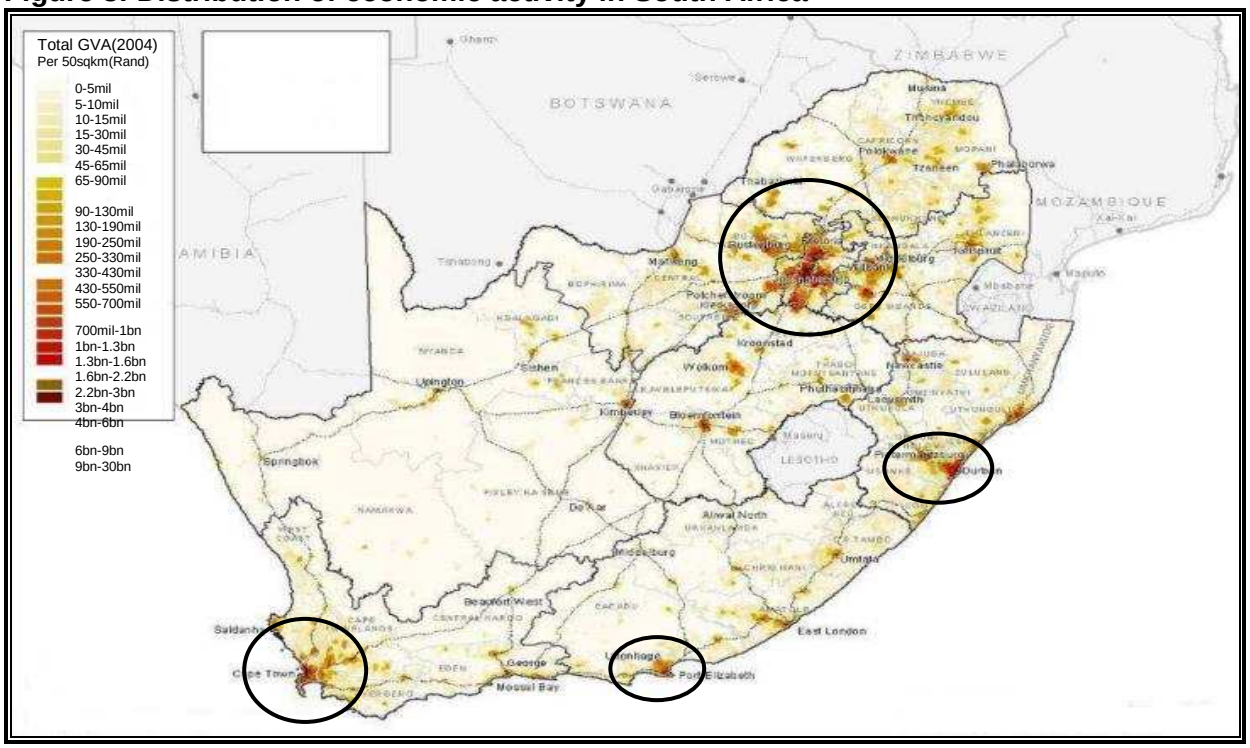
The above-mentioned decline in infrastructure investment led the Accelerated and Shared Growth Initiative – South Africa (ASGISA) to identify insufficient infrastructure as one of the constraints to growth in South Africa (Fedderke & Garlick, 2008:1).

Public goods and private production also have a distinctive spatial character. The six metropolitan cities contributed 55 per cent to South Africa's GDP in 2000 (Naudé & Krugell, 2003), but insufficient infrastructure in metropolitan areas can constrain South Africa's growth performance significantly. The role of public infrastructure in the growth of metropolitan firms is a complex matter. Aspects such as public-good provision, externalities, political decision-making as well as long time periods are involved (McCann & Shefer, 2004:178).

According to McCann and Shefer (2004:178), geography does in fact matter in economic growth and performance. Therefore, adequately supplied public infrastructure plays an important role in the productivity of the metropolitan private sector.

This study will focus on service delivery to firms located in four of South Africa's metropolitan cities, namely Cape Town, Port Elizabeth, Durban and the greater Gauteng area[3]. Figure 3 indicates the reason for this focus by illustrating the distribution of economic activity in South Africa. The darker the area is shaded, the greater the economic activity that takes place in that area, as measured in terms of gross value added.

Figure 3: Distribution of economic activity in South Africa



Source: Oranje, Huyssteen and Meiklejohn (2008:11)

Figure 3 confirms that firms located in Johannesburg, Cape Town, Durban and Port Elizabeth are responsible for the majority of economic activity in South Africa. Johannesburg contributed 14.98 per cent to South Africa's GDP in 2000, while Cape Town contributed 14.01 per cent in the same year (Naudé & Krugell, 2003). Durban and Port Elizabeth are responsible for contributing 7.77 per cent and 2.46 per cent respectively to South Africa's GDP in 2000 (Naudé & Krugell, 2003). Therefore, firms situated in these metropolitan cities have the ability to create national economic growth and improved living standards, should they generate growth on firm level. However, to ensure firm-level growth, adequate and sustained service delivery in specific

[3] In this dissertation the greater Gauteng area comprises of Johannesburg, Pretoria and the East Rand. For the remainder of this dissertation the greater Gauteng area will be referred to as Johannesburg.

infrastructure – water, electricity and transport – is required. Therefore, the provision of adequate public service delivery to firms is essential to accomplish the core government objective by 2014. Therefore, the current state of service delivery to firms needs to be considered.

1.4 Objectives

The general objective of this dissertation is to determine the relationship between public goods, specifically infrastructure, and private firms' experience of delivery in four major cities in South Africa.

This objective will be achieved through a number of specific objectives, which are:

- To present a review of the literature of the link between infrastructure and growth, internationally and in South Africa.
- To describe and interpret the 2007 World Bank Enterprise Survey data, with relevance to the study.
- To compile a public goods and services delivery index per firm by means of Principle Component Analysis (PCA).
- To identify the differences in the delivery index between the various firms located in the four major cities.
- To analyse how the delivery of infrastructure relates to the characteristics of firms in the sample.

1.5 Method

The study will undertake a literature review and empirical analysis. The literature review will focus on international and South African literature on the relationship between infrastructure and growth, at the aggregate and firm level. The empirical investigation will entail an analysis of World Bank Enterprise Survey data of firms in Johannesburg, Cape Town, Port Elizabeth and Durban. The focus will be on firms' experience of the delivery of infrastructure and how it relates to their characteristics. The methods

employed will include PCA to construct an index of delivery and cross tabulation to examine differences in perceptions of delivery and differences in firms' performance, between firms and between cities.

1.6 Delimitation

The dissertation is structured as follows: Chapter 2 will present an overview of literature on the infrastructure-growth relationship from an international perspective to the local stage in South Africa and finally to firms. Topics such as infrastructure maintenance and quality, the role of Government and agglomeration will be discussed. A full description of the data will be given in Chapter 3, followed by Chapter 4 which will contain the empirical analysis of the data using Principle Component Analysis. Chapter 5 will conclude the dissertation and make recommendations.

CHAPTER 2: LITERATURE

2.1 Introduction

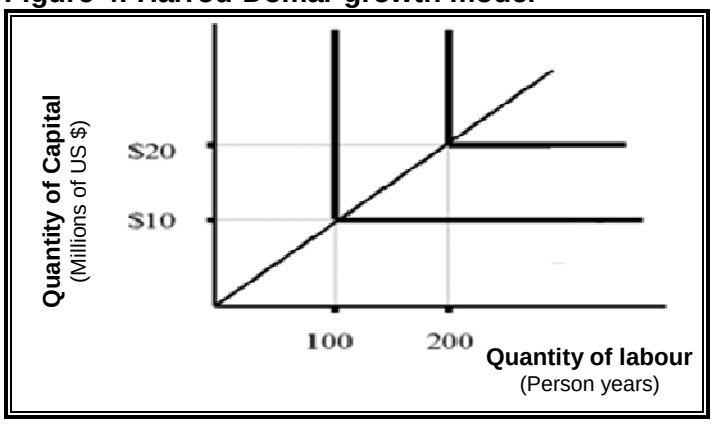
Public service delivery, specifically infrastructure investment, generates various externalities (McCann & Shefer, 2004:179). Both direct and indirect users of infrastructure benefit through either the lower costs of goods and service provision or through increased demand. These benefits affect local output, employment and income in the economy (McCann & Shefer, 2004:179). Infrastructure investment could thus be an important part of generating economic growth. Currently, in South Africa, the generation of economic growth is vital, since the country is faced with severe levels of unemployment, crime and inequality. This chapter will study various aspects of public infrastructure investment in order to evaluate its importance in the process to overcome these difficulties in South Africa. The relationship between infrastructure investment and economic growth, the importance of quality infrastructure and the maintenance thereof as well as previous trends of infrastructure investment in South Africa will be discussed.

2.2 Growth theories

Economic growth is central to the development process of a country (Perkins, Radelet & Lindauer, 2006:104). Many have studied the concept of economic growth and the basic growth model has evolved over decades. The Harrod-Domar growth model was introduced in the 1940s (Gillis, Perkins, Roemer & Snodgrass, 1992:43). It is a cross between the classical and Keynesian theories of growth (Ghatak, 1995:54). With its fixed-coefficient, constant-returns-to-scale production function its primary goal was to explain the growth-unemployment relationship in advanced capitalist societies (Perkins *et al*., 2006:108). Figure 4 illustrates this model with its constant-returns-to-scale function, which assumes that capital and labour are used in a constant ratio to each other to determine total output.

However, this model is not without limitation. Only with full employment of both the labour force and capital stock does the model remain in equilibrium, which leads to inaccurate longer-term economic predictions (Perkins *et al*., 2006:113). The model also fails to account for technological change and productivity gains that are considered vital for long-term growth and development (Perkins *et al*., 2006:116).

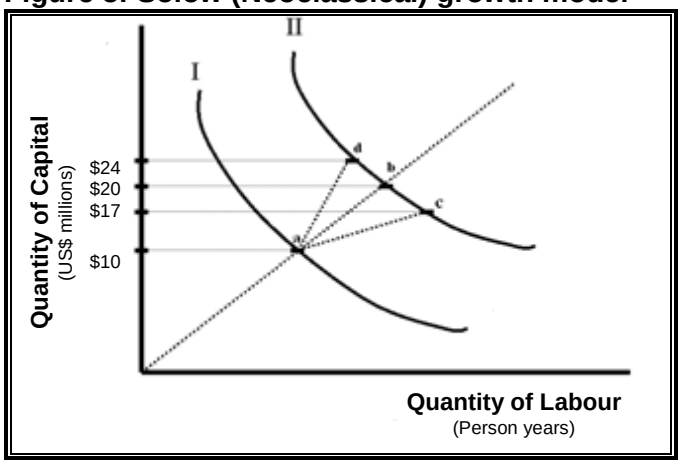
Figure 4: Harrod-Domar growth model



Source: Gillis *et al*. (1992:45)

In 1956, Robert Solow recognised the weaknesses in the Harrod-Domar growth model and introduced the Solow model, which included the neoclassical production function rather than the fixed-coefficient production function (Perkins *et al*., 2006:117). According to Todaro and Smith (2003:141), the Solow model is probably the best known model of economic growth and it remains the basic reference point for growth and development literature. This model allows for substitution between the factors of production, which is illustrated in Figure 5, with the curve shaped isoquants allowing flexibility in using different combinations of capital and labour.

Figure 5: Solow (Neoclassical) growth model



Source: Gillis *et al*. (1992:45)

According to this model, output can increase in one of three ways. Firstly, through the fixed and equal ratio increase of labour and capital. Secondly, through an increase in capital and thirdly through an increase in labour. This model remains at the core of many economic growth theories today (Perkins *et al*., 2006:117). The Solow model provides information on the relationship between population growth, investment,

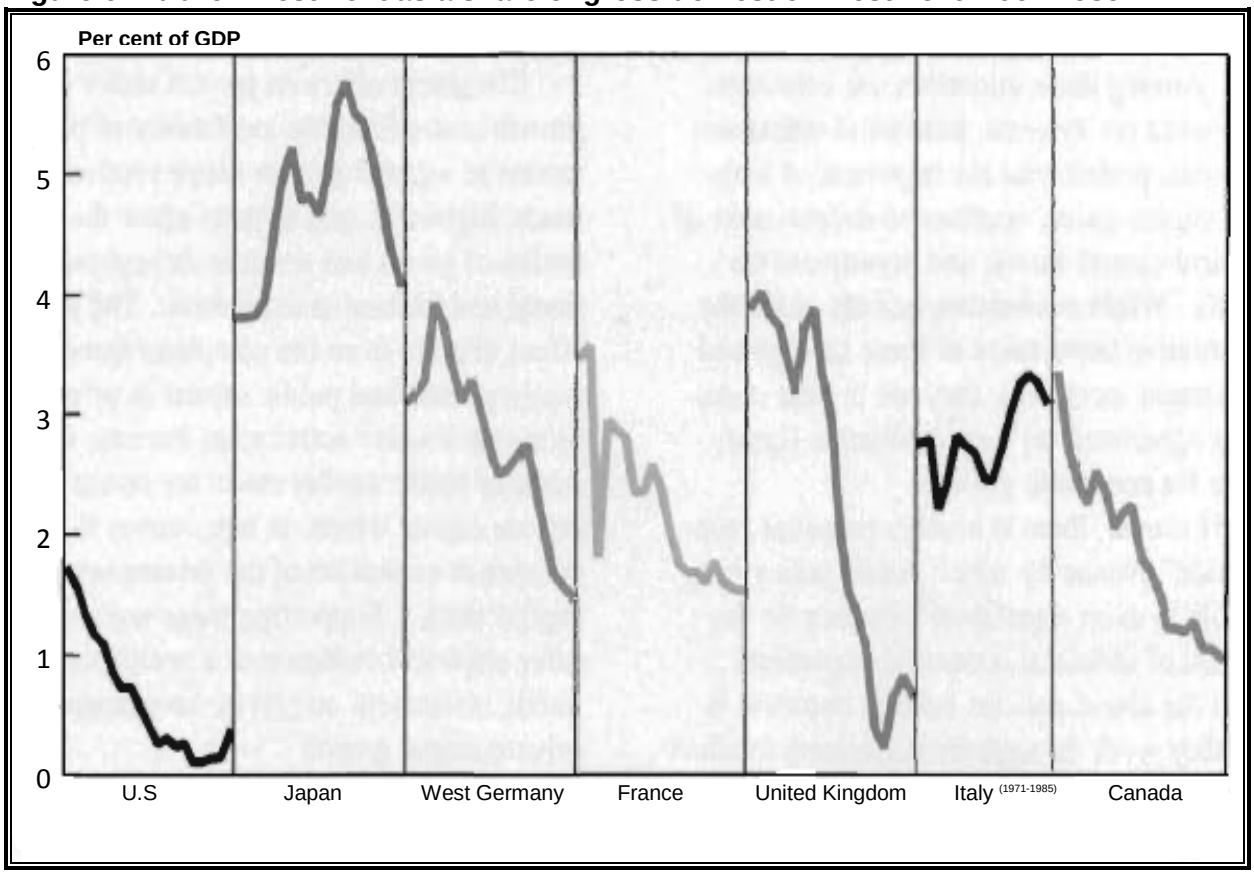
savings and technological change on the steady-state level of output per worker (Perkins *et al*., 2006:118).

New growth models emerged during the 1980s (Romer, 1994:3). They are also known as endogenous growth models that highlight that long-term growth is not only influenced by exogenous factors (Vergara, 2000:16). These models differ in their assumptions when compared to neoclassical growth models. Rather than assuming constant returns to scale, these models assume increasing returns to scale (Vergara, 2000:16). According to Vergara (2000:16), the most significant factor of these models, as well as the fundamental difference from the neoclassical growth model, is the space they provide to policies effecting saving and investment, which eventually affects a country's long-term growth rates.

Endogenous growth can only be obtained through increasing returns to scale (Vergara, 2000:18). Various models have emerged, depending on which factor is emphasised as the main determinant of growth. Romer (1990) constructed a model, in which the main source of growth is technological progress. Lucas (1988) initiated two models in which the key determinant of long-run growth is the accumulation of human capital, while Young (1991) emphasised the effect of learning-by-doing on the long-run growth of a country. However, it was only after the 1970s in the United States that the significance of public infrastructure investment to the economic growth model was investigated.

The 1950s and 1960s was known as the 'golden age' of the United States economy (Aschauer, 1990:5). From the early 1970s, various signs indicated that economic activity was slowing down (Darby, 1984:301). Figure 6 shows public investment as a share of gross domestic investment for the period 1967 to 1985 for the Group of Seven (G-7) industrialised countries. In these countries, the labour productivity growth declined during this period. Overall, the productivity growth for these countries averaged four per cent per annum from 1960 to 1968, 3.2 per cent from 1968 to 1973, 1.4 per cent from 1973 to 1979 and 1.5 per cent in the period 1979 to 1986 (Aschauer, 1989b:18). Figure 6 indicates two facts that stand out. Firstly, the ratio of public investment spending to gross domestic product trended downwards in five of the seven countries and secondly, the public investment ratios across the counties differ a great deal (Aschauer, 1989b:18).

Figure 6: Public investment as a share of gross domestic investment: 1967-1985



Source: Aschauer (1989b:18)

This encouraged David Aschauer to investigate the potential importance of trends in infrastructure spending to the aggregate economy. Aschauer (1990:13) developed the standard neoclassical production function, as introduced by Solow, to illustrate that private sector output is a function of private capital as well as public infrastructure capital. The production function can be shown as $y = f(k,k^g)$, where y equals private sector output and k and k^g represent private capital and public infrastructure capital, respectively (Aschauer, 1990:13).

From Aschauer's (1990:14) regression results, shown in Table 1, it is evident that the category of core infrastructure, which includes various types of transport infrastructure, water and electricity, shows a positive and statistically significant relationship with labour productivity. The coefficient of core infrastructure indicates that with a one per cent increase in the infrastructure capital stock, productivity will increase by 0.24 per cent (Aschauer, 1990:14).

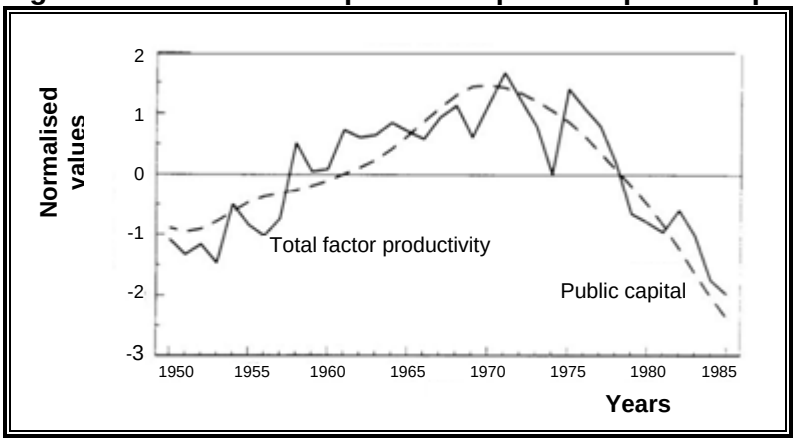
Table 1: Public capital by type and productivity (1949-1985)

The dependent variable is **Total national output**				
Type	**Coefficient estimates***	**T-statistics**	**Percentage of total infrastructure**	**F**
Core infrastructure (Highways, mass transit, airports, electricity and gas facilities and water)	0.24	5.07	55	0.16
Other buildings (Office buildings, police and fire stations, courthouses, garages, and passenger terminals)	0.04	1.57	7	0.01
Hospitals	0.06	1.62	3	0.33
Conservation & development	0.02	0.82	4	0.01
Educational buildings	0.01	-0.18	16	0.88

Source: Aschauer (1990:14)

Figure 7 strengthens the finding in the regression estimates by illustrating how the portion of total factor productivity is explained through the growth in public capital stock. The figure shows the close relationship between productivity and public capital over the period 1950 to 1985 in the United States.

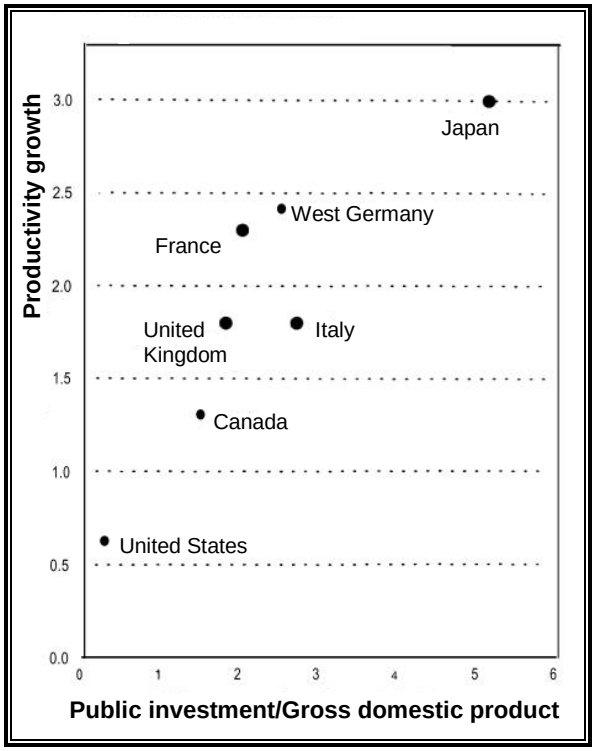
Figure 7: The relationship between public capital and productivity (1950-1985)



Source: Aschauer (1990:15)

Through this analysis, Aschauer (1990:13) highlights a number of important implications. Firstly, increased public capital stock is expected to raise the output of the private sector directly (Aschauer, 1990:13). Therefore, private sector production is directly influenced by public capital. Secondly, public capital and the production factors of the private sector may be complementary inputs to the production process (Aschauer, 1990:13). Therefore, the private sector's efficiency rises as the stock of public capital increases. According to Aschauer (1990:13), this, in effect, causes labour demand and private capital investment to grow. The relationship between productivity growth and the public investment-to-GDP ratio is shown in Figure 8.

Figure 8: A cross-country comparison of productivity growth and public investment to GDP ratio



Source: Aschauer (1990:17)

It is apparent that countries with higher public investment to GDP ratios, such as Japan, show faster productivity growth. The United States, however, shows a lower rate of growth in productivity due to their lower level of public investment. In general, the studies of Aschauer (1989b:20) indicate that public investment is a critical determinant of labour productivity growth in a country. Aschauer (1990:12) concluded that infrastructure, such as transport, water and electricity, is crucial in terms of profitable and efficient production as well as the supply of private sector goods and services. Evidence that countries with high savings and investment rates are the ones in which the productivity, income and living standard increase the most rapidly, is overwhelming (Aschauer, 1989b:17). Therefore, to generate economic growth and better living standards, the key is public investment.

Aschauer's (1990) analysis mainly involved core infrastructure, which he defined as various transport infrastructures, water and electricity. However, infrastructure has various definitions, due to its diverse impacts and incidence (Fourie, 2006b:530). Hirschman (as quoted by Fourie, 2006a:3) defines infrastructure as "capital goods that provide public services". This definition has widely been accepted in literature; however,

a greater debate has formed on the distinction between economic and social infrastructure.

Infrastructure is classified as economic infrastructure when it supports economic activity such as electricity, roads, railways, airports, sea ports, water supply and sanitation (Fourie, 2006b:531). Social infrastructure includes infrastructure activities that have an impact on the quality of life both directly and indirectly through health, education and cultural services (Fourie, 2006b:531). This includes services provided by various institutions, such as hospitals, schools and parks and is linked not only to growth, but also to the broader concept of development. This dissertation will focus on economic infrastructure, specifically transport, electricity and water supply. Throughout this dissertation, the term infrastructure will refer to economic infrastructure. The following section provides a more detailed explanation of the link between infrastructure, growth and development.

2.3 The link between infrastructure and growth

Over the past 40 years, views on development and growth have changed considerably (DBSA, 2006:17). Although development was first measured as growth in Gross National Product (GNP) or Gross Domestic Product (GDP), it became evident that economic growth did not necessarily lead to poverty reduction and a better quality of life for the population at large (DBSA, 2006:17). This encouraged analysts to review the concept of development. According to The World Development Report of 1991, the improvement in quality of life is the challenge of development (World Bank, 1991) . This requires reducing poverty and inequality as well as reducing unemployment (DBSA, 2006:17). The aim of this chapter is to show that through public infrastructure investment all of these development requirements can be accomplished.

2.3.1 Earlier studies on the infrastructure-growth relationship

Early studies by Ratner (1983), Eberts (1986) and Aschauer (1989) all state that infrastructure had a significant influence on United States output. Aschauer (1989a) also argues that the productivity decline in the US in the 1970s was due to declining public capital investment rates (Munnell, 1992:190). The later work of Munnell (1990) confirmed Aschauer's (1989a) results. However, many economists criticise these

studies by questioning the method used for estimation and the direction of causation from public investment to output growth (Munnell, 1992:190).

According to Munnell (1992:191), everyone agrees that via increased resources and the enhanced productivity of existing resources, public infrastructure investment will expand an area's productive capacity. For instance, with a well-constructed highway a truck driver will require less time to transport goods to markets. This results in the producer paying the driver less in wages due to the decrease in time required for the work. Therefore, public investment in highways will allow a private producer to manufacture his products at a lower cost. The quality of the highway is equally important, but this will be discussed in detail in a subsequent section.

Aschauer (1989b) estimated regressions with output as the dependent variable and private capital, public capital and labour as the explanatory variables. A constant was added for the level of technology. The result of these regressions showed public capital to be significant and the consensus was that Aschauer (1989b) made a significant contribution in illustrating the importance of public infrastructure in the production function (Munnell, 1990:191). There was, however, criticism of the large impact of public infrastructure investment on private sector output.

Aschauer's (1989b) studies, as well as both Holz-Eakin's (1988) earlier work and the re-estimates of Munnell (1990), show the effect of public capital on private sector productivity and output to be very large. Munnell's (1990) estimates show that a one per cent increase in the stock of public capital causes output to increase by 0.34 per cent. This entails a marginal productivity of public capital of approximately 60 per cent (Munnell, 1992:191). Therefore, output will increase by $0.60 with every $1 increase in public capital.

Munnell (1992:191) agrees with the critics that the large implied impact emerging from these studies is not realistic. According to Munnell (1992:192), it is unreasonable to accept that public infrastructure investment has a more significant impact than private capital investment on private sector output. To investigate this, Munnell (1992:192) did parallel work to the previous regression estimates, which was done on national data, but this time with state-level data. He finds a positive statistically significant relationship between public infrastructure and output; however, the elasticity of output was much smaller than that of the national estimates. Munnell (1992:192) went further in

estimating the public and private investment relationship as well as the link between public capital and employment. His findings confirm that private investment is encouraged through public capital investment and that public capital has a positive, statistically significant effect on employment growth (Munnell, 1992:192).

To conclude this brief review of Munnell's (1992:192) work – at state level, public capital has a positive impact on economic activity, specifically on output, investment and employment growth. These results are the same as at the national level, but the effects are considerably smaller. Munnell (1992:193) explains this when stating that by narrowing the geographical focus, the impact of the public capital becomes smaller. Table 2 illustrates this by indicating the level of aggregation of each study and then showing the estimated output elasticity of public capital resulting from each analysis.

Table 2: Production function estimates of the output elasticity of public capital by level of geographical aggregation

Author	Level of aggregation	Specification	Output elasticity of public capital
Aschauer (1989a)	National	Cobb-Douglas; log-levels	0.39
Holz-Eakin (1988)	National	Cobb-Douglas; log-levels	0.39
Munnell (1990)	National	Cobb-Douglas; log-levels	0.34
Costa, Ellson and Martin (1987)	State	Translog; levels	0.20
Eisner (1991)	State	Cobb-Douglas; log-levels	0.17
Mera (1973)	Japanese Regions	Cobb-Douglas; log-levels	0.20
Munnell and Cook (1990)	State	Cobb-Douglas; log-levels	0.15
Duffy-Deno and Eberts (1989)	Metropolitan areas	Log levels	0.08
Eberts (1986, 1990)	Metropolitan areas	Translog; levels	0.03

Source: Munnell (1992:194)

With this, Munnell (1992:194) silenced the critics who questioned the large impact of public infrastructure on private output and confirmed the relationship of public infrastructure investment with private investment and employment growth. Another question the critics raised pertained to the direction of causality between output and public investment. This issue was examined by Eberts and Fogarty (1987), who used public and private investment data from 40 metropolitan areas. The analysis shows that causation runs in both directions and that public capital still has a positive, statistically significant effect on output (Munnell, 1992:194).

To conclude on all of these analyses and criticism: the critics were correct to question the credibility of the large impact effects found in the aggregate time series studies, and also that more research should be done on the causation issue. However, the evidence also suggests that the positive link between public infrastructure investment and private sector productivity and output cannot be ignored.

2.3.2 More recent studies on the infrastructure-growth relationship

More recent studies investigated the various channels through which infrastructure investment affects economic growth as well as the direction of causality in greater detail.

2.3.2.1 Channels through which infrastructure generates growth

Public infrastructure investment has an impact on economic growth in a direct and indirect manner, as well as during construction. Firstly, through a direct channel infrastructure is regarded as an input in the production process (Fedderke & Garlick, 2008:4). An increase in the infrastructure stock will increase output, which directly generates economic growth (Fedderke & Garlick, 2008:4). To explain this in more detail, infrastructure investment averts diminishing returns to scale in private sector capital. This improves the marginal product of private-sector capital and eventually raises the output growth rate (Fedderke *et al*., 2006:1039). The use of electricity in the production process is a concrete example of this direct channel. Electricity is a necessary input into most production processes. Insufficient and unreliable power supply will cause the production process to be more expensive or even impossible (Fedderke & Garlick, 2008:4).

Secondly, through the indirect channel, infrastructure is regarded as a complement to the other inputs in the production process in two ways (Fedderke & Garlick, 2008:4). Firstly, infrastructure investment lowers the production costs (Fourie, 2006b:539). For example, inadequate transport infrastructure means that firms incur potentially high costs to seek alternative transport. Insufficient and inadequate infrastructure burdens firms by creating a number of costs to create contingency plans in case of infrastructure failure or to build infrastructure themselves (Fedderke & Garlick, 2008:4). The impact of infrastructure investment and its benefits should also be compared to its opportunity costs (Fourie, 2006b:539). When power supply fails, firms need to obtain alternative

energy sources, such as generators. This is costly and due to economies of scale, smaller firms may not be able to obtain this necessity (Fourie, 2006b:539). Infrastructure investment is crucial due to its significant impact on the production process.

Secondly, as a complement in the production process, infrastructure improves the productivity as well as the accumulation of other input factors (Fedderke & Garlick, 2008:4). Therefore, a supply of reliable infrastructure improves the productivity of inputs such as labour and capital into the production process. This is illustrated by well-constructed roads in metropolitan areas, connecting residential and commercial areas, boosting the productive time of workers (Fourie, 2006b:540), while reliable power supply raises the productivity of capital such as machinery (Fedderke & Garlick, 2008:4).

Finally, infrastructure investment also has an impact on growth in a less significant but also important manner (Fourie, 2006b:540). This effect is present during the initial building and construction period. The investment in infrastructure projects creates a demand for workers in the construction industry (Fourie, 2006b:540). The importance of infrastructure maintenance will be discussed in the following section; however, it is essential to highlight in this section that the maintenance of infrastructure will further enhance long-term job creation in the specific area of the infrastructure project, particularly for unskilled and semi-skilled workers (Fourie, 2006b:540).

2.3.2.2 Positive externalities generated from infrastructure investment

With the three channels being mentioned through which infrastructure investment influences economic growth, it is also important to list the additional positive externalities generated by infrastructure investment. The first externality is international trade. According to Fourie (2006b:540), inadequate and unreliable infrastructure lowers a country's ability to trade internationally. In a regression model estimated by Fedderke and Garlick (2008:14), they found that total public infrastructure stock has a positive impact on exports and that infrastructure stock drives export performance.

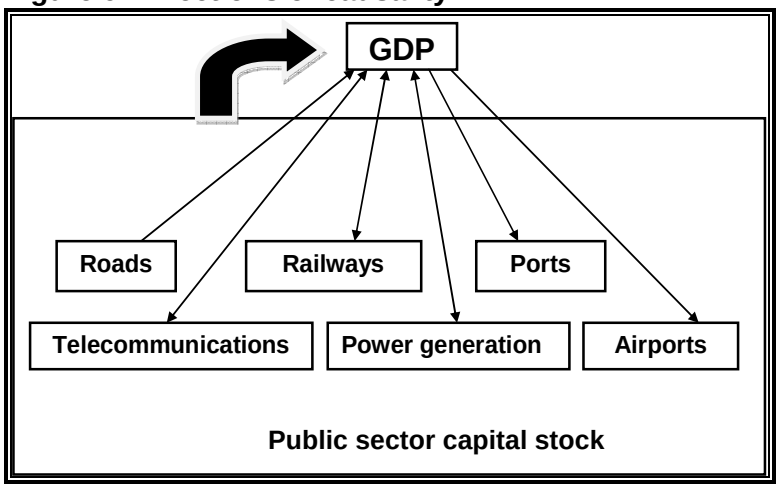
Competitiveness of a country will also increase due to increased productivity and lower prices made possible by lower input costs. This will enable a county to attract foreign direct investment as well as compete for export markets (Fourie, 2006b:540). Competitiveness is therefore the second positive externality generated from infrastructure investment. Regional integration endeavours will benefit from the

increased trade and competition, which is the third positive externality, while tourism is the fourth positive externality (Fourie, 2006b:541). Although much attention has been given to the benefits of a large quantity of infrastructure for economic efficiency, it is important to remember that infrastructure quality is just as important. This will be discussed in more detail in section 2.4.

2.3. The direction of causality within the infrastructure-growth relationship

Perkins *et al*. (2005) as well as Fedderke *et al*. (2006) examined the question of causality, using South African data and controlling for time trends in the data. Their conclusions are illustrated in Figure 9.

Figure 9: Directions of causality



Source: Fedderke and Garlick (2008:24)

Figure 9 illustrates that aggregate public sector investment and public sector fixed capital stock, together with roads, generate GDP. On the other hand, GDP drives the freight handling levels of ports as well as airports' passenger levels. The direction of the link between GDP and power generation, telecommunication as well as some measures of railways is indefinite. The magnitude of these relationships will be presented and discussed in section 2.7.2.

2.4 The importance of infrastructure quality and maintenance

The role of public service delivery, including transport, power supply and the provision of water in the performance of private sector firms, was identified in the previous

sections. Therefore, it can be said that the availability and thus quantity of infrastructure has a significant influence on a country's economic performance. This section aims to highlight that infrastructure quality is just as essential as the availability thereof to the economic performance of a country. To achieve sustainable economic growth through public infrastructure investment, the supplied infrastructure needs to be maintained and must also expand fast enough to accommodate the growth (World Bank, 1994:2).

2.4.1 The link between infrastructure quality and economic performance

Infrastructure quality has a persistent influence on a country's economy (Escribano, Guasch & Pena, 2009:3). With quality infrastructure, the productivity of private firms is higher, along with lower production costs (World Bank, 1994:2). On the other hand, low-quality infrastructure generates higher production costs causing competitive products to become uncompetitive (Escribano *et al*., 2009:3). The cost of low-quality infrastructure is forgone economic growth, as well as the lost opportunities to reduce poverty and improve environmental conditions (World Bank, 1994:2). Empirical results tend to confirm this link.

In Calderón and Servén's (2005:19) country-level analysis of the impact of both infrastructure quantity and quality on growth, they found that the quantity of infrastructure is a statistically significant predictor of growth, while the effect of infrastructure quality on growth appears to be statistically insignificant. Their possible justification for this result is the dominant effects of infrastructure quantity.

Limi (2008:5) considers the fact that the quality level of infrastructure services, received by firms, potentially differs depending on their location. With this in mind, Limi (2008:5) analyses firm-level micro-data, for 27 European and Central Asian countries, to determine the impact of improved infrastructure quality on business costs. The analysis was done on three types of public infrastructure, namely electricity, water supply and telecommunication.

The results of Limi (2008:21) differ considerably from the results found by Calderón and Servén (2005:19). Limi (2008:21) highlights the importance of quality infrastructure throughout his results. Table 3 indicates that if electricity outages were reduced by one hour, firms will save an average of 1.5 per cent on operating costs (Limi, 2008:17). A

firm's operating cost can further be reduced by an average of 4.4 per cent, should the existing water supply suspensions be shortened by one hour (Limi, 2008:17).

Table 3: Estimated cost savings from infrastructure quality improvements

	Estimated cost savings per operating cost (%)
Reducing service interruptions by 1 day	
Electricity	0.087
Water supply	0.430
Telecommunications	0.200
Making service recovery faster by 1 hour	
Electricity	1.533
Water supply	4.410
Telecommunications	0.907

Source: Limi (2008:17)

If the current electricity and water suspensions were all removed, firms will save operating costs of approximately four per cent and seven per cent, respectively (Limi, 2008:21). From these results, it is apparent that quality infrastructure can benefit a country's economic substantially. The total cost saving, generated from improvements in the quality of infrastructure services, may range between 0.5 and two per cent of GDP (Limi, 2008:21). Therefore, public investment in quality infrastructure is essential, since it ensures increased firm-level competitiveness (Limi, 2008:17) as well as modernised and diversified production, greater international trade and hence accelerated growth (World Bank, 1994:3).

2.4.2 The importance of maintenance

According to Gyamfi, Guitierrez and Yepes (1992:2), maintenance is an act that ensures efficient public infrastructure in order to generate the necessary output. Many developing countries tend to neglect infrastructure maintenance in favour of building new infrastructure (Rioja, 2003:2282). Academic research has also focused more on the overall effect of public investment on economic growth; however, recent empirical evidence suggests that to fully know the public infrastructure effects, an important factor that should also be taken into account is the role of maintenance (Rioja, 2003:2282).

In general, a well-maintained road should last ten to fifteen years before resurfacing is necessary (Rioja, 2003:2282). However, with a lack of maintenance, resurfacing may be

required within five years (Rioja, 2003:2282). If an additional $12 billion was spent on road maintenance in Africa over the last decade, $45 billion that was spent on reconstruction could have been saved (World Bank, 1994). A similar result was found with regard to power lines. By spending $1 million to reduce line losses, $12 million in generating capacity could have been saved (World Bank, 1994).

African countries are not the only ones guilty of poor infrastructure maintenance. In Brazil, 6000km of paved roads were built during 1979 and 1984. However, during this period, another 6000km of roads went from fair to poor quality, due to the lack of maintenance (Harral, 1988). In Chile in the 1960s, approximately 3000km of the main north-to-south highway was paved; however, due to poor maintenance, this highway collapsed during the 1970s (Rioja, 2003:2284).

Despite the increased future expenditure due to poor road maintenance, an immediate cost to producers is also imposed. In Zambia, during 1992, the Federation of Zambian Road Hauliers conducted a study on the effect of bad roads on the operating costs of a vehicle and Table 4 illustrates their findings (Rioja, 2003:2284). The total increase in operating costs due to unmaintained roads was as high as $14 331 for a vehicle. This increase in the costs results in a decrease in the supply of transport services and ultimately of goods and services.

Table 4: Additional operating costs due to bad roads

Quantity	Item	Extra annual cost
10	Extra tires and tubes	$5952
1	Extra clutch and pressure plate	$1071
4	Extra wheel bearing	$803
1	Extra set of brake shoes	$1050
1	Extra set of springs	$1667
4	Extra spring hangers and bushes	$452
-	Welding	$952
1	Extra steering assembly	$1874
4	Extra absorbers	$510
	Total extra costs	**$14 331**

Source: Rioja (2003:2284)

Therefore, now we know that poor infrastructure maintenance leads to reduced service quality, increased costs and reduced supply of goods. Deteriorating infrastructure such as roads, electricity outages etc. reduces the productive capacity in the economy and

necessitates increased future expenditure (Rioja, 2003:2282). However, a more important question is what the quantitative effect of poor maintenance is on a country's GDP.

Rioja (2003:2283) uses a dynamic general equilibrium model that includes both the expenditure on new infrastructure and on repairing existing infrastructure to determine certain quantitative macroeconomic effects. It is important to mention that, according to Rioja (2003:2283), it is a common trend that developing countries finance their new public infrastructure projects through international donors, while public infrastructure maintenance is financed through taxes. Rioja (2003:2283) also assumes that the depreciation rate of infrastructure in this model is endogenous, thus dependent on the maintenance and usage level. By using historical data from seven Latin American countries (Brazil, Argentina, Chile, Mexico, Peru, Colombia and Venezuela), Rioja (2003:2283) obtained quantitative results suggesting that a part of donor aid should rather be reallocated away from new infrastructure to maintenance, due to its positive effects on GDP.

Rioja (2003:2292) starts his quantitative evaluation by determining the benchmark allocation between new infrastructure and maintenance and with the result he aims to answer two questions. Firstly, what the effect on the economy would be should a fraction of donor aid be redistributed towards the maintenance of infrastructure and secondly, what the effect would be on the economy if maintenance was reduced and the resources were used to construct new infrastructure instead (Rioja, 2003:2292).

Table 5 illustrates the benchmark allocation used by Rioja (2003:2293). According to these benchmark parameters, only one per cent of GDP is spent on maintenance of public infrastructure, while new infrastructure construction receives five per cent of GDP.

Table 5: Benchmark parameters

Parameter	Value	Description
α	0.54	Capital share
θ	0.10	Public infrastructure coefficient
δ	0.12	Public capital depreciation rate
λ	0.01	Share of GDP devoted to maintenance
d	0.05	Share of GDP devoted to new infrastructure
β	0.99	Discount rate

Source: Rioja (2003:2293)

Table 6 shows the outcome to the two questions Rioja (2003:2294) attempts to answer. The highlighted numbers indicate the allocated benchmark.

Table 6: Long-run effect of public expenditure reallocation (Benchmark 1)

Maintenance (my)	New investment (dy)	δ	ΔK	ΔY	ΔC
0.50	5.50	0.15	-15.00	-3.48	-3.48
1.00	**5.00**	**0.12**	**0.00**	**0.00**	**0.00**
1.50	4.50	0.10	7.09	1.50	1.50
2.00	4.00	0.09	8.90	1.87	1.87
2.50	3.50	0.08	6.38	1.35	1.35
3.00	3.00	0.07	-0.05	-0.01	-0.01
3.50	2.50	0.06	-10.20	-2.30	-2.30
4.00	2.00	0.06	-23.80	-5.73	-5.73
4.50	1.50	0.05	-40.70	-10.70	-10.70
5.00	1.00	0.05	-60.40	-18.20	-18.20
5.50	0.50	0.04	-81.70	-30.80	-30.80

Source: Rioja (2003:2294)

The first row of numbers in Table 6 determines the answer to the second question, which is what the effect on the economy will be when maintenance was reduced and the resources were used to construct new infrastructure instead. This shows that with only 0.5 per cent of GDP spent on maintenance (which is less that the benchmark allocation) and 5.5 per cent of GDP spent on new infrastructure construction (being more than the benchmark allocation), it is evident that the depreciation rate of public infrastructure increased to 0.15 per cent per year (Rioja, 2003:2295). This causes the stock of public infrastructure (ΔK) to fall from its benchmark level by 15 per cent in the long run. Due to the reduced capital stock, which is an essential input into the production process, output (ΔY) and consumption (ΔC) are affected, falling by 3.48 per cent (Rioja, 2003:2295).

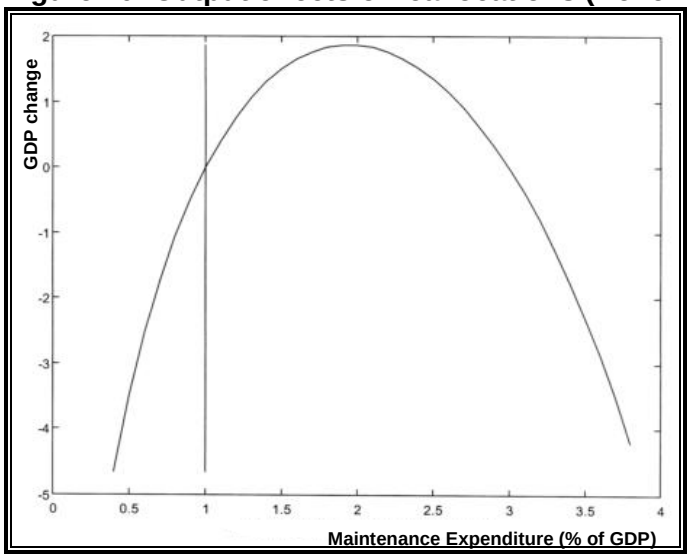
The first question, namely what the effect on the economy will be when a fraction of donor aid is redistributed towards maintenance of existing infrastructure, is illustrated by the third row of numbers in Table 6. In this case, maintenance is increased to 1.5 per cent of GDP and new infrastructure investment is reduced to 4.5 per cent of GDP. The results show that with more spent on maintenance, the depreciation rate of capital stock is reduced from 0.12 per cent at the benchmark allocation to 0.10 per cent. With less depreciation of existing infrastructure, more of the public capital stock will survive in the long run, causing the public infrastructure stock to be 7.09 per cent larger (Rioja,

2003:2295). Therefore, even though there is less investment in new infrastructure, through more maintenance more public capital stock survives in the long run (Rioja, 2003:2295). By being an essential input in the production process, the larger public capital stock affects consumption and output positively by 1.50 per cent. This shows that higher expenditure on maintenance has positive effects on a developing country's GDP.

It is important to notice that although higher expenditure of GDP on the maintenance of existing infrastructure benefits a country more, there is a point where the effect thereof becomes negative (Rioja, 2003:2295). If the eighth row of Table 6 is analysed, where the share of GDP spent on maintenance and new infrastructure are four per cent and two per cent respectively, it shows that although the depreciation rate of public capital is reduced significantly to 0.06 per cent, the public infrastructure stock will be 23.8 per cent less in the long run (Rioja, 2003:2295). This reallocation will affect both output and consumption negatively by 5.73 per cent. Therefore, too much maintenance with too little investment in new infrastructure can be damaging. Rioja (2003:2296) illustrates his findings graphically through Figure 10.

The vertical line at maintenance = 1.0 marks the starting point of benchmark 1. Figure 10 shows that lowering below the benchmark reduces GDP, increasing above the benchmark has positive effects on GDP, and that the positive effects have a maximum point beyond which the effect of higher maintenance expenditure has a negative effect on GDP.

Figure 10: Output effects of reallocations (Benchmark 1)



Source: Rioja (2003:2296)

From this model it can be concluded that maintenance of existing infrastructure is just as important as investing in new capital stock. Developing countries frequently make the error to invest in new infrastructure rather than maintaining the existing infrastructure. The idea is that every country should determine their optimal allocation level of expenditure on maintenance and new infrastructure in order to obtain the best effect on GDP through long-run capital stock, output and consumption.

2.5 The role of the Government and public service delivery

Until now, the focus of this chapter was to determine the influence of public services delivery, specifically infrastructure such as electricity, water and transport, on the economic performance of a country. It was found that public infrastructure is in fact a significant driver of economic growth via increased firm output and lower production costs. It is also clear that quality infrastructure and the maintenance thereof is just as important as the quantity of infrastructure. It was presupposed that Government supplies public infrastructure, but this section focuses on the public goods nature of infrastructure and the government intervention in the economy required to supply infrastructure.

A government can intervene both directly and indirectly. Indirect government intervention refers to the regulatory functions of the government, while direct government intervention is the actual participation of the government in the economy (Black, Calitz & Steenekamp, 2005:26). These include actions such as taxation of individuals and companies, borrowing funds on the financial markets as well as their response to market failure by supplying public goods and services such as national defence, electricity and infrastructure (Black *et al*., 2005:26).

One of the most influential arguments for an expansive role for government is market failure (Cowen & Crampton, 2002:1). Arguments regarding market failure throughout the twentieth century were based on public goods and externality theories that suggested that market participants will fail to produce certain goods and services that are mutually beneficial (Cowen & Crampton, 2002:1). During the 1950s, Paul Samuelson, James Meade and Francis Bator were known for laying down the modern formulations regarding government intervention (Cowen & Crampton, 2002:1). Despite significantly

different arguments by Cowen (1988), a consensus developed on the modern formulations was that a few basic public goods and services should be provided by the government; however, the markets are best at providing most other goods and services (Cowen & Crampton, 2002:1).

It was during the 1970s and 1980s that economists started to construct new market failure arguments and the consensus fell apart. During the 1980s, the new theoretical arguments on market failure, which tend to focus on problems of information, agency and coordination, became prominent (Cowen & Crampton, 2002:1). These new ideas on market failure included 2001's Nobel Prize winners Joseph Stiglitz with his efficiency wage hypothesis and Akerlof (1970) with the "market for lemons" model (Cowen & Crampton, 2002:1). Oliver Williamson's notion of opportunistic behaviour and the network and lock-in effects argued by Paul David and others were also part of the new arguments (Cowen & Crampton, 2002:1).

The leading figure in the new market failure arguments is economist Joseph Stiglitz, who generated a new way of thinking with regard to market prices (Cowen & Crampton, 2002:3). According to the earlier Hayekian version of the theory, prices generate and communicate information on resource scarcity and help markets economise on information. Therefore, a price clears the market and informs distant buyers and sellers on the relative scarcities of certain goods and services (Cowen & Crampton, 2002:3). Stiglitz, on the other hand, highlights how agency and quality verification problems are solved through prices (Cowen & Crampton, 2002:3). This can be explained by the higher quality of goods and services that buyers expect to receive, the higher the price of that good and service will be, and vice versa (Cowen & Crampton, 2002:3). It is therefore argued by Stiglitz that when prices are used to illustrate quality, they cannot also clear the market, and the relative scarcities of goods and services will not be measured properly (Cowen & Crampton, 2002:3). To demonstrate his view, Stiglitz presents two clear examples, both based on imperfect information, to demonstrate how markets may fail. These two examples are known as the credit rationing and efficiency wage models (Cowen & Crampton, 2002:2).

The credit rationing is concerned with credit markets and the efficiency wage theory is concerned with the labour market (Cowen & Crampton, 2002:3). Individuals tend to work harder for higher wages (Stiglitz, 1984:44). Because employers do not always

know how hard the employees are working, asymmetric information is very common in the labour market. Stiglitz (1984:44) argues that when an individual is paid the same wage as in the next best job, the individual will tend to work less hard. Therefore, employers should pay employees a certain premium should they expect good quality work (Stiglitz, 1984:46). This will, however, result into some unemployment, due to the higher overall wages and more individuals will seek a job than can actually find one (Stiglitz, 1984:46). This example illustrates how the market price fails to clear the market and how a higher wage attracts a higher quality of job applicants.

Another important market failure argument by a theorist in the 1980s is that highlighted by Paul David (Cowen & Crampton, 2002:17). He combined theories of network effects, path dependence and lock-in to argue market failure in technological markets (Cowen & Crampton, 2002:17). The lock-in argument is based on problems of collective action that may cause individuals to be stuck at a less than optimal level of technology (Cowen & Crampton, 2002:17). According to David (1997:3), the market may fail to move from the established standard to a new superior standard, since it has no mechanism to coordinate. The private gain of an individual move to the superior standard will be less than the social gains, when compatibility effects are strong (David, 1997:3). This, together with the fact that individuals fail to realise that a successful collective move to a superior standard will benefit others as well cause individuals to be more reluctant to switch to a superior standard (David, 1997:3). The result of this is a locked-in market to an inefficient standard.

It seems as though that the lack of information in the market is the biggest contributor to market failure. It thus follows that government intervention is required to a certain extent. With the significant importance of supplied, quality infrastructure to a country's economic performance already established, it should not even be necessary to highlight the important role of the government in the delivery of public goods and services.

In addition to its public-goods nature, infrastructure also has particular spatial characteristics that should be accounted for in a discussion of the links between infrastructure, growth and development.

2.6 Agglomeration and public infrastructure

The primary lesson in the work of Porter (1990) and Krugman (1991) was that economic growth and performance do rely on geography (McCann & Shefer, 2004:178). The characteristics of an urban area create a number of potential economic opportunities in each of these areas (Jordaan, 2000:66). Industries in urban areas can produce at lower costs if their economic activity is located in one place (Jordaan, 2000:67). The advantage that is derived due to economic activities that are spatially concentrated is known as agglomeration economies (Graham, 2007:4). The purpose of this section is to briefly review the literature on the different types of agglomeration economies and to determine whether public infrastructure investment generates economic growth as a positive externality of agglomeration economies.

2.6.1 Agglomeration economies

The economies of agglomeration can be divided into three categories. The first category is internal scale economies (Eberts & McMillen, 1999:1460). The second category entails economies that are internal to the industry, but external to the firm, also known as localisation economies, while the third category is economies, also known as urbanisation economies, which are external to firms as well as industries (Eberts & McMillen, 1999:1460). Urbanisation economies occur due to the industry being concentrated in an urban area (Eberts & McMillen, 1999:1460).

Economists are the most familiar with internal economies of scale, which exist when a firm's unit costs are lower when production expands (Eberts & McMillen, 1999:1460). The positive externalities of the internal scale economies are generated from increased worker skills due to repetition, the under-pricing of smaller competitors by large firms and the establishment of large-scale manufacturing (Eberts & McMillen, 1999:1460).

Localisation economies occur when an industry in a specific location has an increase in total output, while the group of firms within that particular industry experiences a decrease in production costs (Jordaan, 2000:70). The scale economy is external in order for the firm to remain small; however it is internal to the industry for the industrial concentration to be high in the urban area (Eberts & McMillen, 1999:1460). Localisation economies consist of various sources.

- Firstly, the pool of knowledge and labour (Jordaan, 2000:70). When firms locate close together, a pool of skilled labour is formed. Firms may extend their workforce effortlessly due to an increase in available qualified workers. This will contribute to the creation of employment opportunities, due to increased demand and the concentration of employment (Jordaan, 2000:71). Localisation economies will also ensure that knowledge spillovers take place.

- Secondly, specialised machinery. When firms locate close together they are able to share specialised machinery, other production factors, a warehouse centre or modified loading and handling equipment that will increase the efficiency of all the firms operating in the area (Jordaan, 2000:74).

- Thirdly, imitation and modification. Firms will adapt more readily to changes in the industry when they are able to copy and imitate one another. The firms located in the same cluster will then have a comparative advantage over industries located elsewhere (Jordaan, 2000:74).

- Fourthly, shopping externalities. This externality occurs when one store's sales are affected by the location of the other store's location; therefore, when a store attracts customers to the cluster, it benefits the other stores as well (Jordaan, 2000:74).

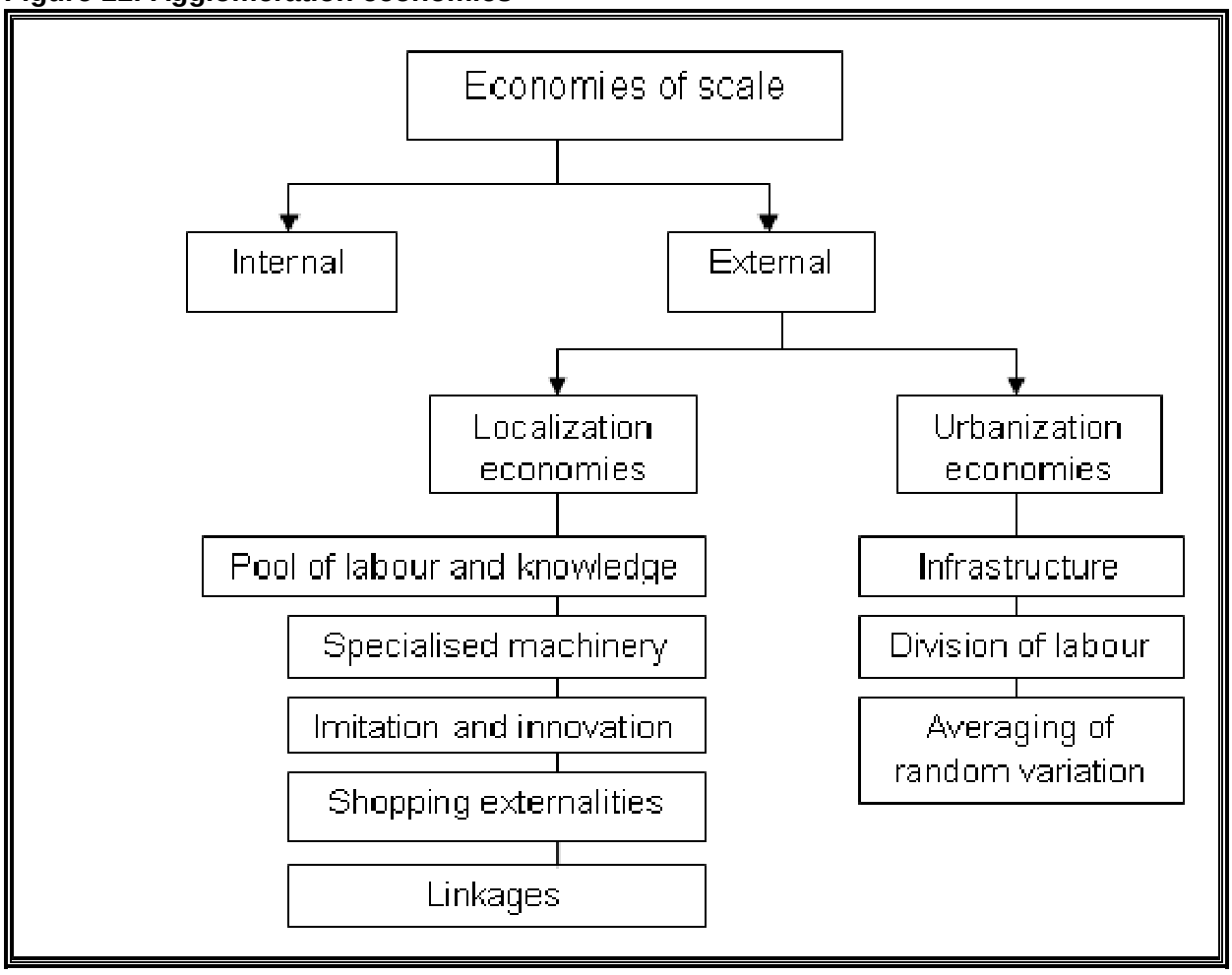
- Lastly, linkages that refer to firms that locate together due to their trading with one another.

Urbanisation economies occur when economies are external to the firm and the industry (Eberts & McMillen, 1999:1463). Therefore, when the economic activity of the total urban area increases as the firms experience cost savings, urbanisation economies are present (Jordaan, 2000:76). The difference between localisation economies and urbanisation economies is noted in the fact that urbanisation economies are generated from the entire urban economy and not only a particular industry, as well as the fact that urbanisation economies create advantages to firms throughout the urban area that is not only limited to a particular industry (Jordaan, 2000:76). Urbanisation economies are also generated from a number of sources, of which the first is infrastructure. Urban infrastructure includes transport, electricity, water and communication facilities. When these infrastructures are provided and work efficiently, the cost of doing business in an

urban area will lower for all firms, creating external scale economies (Eberts & McMillen, 1999:1463). Secondly, due to the higher number of activities in an urban area, greater division of labour is present, resulting in urbanisation economies (Jordaan, 2000:77). This implies that the decrease in quantity demanded by one consumer is offset by the increase in quantity demanded by another consumer (Jordaan, 2000:77). Figure 11 summarises the outlay of agglomeration economies through a visual illustration. The different types of agglomeration are clear as well as the sources from which these economies are generated.

The focus of this dissertation is on the public service delivery of infrastructure and therefore it is important to determine the role of infrastructure investment in agglomeration economies and the positive externalities that it can generate. From Figure 11 it is clear that infrastructure is one of the sources generating advantages to the overall economy by developing external economies of scale in urban areas.

Figure 11: Agglomeration economies



2.6.2 The role of public infrastructure in agglomeration economies

Public infrastructure and agglomeration economies are essential to the economies of urban areas (Eberts & McMillen, 1999:1457). Urban public infrastructure directly influences a city's efficient operation, particularly metropolitan areas (Eberts & McMillen, 1999:1457). This highlights the importance of public infrastructure and encourages the understanding of agglomeration economies. For example, firms that are close in proximity will not benefit in an urban area characterised by an inefficient highway system or inadequate water capacity (Eberts & McMillen, 1999:1457). It is therefore evident that due to different quality and quantity in public infrastructure, firms that are located in cities with the same size may experience diverse productivity levels due to agglomeration economies (Eberts & McMillen, 1999:1457). The effect of agglomeration economies and public infrastructure has received significant attention in literature; however, these two topics have rarely been studied together (Eberts & McMillen, 1999:1457). Mera (1973), Moomaw (1983) and Seitz and Licht (1993) are part of the limited studies that include both public infrastructure and agglomeration effects.

Mera (1973:157) attempted to quantitatively measure the mechanics that generate agglomeration economies in order to answer the question as to what the effect of infrastructure investment will be on income levels in low income regions. His findings show that higher per capita income in high-density areas is explained by the public investment and the increase in the efficiency of inputs (Mera, 1973:181). Cities that increase their public investment will experience less diseconomies and greater aggregate productivity for a given city size (Mera, 1973:181). Therefore, with his positive and significant results, Mera (1973:181) states that public investment does affect productivity and contributes to agglomeration economies. Moomaw (1983:539) contributes to this finding by analysing the impact of public infrastructure investment, specifically transportation, as an effect on some United States industries within metropolitan areas. The outcome of his analysis shows a positive and statistically significant transportation variable, indicating that public infrastructure does have a positive effect on the productivity of metropolitan areas, thus creating a situation in which agglomeration economies are generated.

It can be concluded that public infrastructure investment increases productivity and income per capita, resulting in more efficient inputs in the production process and finally

higher output levels. Therefore, public infrastructure investment does contribute to the creation of agglomeration economies.

2.7 Public infrastructure in South Africa

Infrastructure investment in South Africa has been disappointing over the last few decades. During the period 1976 to 2002, the infrastructure investment per capita declined by 72 per cent (Bogetić & Fedderke, 2006:4). Investment, as a percentage of GDP, decreased from 8.1 per cent to 2.4 per cent over the same period, falling below the international benchmark of approximately three to six per cent (Fedderke & Bogetić, 2009:1522). The World Competitiveness Report of 1998 rates South Africa's infrastructure ability to satisfy business needs 35th out of 46 countries (Naudé, 1999:31). Insufficient infrastructure was also identified by ASGISA as one of the constraints to development in South Africa (Fedderke & Garlick, 2008:1).

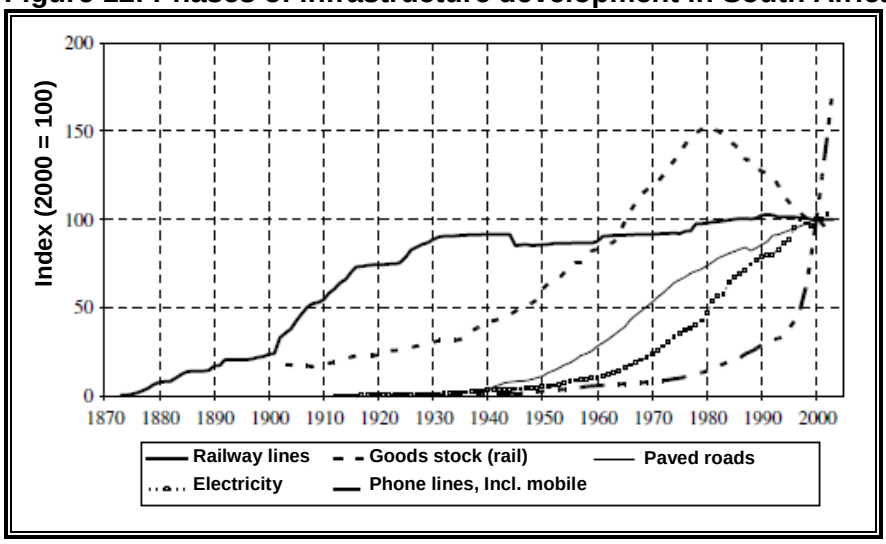
One of the main findings in the study of Fedderke *et al*. (2006:1037) on the relationship between economic growth and infrastructure in South Africa was that it appears that economic growth in South Africa is led by infrastructure investment. Fedderke *et al*. (2006:1042) highlight two implications of their study. Firstly, economic infrastructure stock in South Africa has developed in stages and secondly, it appears as though causality between aggregate economic growth and infrastructure investment runs in both directions.

2.7.1 The range of infrastructure development stages in South Africa

Economic infrastructure investment in South Africa is illustrated in Figure 12, which shows the different investment stages since 1875. Railways were the first infrastructure development in South Africa during the period 1875 to 1930. Although the rolling stock increased since then, there was little change in the length of railway lines since the 1930s (Fedderke *et al*., 2006:1042). The second wave of infrastructure investment was in inter-city roads, which reached a level of stability around 1940 (Fedderke *et al*., 2006:1042). Since then, national and provincial roads became the focus (Fedderke *et al*., 2006:1042). The growth in road traffic during the 1920s exceeded the growth in rail transport (Jones & Müller, 1992:187). This situation continued especially after the paving of roads after 1940 (Fedderke *et al*., 2006:1042). Ports are the oldest form of

infrastructure in South Africa; however, important expansion in the capacity of ports was limited to the 1970s. Only then did the construction of two new ports double the volume of cargo handling (Fedderke *et al*., 2006:1042). Telephones and electricity were part of the final wave of infrastructure development (Fedderke *et al*., 2006:1042). Although fixed phone lines' average growth rate decreased during the 1960s, it increased again later due to newly introduced information and cell phone technology (Fedderke *et al*., 2006:1042).

Figure 12: Phases of infrastructure development in South Africa



Source: Fedderke *et al*. (2006:1042)

It can be concluded that infrastructure development in South Africa has taken place in phases of development. These phases of infrastructure development are in response to structural economic changes, while also having an impact on the performance of the economy (Fedderke *et al*., 2006:1042). It appears as though the requirement for investment in economic infrastructure is constantly present. While existing infrastructure needs to be maintained, maturity is reached by other infrastructure programmes and the demand for new infrastructure to be implemented in reaction to the changing economic technological needs, appears (Fedderke *et al*., 2006:1042).

2.7.2 Causality between infrastructure investment and economic growth in South Africa

Fedderke *et al*. (2006:1042) did an analysis on the long-run relationship between infrastructure and real GDP. Table 7 shows the results with variables statistically significant at a five per cent level. The asterisk marked values signify a forcing relationship, with the relationship's direction being indicated in the column heading.

A dominating relationship that runs from fixed capital stock to GDP was found (Fedderke *et al*., 2006:1042). This indicates that infrastructure leads to growth. Evidence was also found to suggest potential simultaneity among infrastructure and output (Fedderke *et al*., 2006:1042). While public sector infrastructure, railway goods stock, locomotives, paved and unpaved roads, electricity generation and goods vehicles seem to create output, output was found to equally generate railway lines and rolling stock, goods vehicles, port cargo, the number of telephone lines and electricity generation (Fedderke *et al*., 2006:1042).

Table 7: The relationship between real GDP and infrastructure investment

Type of infrastructure or infrastructure service	Relationship between GDP and infrastructure variables, both based on actual values unless otherwise indicated	
	GDP on LHS; * indicates GDP affected by particular infrastructure variable	Infrastructure variable on LHS; * indicates infrastructure variable affected by GDP
Infrastructure investment	0.93	1.76
Infrastructure fixed capital stock	1.83	1.67
Infrastructure investment (with per capita GDP)	4.71	4.66
Infrastructure fixed capital stock (with per capita GDP)	7.31*	3.31
Infrastructure investment (both in per capita)	6.39*	0.88
Infrastructure fixed capital stock (with in per capita)	7.69*	2.78
Railway lines	0.52	5.79*
Locomotives	8.96*	12.00*
Goods stock	6.61*	6.17*
Unpaved and paved roads	6.38*	3.78
Goods vehicles	8.96*	7.23*
Ports	3.87	19.73*
Fixed phone lines	3.06	15.72*
Electricity generated	11.87*	14.33*
Significance at a 5% level		

Source: Fedderke *et al*. (2006:1044)

The statistical relationships between variables were also found to be economically meaningful. Output elasticity with respect to physical capital stock investment ranges from -0.06 to 0.20, and with regard to electricity generation, it is 0.20 (Fedderke *et al*., 2006:1045). In their analysis, Fedderke *et al*. (2006:1047) found that investment in physical capital stock is responsive to output as well as infrastructural investment. The total investment in physical capital stock's elasticity with respect to public sector infrastructure investment is strong, with elasticity at the mean value of 1.37 (Fedderke *et*

al., 2006:1047). The elasticity of investment in physical capital with respect to output equals 2.44 at the mean value of investment (Fedderke *et al*., 2006:1047).

Therefore, it appears as though infrastructure has a direct and indirect effect on output in South Africa (Fedderke *et al*., 2006:1052). It is shown that electricity generation has a consistent and positive impact on output, with an elasticity of approximately 0.10 to 0.20 (Fedderke *et al*., 2006:1052). The elasticity of public sector infrastructure investment with regard to private sector investment in physical capital is 1.70 (Fedderke *et al*., 2006:1052). Fedderke *et al*. (2006:1052) recommend that the level of investment in South Africa should be raised from 16 per cent of GDP to 25 per cent of GDP, and highlight that the public sector plays an important role in this regard.

It appears that economic growth presents the need for as well as the source of capital to fund diverse infrastructure types. It is important to look at the different infrastructure types, specifically transport, electricity and water, individually. These infrastructure types play a central role in the production process of most firms and therefore it is vital to know the quality, availability and efficiency thereof. Section 2.7.3 will give a brief overview and discuss various aspects with respect to each infrastructure type.

2.7.3 Specific infrastructure types in South Africa

2.7.3.1 Transport

Naudé (1999:8) points out six reasons why transport services in South Africa are important. Firstly, approximately 5.3 per cent of South Africa's economic output was contributed directly by the transport sector. Secondly, exports of transport services are annually more than R6 billion. Thirdly, transport as a transitional input into many economic sectors such as mining, manufacturing and agriculture, is important. Fourthly, part of the government assets that require privatisation is in the transport sector, such as road, rail and ports. Fifthly, upgrading of regional transport infrastructure is essential to unlock the economic potential of the SADC countries and finally, the policies that improve the transport services' competitiveness are very important, since South Africa is geographically distant from its major markets (Naudé, 1999:8).

From Table 8, it is clear that the transport infrastructure's rate of return is the best for middle-income countries, such as South Africa (Naudé, 1999:9).

Table 8: Rate of return to transport infrastructure

	Transport
Low-income countries	0.39
Middle-income countries	0.71
High-income countries	0.42

Source: Naudé (1999:9)

South Africa has much to gain from improving transport infrastructure. It is essential for South Africa's international competitiveness to assure access to efficient transport services, since the globally-traded products are becoming more time sensitive, due to shorter life cycles and just-in-time production management techniques (Naudé, 1999:9). Therefore, by improving the infrastructure of transport and service productivity and lowering the costs of transport, South Africa can improve its international competitiveness significantly (Naudé, 1999:9).

Despite the fact that international competitiveness is vital, transport infrastructure is also important to South Africa due to its large contribution to GDP and employment. South Africa's service sector is the largest contributor to national output, with 65 per cent in 1997 (Naudé, 1999:21). The contribution of the transport sector to South Africa's GDP and total formal employment, valued 5.3 per cent and 3.7 per cent, respectively (Naudé, 1999:21). Table 9 indicates the various contributions of the service sector to GDP during 1997 and formal employment during 1995, in South Africa.

Table 9: Service sector contributions to South Africa's GDP and formal employment

Service sub-sector	% of GDP (1997)	% of Formal employment (1995)
Utilities	3.8	1.1
Construction	2.8	4.9
Internal trade services (Distribution)	14.5	15.6
Catering & accommodation	0.9	1.9
Transport	**5.3**	**3.7**
Communication	2.1	1.8
Financial services	6.1	3.4
Business services	11.1	3.9
Community services	18.6	27.1
Total service sector	**65.1**	**63.3**

Source: Naudé, (1999:21)

When the informal sector employment is also taken into consideration, the contribution of the transport sector to employment is significantly more, rising from 3.7 per cent to 7.5 per cent (Naudé, 1999:21).

With the importance of transport infrastructure to international competitiveness, GDP and employment being highlighted, it is also important to state the importance thereof to trade in South Africa. Transport services accounted for 5.6 per cent of total export and 7.9 per cent of imports in South Africa during 1996, as illustrated in Table 10 (Naudé, 1999:23).

Table 10: Service sector shares in South Africa's imports and exports

Service sub-sector	Imports share %	Import growth % (1988-1996)	Export share %	Export growth % (1988-1996)
Utilities	0.0	N/A	0.1	6.7
Construction	0.1	4.3	0.0	2.2
Transport services	**7.9**	**6.5**	**5.6**	**1.8**
Communication services	0.8	7.0	0.6	14.9
Financial services	1.0	1.5	1.9	10.1
Community services	0.1	-6.3	0.3	9.4
Total service sector	**17.8**	**2.7**	**16.8**	**5.7**

Source: Naudé (1999:23)

Table 10 confirms that transport services' export share was the second largest during 1996, after distribution and tourism, but that the annual growth rate in this regard has been the lowest of all the sectors, namely 1.8 per cent (Naudé, 1999:23). This indicates that this sector has experienced considerable export growth constraints (Naudé, 1999:23).

With this knowledge of the importance of transport infrastructure to South Africa, it is necessary to determine how South Africa's transport sector is performing relative to a certain benchmark in order to see whether South Africa's transport sector is performing efficiently enough compared to relevant countries. Bogetić and Fedderke (2006:3) analysed the transport sector of South Africa by comparing it to comparator groups such as Sub-Saharan Africa, the Middle East and North Africa, South Asia, East Asia Pacific, Latin America and Caribbean, Europe and Central Asia and the world, as well as four country groups clustered by income per capita levels (Naudé, 1999:3). The greatest focus in this analysis is South Africa's per capita income group of upper middle-income countries, since this is the most meaningful comparator group due to the strong

relationship between infrastructure and income levels (Naudé, 1999:3). Table 11 reports the findings.

South Africa's road density in terms of population is twice the average of low-income countries, but only a third of high income OECD countries (Naudé, 1999:12). The road density in terms of land is exceptionally low when compared to the other country groups, especially upper middle-income groups, exceeding only that of low-income countries (Naudé, 1999:12). The rail lines' density in terms of population is extremely high in comparison with low income groups, somewhat higher than the middle-income group and immediately below the benchmark upper middle-income groups (Naudé, 1999:12).

Table 11: Benchmarking of South Africa's performance in the Transport sector

Transport	South Africa	Upper Middle Income	Low income	Middle income	High income OECD	World
Road density in terms of population (road-km/1000 people)	6.1	8.2	3.0	7.0	17.3	6.7
Road density in terms of land (road-km/1000 sq km)	227	1076	181	702	1340	841
Rail lines' density in terms of population (rail-km/1000 people)	0.44	0.51	0.13	0.40	0.53	0.33
Rail lines' density in terms of land (rail-km/1000 sq km)	16.5	31.3	9.3	23.3	46.2	23.1
Travel time to work in main cities (minutes/one way work trips)	35	29	33	29	32	31
Commercial perception of services delivered by roads department public works (1=worst 7=best)	5.3	4.1	3.4	4.1	4.3	4.0
Commercial perception of port facilities (1=worst 7=best)	4.7	3.8	2.6	3.6	5.4	4.2
Commercial perception of railroad services (1=worst 7=best)	4.3	2.9	2.7	2.7	4.8	3.4
Commercial perception of air transport services (1=worst 7=best)	5.6	4.5	3.6	4.4	5.7	4.8
Paved roads (% of total roads)	21	57	30	52	82	50

Source: Naudé (1999:23)

South Africa's travel time to work within main cities is one of the longest (35 minutes) relative to the upper middle-income group (29 minutes) and the high-income OECD countries (32 minutes) (Naudé, 1999:12). South Africa's time also exceeds that of the

world, which is on average 31 minutes. When paved roads are considered, South Africa is far behind with one of the least paved roads percentages, at 21 per cent, being even lower than the low-income countries.

Table 11 also indicates commercial perceptions of various transport infrastructures. With regard to service delivery by the roads department and the air transport service, South Africa has one of the highest rankings in the world at 5.3 and 5.6 out of 7, respectively. Considering the port and railroad facilities, the perception of South Africa, although it is lower compared to road services, exceeds that of the upper middle-income countries.

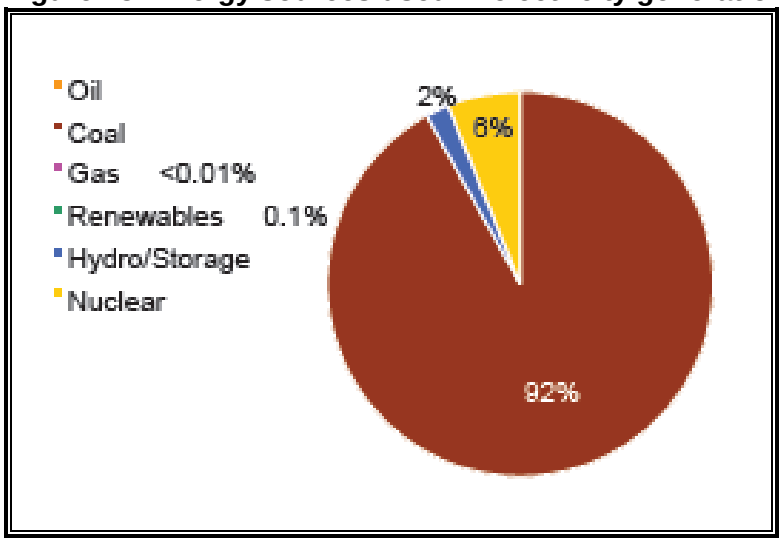
It can thus be concluded that compared to its benchmark of upper middle-income countries, there are certain areas in which South Africa's transport sector under-performs. This includes transport infrastructure of road and rail line density in terms of land, travel time to work in main cities and the percentage of paved roads. When it comes to the commercial perceptions on services of the Roads department and air transport, South Africa exceeds the benchmark considerably. The perceptions of railroad services and port facilities are also above the benchmark, although not as much as roads and air transport.

2.7.3.2 Electricity

Electricity has a critical impact on sustainable economic growth, the alleviation of poverty and international competitiveness (Kessides, Bogetić & Maurer, 2007:5). Odhiambo's (2009:639) empirical analysis of the relationship between electricity consumption and economic growth indicates that bidirectional causality occurs between the two variables. These results apply in both the short and long run. The electricity sector in South Africa contributes significantly to industrialisation and economic development (Kessides *et al*., 2007:5). The high level of energy supply, due to abundant coal reserves, creates a distinct comparative advantage for South Africa, which contributes to economic growth opportunities (Kessides *et al*., 2007:5). South Africa holds approximately five per cent of the world's total coal reserves (Kessides *et al*., 2007:11). This, and the fact that South Africa has no natural gas fields, contributes to the fact that the energy sources used to generate electricity in South Africa differ significantly from the rest of the world. It is indicated by Figure 13 that the bulk of

electricity generation in South Africa is from coal, which accounted for 92 per cent of gross energy generation during 2003 (Kessides *et al*., 2007:11).

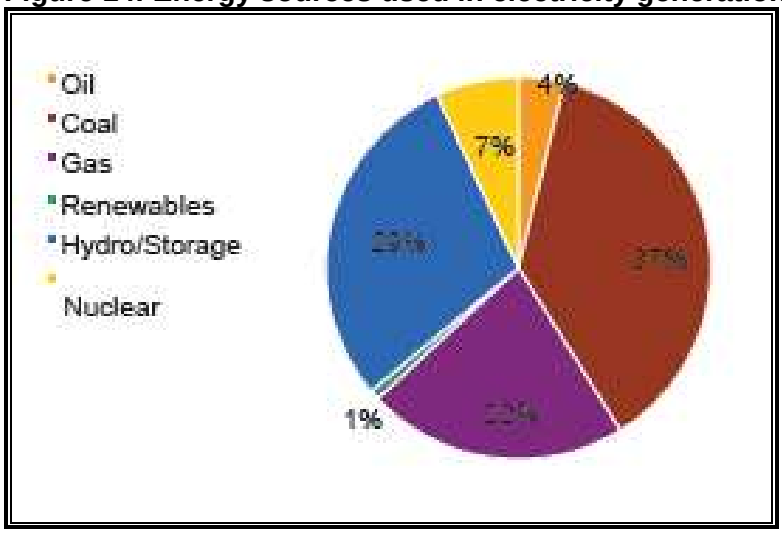
Figure 13: Energy sources used in electricity generation in South Africa



Source: Kessides *et al*. (2007:11)

Figure 14 shows the different energy sources that are used to generate electricity in the world. It is clear that coal, gas and hydro are the three main energy sources used across the world.

Figure 14: Energy sources used in electricity generation in the world

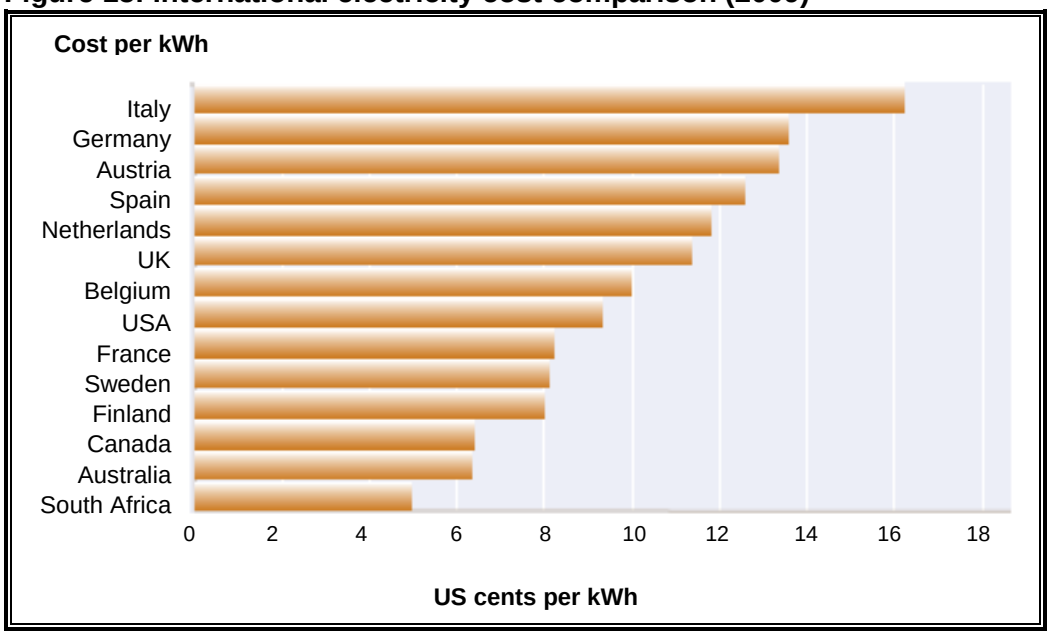


Source: Kessides *et al*. (2007:11)

Due to the large amount of coal reserves, South Africa has been able to produce low-priced electricity (Kessides *et al*., 2007:5). Figure 15 shows the international electricity cost comparison of prices as shown on 1 June 2009 for the supply of 1000KW for a site with a monthly usage of 450 000 kWh (Eskom, 2009:xii). Form Figure 15 it can be seen that, in relation to the relevant countries, South Africa's electricity cost generation is the

lowest, which results in another key comparative advantage for South Africa in the energy sector.

Figure 15: International electricity cost comparison (2009)

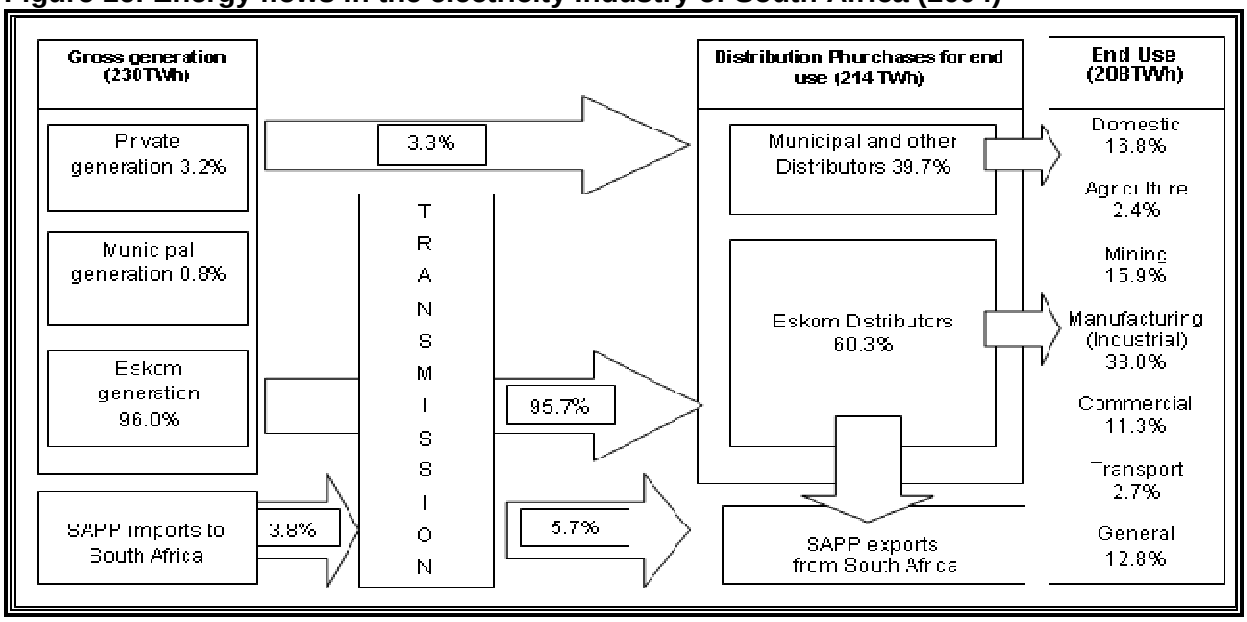


Source: Eskom (2009:xii)

ESKOM is the main operating entity in South Africa's energy sector (Kessides *et al*., 2007:5). It also accounts for more than 50 per cent of electricity generation in Africa (Kessides *et al*., 2007:10). Because ESKOM manages to generate some of the world's lowest priced electricity, meet and occasionally exceed the government's electricity targets together with their robust financial and operational performance, it appears as through ESKOM is an efficient and well-functioning utility (Kessides *et al*., 2007:5).

The extent of ESKOM's horizontal and vertical dominance in the market is illustrated by Figure 16. Close to being a monopoly, ESKOM accounted for approximately 96 per cent of both South Africa's total installed generating capacity and generated electricity during 2004 (Kessides *et al*., 2007:10). ESKOM distributes 60.3 per cent of electricity to end users, of which the manufacturing sector (38.0%) is the biggest consumer, followed by domestic consumers (16.8%) and mining (15.9%) (Kessides *et al*., 2007:10).

Figure 16: Energy flows in the electricity industry of South Africa (2004)



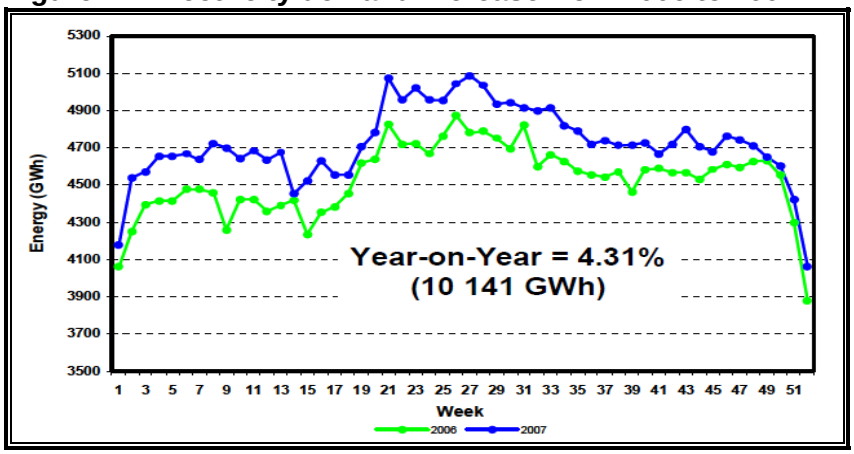
Source: Kessides *et al*. (2007:10)

Even through ESKOM appears to be an efficient and well-functioning utility, several problems have recently emerged that could potentially undermine its future performance significantly (Kessides *et al*., 2007:6). Firstly, the distribution of electricity, which is mainly controlled by municipalities, is inefficient and municipalities have been suffering from financial difficulties for many years (Kessides *et al*., 2007:6). Secondly, Parliament introduced the new Electricity Regulation Bill during August 2005, which may undermine the independence and consistency of the sector's regulatory structure and finally, the market dominance of ESKOM is inconsistent with international policy developments within the electricity sector and is a primary barrier to the sector's future competitive developments (Kessides *et al*., 2007:8).

Finally, although South Africa's electricity reserve margins were considered as one of the highest in the world, a tight demand/supply balance occurs today, which threatens the adequacy and reliability of supply by ESKOM (Kessides *et al*., 2007:7). The electricity reserve margin has decreased from 25 per cent in 2002 to 20 per cent in 2004, and decreased even further to 16 per cent in 2006. The projected reserve margin for 2008 was between eight per cent and 10 per cent, a level that is much lower than the country's target (Odhiambo, 2009:636). The decline in the reserve margin is largely due to the rise in electricity consumption. Figure 17 indicates the significant levels of growth in the level of electricity demand. From 2006 to 2007, the demand for electricity

consumption increased by 4.31 per cent, placing pressure on South Africa's reserve margins and electricity supply.

Figure 17: Electricity demand increase from 2006 to 2007



Source: SARB, 2008

ESKOM has been forced to respond to the continued electricity demand in South Africa and the decline in the reserve margin. This crucial situation led ESKOM to a number of interventions during 2008, including national awareness campaigns and load-shedding, which was the last attempt to prevent a system-wide blackout (Odhiambo, 2009:636). At present, both medium- and long-term programmes are being developed by the government in an attempt to enable South Africa to manage the future electricity demand (Odhiambo, 2009:636).

2.7.3.3 Water

Water scarcity in South Africa has increased significantly, creating a situation in which the need for water management is imperative (Nieuwoudt, Backeberg & du Plessis, 2004:162). The South African Government is mandated by The National Water Act (No 36 of 1998) as the trustee of water resources in South Africa, and the objective to ensure that water is protected, developed, conserved, managed and controlled in an equitable and sustainable manner to the benefit of all people (Nieuwoudt *et al*., 2004:163). The National Water Act also entails that the Department of Water Affairs and Forestry (DWAF) should act as custodian of the water resources in the country (DWAF, 2002:2). The South African Water Research Commission (WRC) and the Department of Water Affairs have worked together over the past few years by initiating economic research projects aimed at determining the value of water in the different sectors in the South African Economy (Nieuwoudt *et al*., 2004:163).

There are various reasons why it is important to frequently evaluate the performance of the water sector. The main reason is the demand for water as an input in the production process. Alternative reasons include the energy shortage, growing importance of biofuels, surging food prices (Hassan *et al*., 2008:3), urbanisation, poverty, and declining water quality (DWAF, 2008:4). It is important to evaluate the efficient distribution of water to the various sectors as well as any factors that might influence the availability of water supply in the future. At present, the changing climate together with changing land use and degradation are the main drivers for the changing water resource situation in South Africa (DWAF, 2008:6).

It is likely that South Africa's climate will be warmer in the future, changing both rainfall and evapo-transpiration (DWAF, 2008:6). According to the DWAF (2008:6), a temperature increase of approximately 1^0 to 3^0C is expected for the summer and winter seasons, in 2050. This increase in the temperature will enhance the evaporation from dams and reduce soil moisture, which will cause the demand for water, specifically for irrigation, to rise (DWAF, 2008:7). Therefore, the availability of water will significantly be influenced by the changing temperature and rainfall and the majority of economic sectors will be influenced (DWAF, 2008:7).

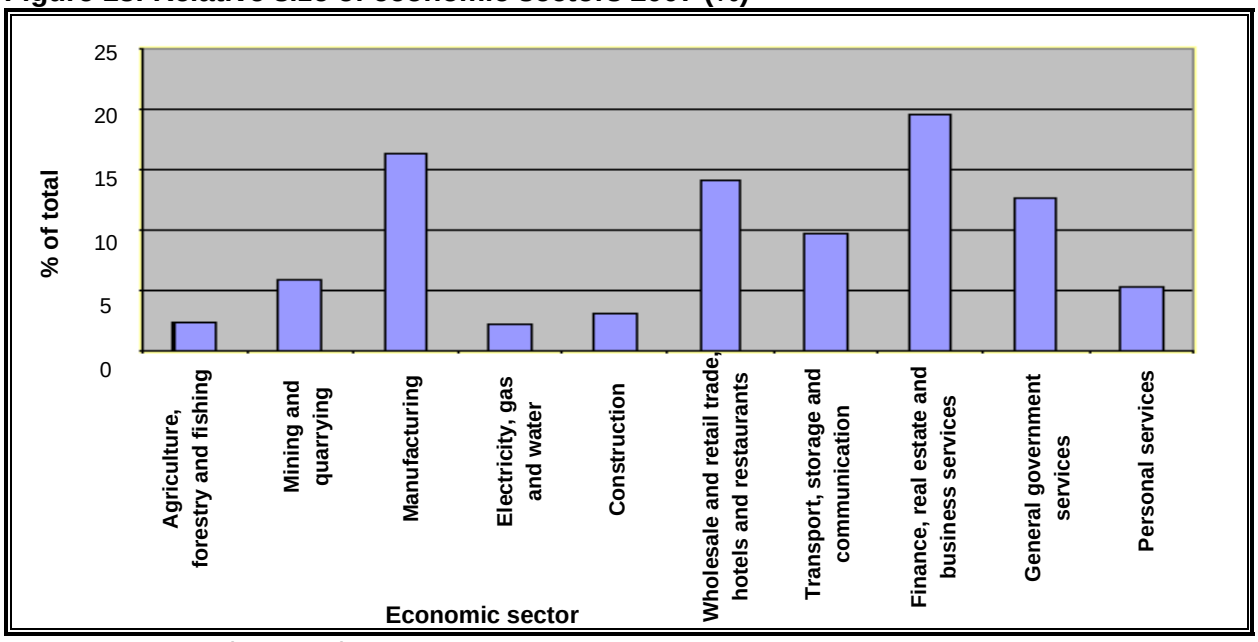
The main drivers of change in South Africa's future land-use patterns causing uncertainty include economic, political and social processes that force growth and reduction of irrigated agriculture together with steam-flow reduction activities, increased technology that raises production efficiency and the use of water (DWAF, 2008:8). There are four ways in which land use and degradation influence South Africa's water resources. Firstly, floods and reduced groundwater develop due to changes in the run-off and infiltration (DWAF, 2008:8). Secondly, a loss of top-soil at reservoirs, rivers and estuaries occurs due to the rise of sediment (DWAF, 2008:8). Thirdly, increased pollution and finally the change in the ecosystem that reduced the systems' resilience and assimilative capacity (DWAF, 2008:8). Although these factors are not directly part of the water managers' mandate, these changes have a profound impact on water resources and the use thereof; therefore they are just as important.

Despite the changing climate and changing land-use and degradation, South Africa also has very low rainfall compared to international averages – only 60 per cent of the world's average (DWAF, 2008:13). On average, 31 per cent of the world's rainfall

reaches the rivers, while in South Africa it is only nine per cent (DWAF, 2008:13). Seasonal rainfall with high inconsistency from year to year is anticipated in South Africa and the possibility of drought is always present (DWAF, 2008:13). Due to this uncertainty, South Africa has developed infrastructure to optimise the available water resources by means of storage systems and inter-basin transfer schemes (DWAF, 2008:13). With most of the focus on surface water together with poor management and little knowledge, South Africa's groundwater reserves have been underexploited (DWAF, 2008:8, 13). At present, due to climate change, groundwater has become important, since it is less exposed to evaporation (DWAF, 2008:13). Groundwater contributes approximately 15 per cent of South Africa's total water utilisation, with a big proportion still being untapped (DWAF, 2008:13). It is thus important that the possibilities of groundwater be investigated in South Africa, in view of the expected water shortage.

When the efficient allocation of water supply to the different sectors in South Africa is evaluated, a concern is raised on the inefficient use of water by the agricultural sector. The agricultural sector consumes 60 per cent of South Africa's water supply, but its contribution to GDP and employment is small and continues to decline (Hassan *et al*., 2008:2). While Figure 18 visually illustrates the relative size of each sector to the economy during 2007, Table 12 indicates the value added and employment indicators of water use by various sectors during 2000 (Hassan *et al*., 2008:2).

Figure 18: Relative size of economic sectors 2007 (%)



Source: DWAF, (2008:22)

In Figure 18, it can be seen that agriculture is one of the sectors in the economy that contributes the least to GDP and, relative to the included sectors, agriculture is the second lowest contributor to GDP in South Africa.

Table 12: Value added and employment indicators of water use (2000)

	Water use	Value added (GDP) indicators				Employment indicators	
	Total in m^3	R million	% of GDP	% of total water	GDP/m^3	Employment (millions)	Employment / 000m^3
Agriculture	8,665	27,451	3.30%	79.40%	3	1.10	0.13
Electricity	297	19,431	2.30%	2.70%	65	0.08	0.26
Mining	388	63,391	7.60%	3.60%	163	0.48	1.23
Manufacturing	700	162,465	19.40%	6.40%	232	1.50	2.14
Trade & services	865	565,480	67.50%	7.90%	654	7.07	8.17
Total	**12,873**	**838,218**	**100.0%**	**100.0%**	**77**	**10.22**	**0.94**

Source: Hassan *et al*. (2008:54)

Table 12 indicates that relative to the above-mentioned sectors, the agricultural sector contributed only 3.30 per cent to GDP. In comparison to these sectors, agriculture played an insignificant role in GDP during 2000. Compared to the electricity, mining and manufacturing sectors, the agricultural sector's employment indicators are standard. The interesting factor in Table 12 is that although the agricultural sector was responsible for only 3.30 per cent of GDP during 2000, it used 79.40 per cent of the total water supply, which classifies this sector as the greatest consumer of water resources in South Africa. Therefore, the time has come for the government to evaluate the performance of the water sector and determine its efficiency to contribute to factors generating economic growth in South Africa.

2.8 Summary and conclusions

This chapter examined the links between infrastructure investment and economic activity. It started with the growth theories and the development of growth models. Infrastructure as a determinant of growth was initially studied by Ashauer (1990:18), using an endogenous growth model. This led to the discussion on the various channels through which infrastructure generates economic growth. The importance of not only infrastructure quantity but also quality and the maintenance thereof has been emphasised. Infrastructure is a public good that requires a role for government and the discussion on market failure underlined the importance of government intervention in

the provision of infrastructure service delivery. Apart from the above topics, infrastructure also has spatial characteristics that determine its links to economic activity through localisation and urbanisation economies. Finally, the aggregate importance of a higher level of public infrastructure investment, specifically transport, electricity and water supply in South Africa, was highlighted.

The following two chapters will contain an empirical analysis of the private firms in South Africa, located in the four major metropolitan areas.

CHAPTER 3: DATA DESCRIPTION

3.1 Introduction

Economic growth in South Africa has accelerated since the advent of democracy in 1994. However, despite certain accomplishments by the new government, South Africa is still struggling with a number of difficulties. High unemployment, poverty, inequality and crime remain some of South Africa's greatest predicaments today (Landman *et al*., 2003:1). Therefore, the South African Government initiated a Medium Term Strategic Framework 2009 to 2014, to build on the success of fifteen years of democracy and to overcome the difficulties of high unemployment, poverty and inequality. The Government is not directly responsible to create jobs; however, they are responsible to take active steps that will create favourable economic and social conditions in general, through which employment opportunities can be created. Part of the steps that the government can take (and has been taking) is the provision of public goods and services, specifically the provision of infrastructure that has been seen as key to creating an environment conducive for growth and development. The aim of this dissertation is to determine private firms' experience of public service delivery, and to know whether these experiences differ between the major cities in South Africa and how it relates to the characteristics of the firms.

Chapter 2 explained the link between infrastructure and economic growth internationally and in South Africa. The key contribution by Aschauer (1990:13) illustrated that private sector output is a function of private capital as well as public infrastructure capital. The implications were that increased public capital stock is expected to raise the output of the private sector directly. Also, public capital and the production factors of the private sector may be complementary inputs into the production process. According to Aschauer (1990:13), this causes labour demand and private capital investment to grow.

Chapter 2 also studied various factors related to public infrastructure, including infrastructure maintenance, the role of the government in providing service delivery as well as the ability of public infrastructure investment to create agglomeration economies. Public service delivery, specifically transport, electricity and water supply to South Africa's private firms were also discussed in Chapter 2 and it was found that there are

certain areas within transport, electricity and water supply in which South Africa lag behind.

Chapter 3 is the start of the empirical analysis. The aim is to describe the firms that were included in the 2007 World Bank Enterprise survey data on which the analysis is based. General information regarding firm location, size and industry will be discussed as well as information regarding the main markets of the firms, sales and supplies and certain operation information, including capacity utilisation, operating hours and obstacles to doing business. More detail about the information concerning infrastructure, specifically electricity, water supply, transport and internet connections will follow.

3.2 Data on the firms

The empirical analysis that follows in Chapter 4 is based on the 2007 World Bank Enterprise Survey data. In South Africa, firm-level data presents particular challenges to researchers. Rankin (2006) explains that a number of firm-level studies have been carried out in South Africa, but they have been *ad hoc*. Currently, only the World Bank Enterprise Survey data presents a small panel. Furthermore, the surveys have not always been designed for quantitative analysis and none of them have explicitly focused on aspects of the location of the firms surveyed. Given these constraints, this paper employs data from the 2007 World Bank Enterprise Survey. The data includes place identifiers for firms in South Africa's four major urban agglomerations: Cape Town, Port Elizabeth, Durban and the greater Gauteng economy[4], which groups together Johannesburg, the East Rand and Pretoria. The data consists of information collected from 1057 small (5-19 employees), medium (20-99 employees) and large (100 employees and more) firms. Table 13 shows the number of firms by size and location and indicates that 68 per cent of the firms are located in Johannesburg and 13.7 per cent in Cape Town, while 6.2 per cent and 12 per cent are located in Port Elizabeth and Durban respectively. In Johannesburg, Cape Town and Port Elizabeth, the majority of firms reached by the survey are small firms, while medium-sized firms are the majority in Durban. Therefore, the majority of this survey consists of small firms, with large firms

[4] Also referred to as Johannesburg throughout this dissertation.

being the fewest. Of these enterprises, 29.7 per cent indicated that they are part of a larger firm.

Table 13: Cities and firm size

	% of firms	Size		
		Small (5-19 employees)	Medium (20-99 employees)	Large (100 employees and more)
City				
Johannesburg	68.0	243	231	125
Cape Town	13.7	60	53	32
Port Elizabeth	6.2	30	19	17
Durban	12.0	42	63	22
Total	**100.0**	**375**	**366**	**196**

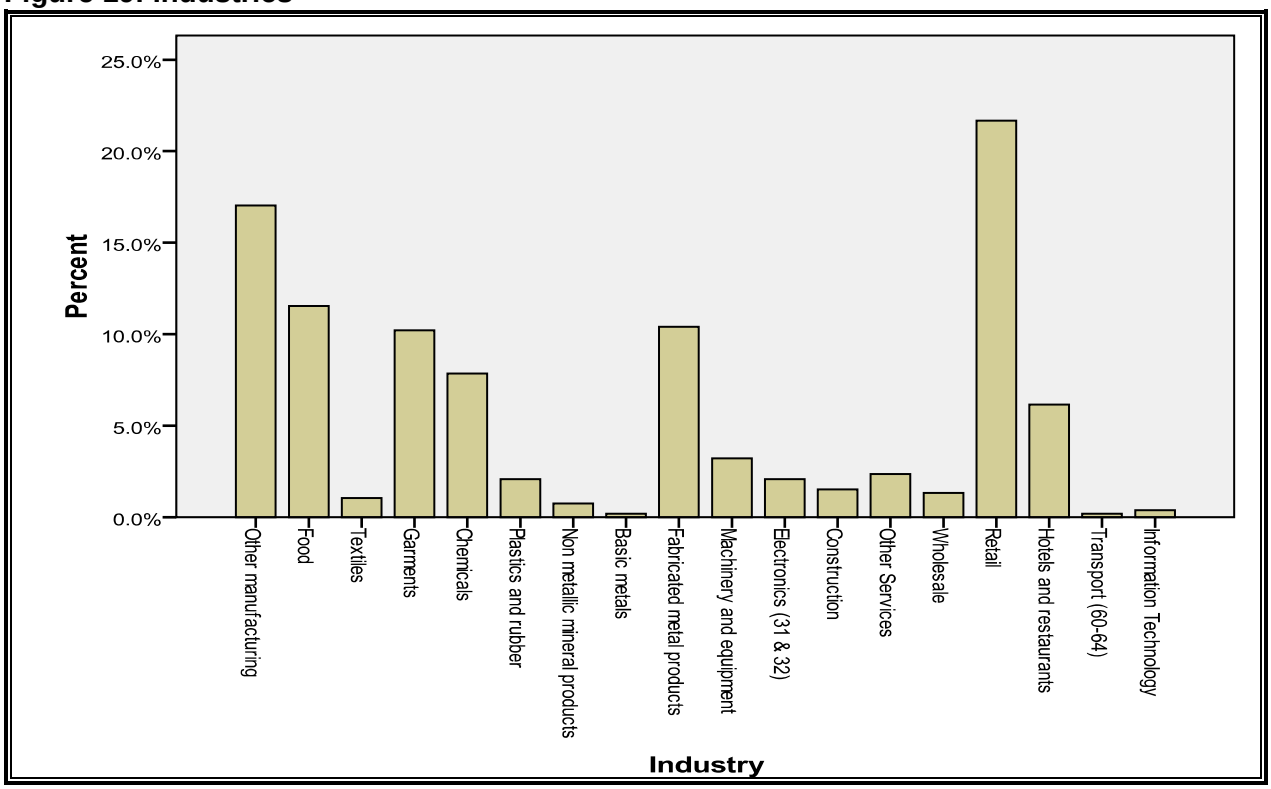
Table 14 indicate the average year in which the firms started their operation per firm size. The average small firm in the survey started operations in 1996, while the average medium and large firms started operations in 1987 and 1974 respectively. Therefore, the large firms are on average the oldest and most established firms in the survey.

Table 14: Year operations started relative to firm size

Size	Mean	N
Small (5-19 employees)	1996	375
Medium (20-99 employees)	1987	366
Large (100 employees and more)	1974	196

These firms are part of 19 different industries. The majority of firms, approximately 22 per cent, do business in the retail industry, while firms in the food, garments, fabricated metal and chemical industries vary between eight per cent and 11 per cent of the respondents surveyed. Figure 19 shows all the industries included in the survey. In addition to the 680 firms that answered the question, 49.3 per cent indicated that they are located within an export processing or other industrial zone.

Figure 19: Industries



Along with the information about the industries in which these firms do business, it is also important to know what the legal status of the majority of the firms in the survey is. From Table 15 it is clear that 54.4 per cent of the firms are registered as privately held limited companies. Firms registered as sole proprietorships make out 27 per cent of the survey, while partnerships and limited partnerships are 8.8 per cent and 7.6 per cent respectively. Only 0.7 per cent of the firms are publicly listed companies.

Table 15: Legal status of the firms

Legal status	**% of firms**
Publicly listed company	0.70
Private held, limited company	54.4
Sole proprietorship	27.0
Partnership	8.80
Limited partnership	7.60
Other	1.60
Total	100.0

Therefore, it can be concluded that the outcome of the survey was to collect information from small, medium and large private firms, located in the four metropolitan cities of South Africa, doing business in several industries.

To value and utilise the information gathered through this survey, it is firstly important to know more about the firms. Therefore, the rest of this section will present more information about the firms regarding main markets, exports and imports, capacity utilisation as well as obstacles to doing business in South Africa. Section 3.3 will focus in greater detail on the link between infrastructure and the firms.

3.2.1 Main markets, sales and supplies

The main markets are categorised into local, national and international markets. Of the 64.2 per cent of the firms in the survey that responded to the question on main markets, 70.4 per cent of the firms' main market is local, while 25.2 per cent and 4.4 per cent of the firms' main market is national and international. Therefore, the majority of the firms supply to markets located in close proximity. Figure 20 verifies this information.

Figure 20: Main markets

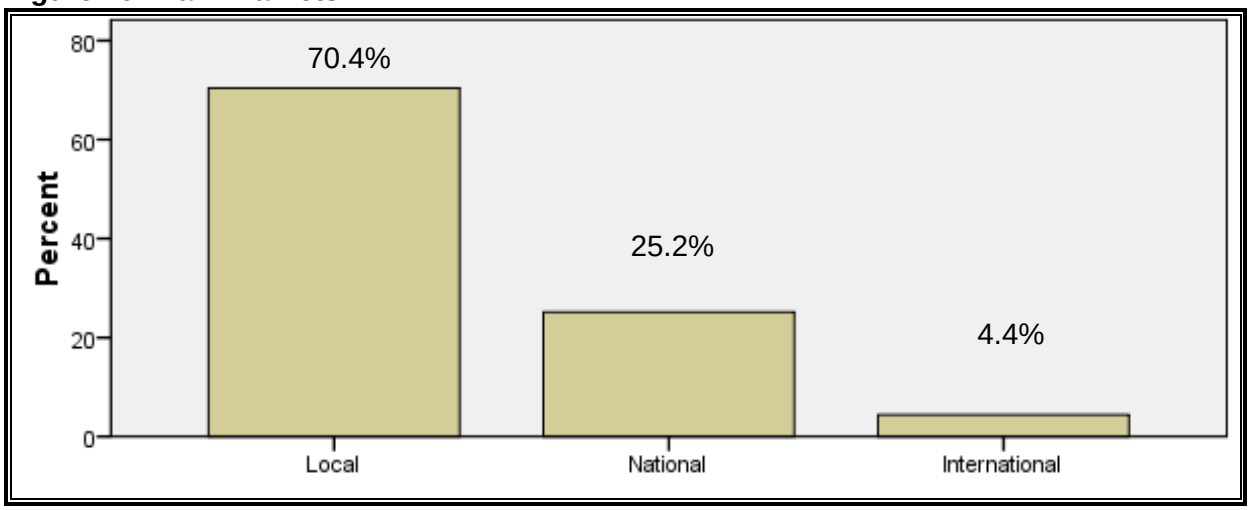


Table 16 shows that the local focus of the firms is also reflected in the difference in the percentage of national sales and exports. On average, 95.22 per cent of sales are national, while only 3.42 per cent of sales are direct exports and 1.36 per cent of sales are indirect exports. Of the total sales, 83.52 per cent was manufacturing sales, while 16.48 per cent was sales of services, during 2006.

Table 16: Information regarding sales

	Sales			Type of sales	
	National	Direct exports	Indirect exports	Manufacturing	Services
Mean %	95.22	3.42	1.36	83.52	16.48

When the main market per city is considered, Table 17 shows that in all four cities the main market for the majority of firms is local, with a small number of firms that export their products.

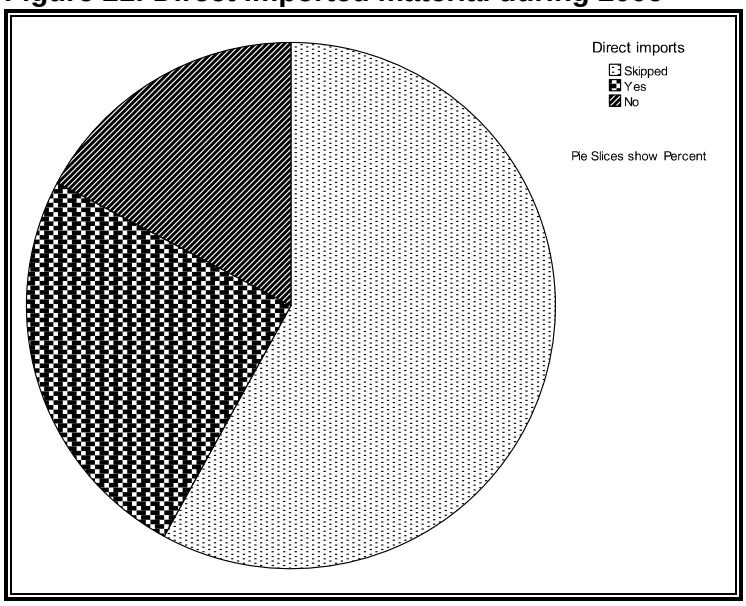
Table 17: Main market per city

		Main market				Total
		Not	Local	National	International	
City	Cape Town	0	80	28	7	115
	Durban	0	62	20	2	84
	Johannesburg	1	296	113	18	428
	Port Elizabeth	0	40	10	3	53
Total		1	478	171	30	680

When comparing the average Rand value of sales of all firms between 2003 and 2006, aggregate sales increased. During 2003, the average sales were estimated at R59 846 999.13, while the average sales for 2006 were estimated at R70 114 517.95, thus, an increase in average sales of R10 267 518.82.

Information about firms' supplies and suppliers describes the chain or network within which they produce. Unfortunately, this information from the survey is limited. It was, however, found that during 2006, the firms knew their primary supplier of their main sales item, on average, for ten years. Taking into account that 64.1 per cent of the firms responded, Figure 21 shows that 24.8 per cent responded positively to the question as to whether they used directly imported inputs.

Figure 21: Direct imported material during 2006

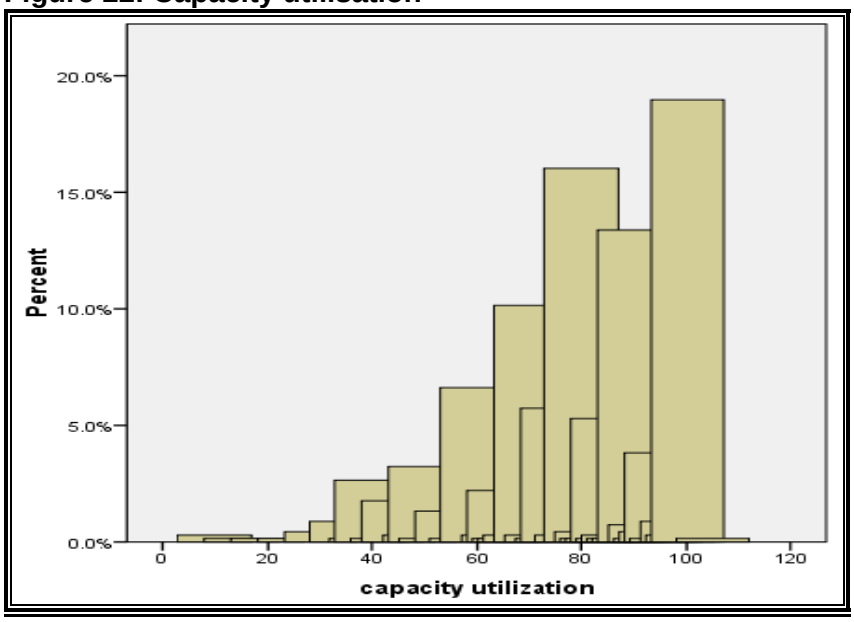


Approximately 17.3 per cent indicated that they did not use directly imported material as inputs during 2006. It was also found that more than half of the firms (54.97 per cent) make payment to their suppliers only after delivery. Approximately 48 per cent of firms receive payment for their sales after delivery.

3.2.2 Operations

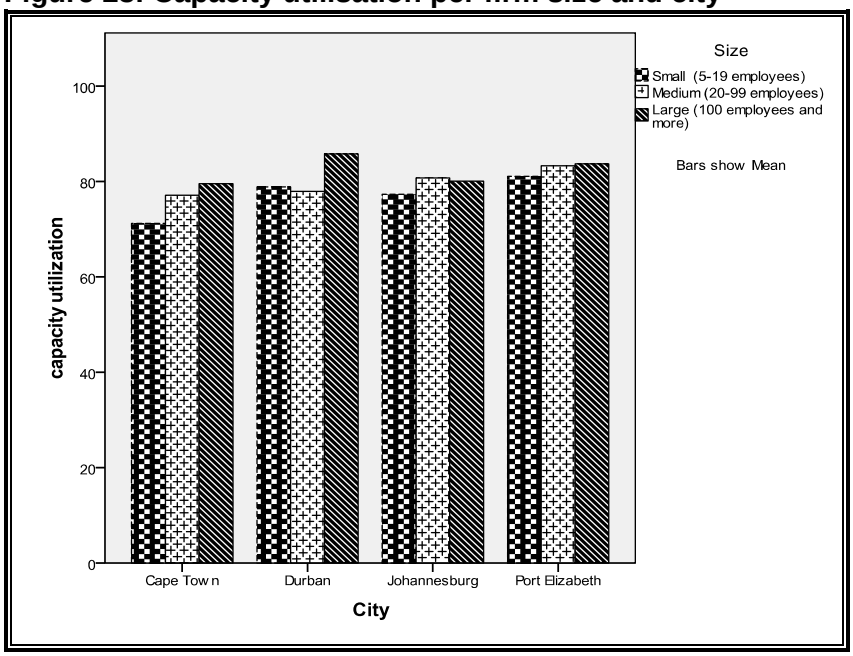
When the operation of the firms is considered, the focus is on the firm's capacity utilisation, operating hours as well as obstacles to doing business. Capacity utilisation is the amount of output that a firm produces relative to the maximum amount of output that the firm could have produced, using the available facilities. Figure 22 illustrates the capacity utilisation of the firms in this survey. Almost 20 per cent of the firms utilise their capacity at 100 per cent. According to the descriptive statistics, the average capacity utilisation among the responding firms is 79.03 per cent. This average capacity utilisation is visible in Figure 22, with 10 to 20 per cent of the firms maintaining a capacity utilisation of 60 to 100 per cent.

Figure 22: Capacity utilisation



The average capacity utilisation per firm size in each city should also be considered. Figure 23 shows that in Durban and Port Elizabeth, large firms maintain average capacity utilisation above 80 per cent, while medium firms in Johannesburg and Port Elizabeth maintain average capacity utilisation of 80 per cent and above. Small firms in Port Elizabeth also uphold capacity utilisation above the average of 79.03 per cent.

Figure 23: Capacity utilisation per firm size and city



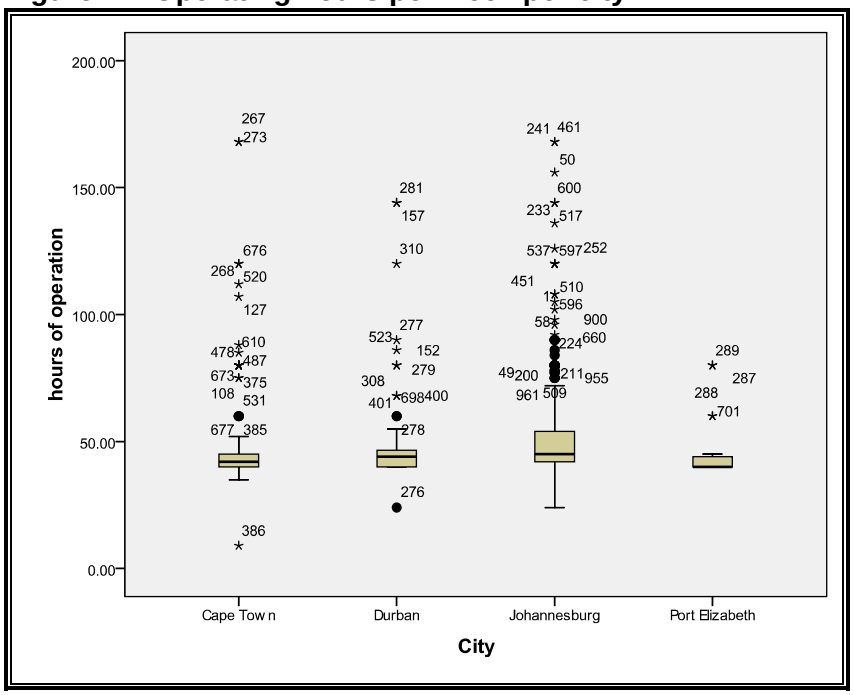
The operating hours per week is related to the capacity utilisation of a firm. Table 18 shows that the firms operate, on average, 50.72 hours per week. The minimum operating hours per week is nine hours, with 168 hours being the maximum hours of operation.

Table 18: Operation hours per week

Descriptive statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. deviation**
Hours of operation	800	9.00	168.00	50.72	18.54

The average operating hours per week of 50.72 are also relevant when one considers the location of the firms among the four cities covered in the survey. Figure 24 illustrates that Port Elizabeth, Johannesburg, Durban and Cape Town all maintain an average of approximately 50 operating hours per week. It is also evident from Figure 24 that there are a few outliers. The distribution of operation hours shows more variance in Johannesburg, but in each city there are firms that operate more hours than the average and a few of these firms seem to be extreme outliers.

Figure 24: Operating hours per week per city



A high level of capacity utilisation and acceptable operation hours is only one side of a firm's operation and does not tell whether the firm experiences difficulty with operations. Table 19 indicates the factors that the firms perceive as major or severe obstacles to doing business in South Africa.

When the focus is on the major obstacles to doing business in South Africa, the results show that firms perceive crime, theft and disorder (22.10 per cent), electricity (15.10 per cent) and corruption (11.60 per cent) as the top three obstacles. When the focus shifts to the most severe obstacles perceived by firms to doing business in South Africa, it is no surprise to find that crime, theft and disorder (13.30 per cent), electricity (7.00 per cent) and corruption (4.40 per cent) are also considered as the top three obstacles.

When infrastructure such as electricity, telecommunication and transportation of goods, supplies and inputs are considered, it is found that the majority of firms perceive these factors as minor obstacles to doing business in South Africa. However, 15.1 per cent of the firms perceive electricity as a moderate obstacle to doing business, while 5.1 per cent and 8.0 per cent of firms consider telecommunication and transportation of goods as moderate obstacles to doing business in South Africa.

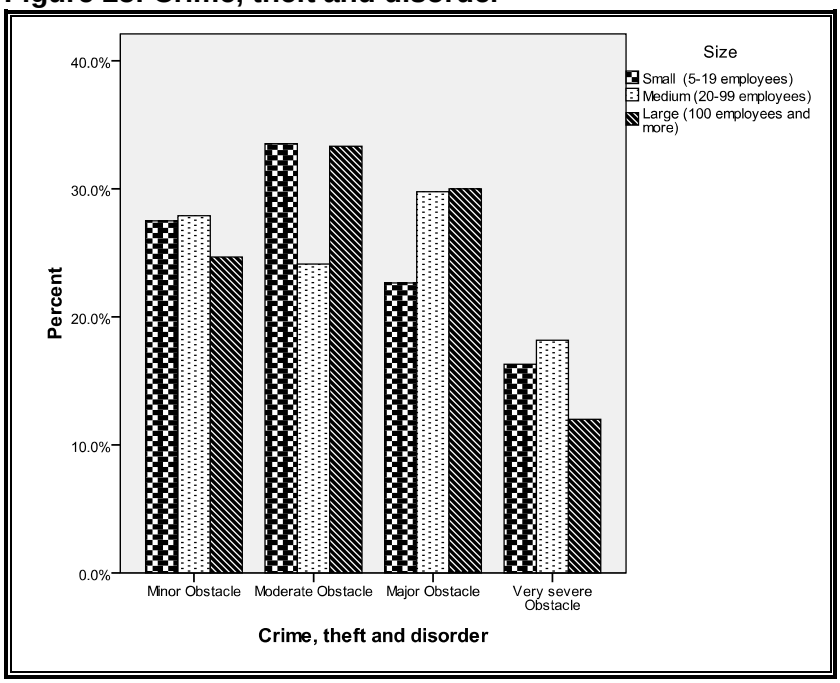
Table 19: Obstacles to doing business in South Africa

Obstacle	% of respondents	
	Major obstacle	Severe obstacle
Access to finance (Availability and costs)	**10.80**	3.90
Access to land	7.20	1.90
Business licensing and permits	3.20	0.90
Corruption	**11.60**	**4.40**
Courts	1.10	0.50
Crime, theft and disorder	**22.10**	**13.30**
Customs and Trade Regulations	1.80	0.70
Electricity	**15.10**	**7.00**
Inadequately educated workforce	6.40	1.90
Labour regulations	4.90	0.90
Political instability	1.70	1.00
Practices of competitors in the informal sector	6.90	3.60
Tax administration	2.00	0.60
Tax rates	4.10	0.50
Efficiency of Tax authority	1.10	0.60
Tax compliance costs incurred by the establishment	1.50	2.00
Transportation of goods, supplies, and inputs	4.40	1.20
Macroeconomic instability	4.80	2.20
Zoning restrictions	0.10	0.00
Regulations on hours of operation	0.20	0.00
Regulations on pricing and mark-ups	0.30	0.10
Telecommunications	2.70	1.10

It is important to determine whether the size of a firm influences its perception of obstacles faced to doing business. Figures 25 to 27 illustrate the three most severe obstacles perceived by small, medium and large firms respectively.

In Figure 25, it is clear that the majority of small and large firms perceive crime, theft and disorder as moderate obstacles, while medium firms perceive crime, theft and disorder as major obstacles to doing business.

Figure 25: Crime, theft and disorder



With regard to electricity, Figure 26 illustrates that large firms perceive electricity to be a moderate to major obstacle to doing business in South Africa, while the majority of small and medium firms consider electricity to be a minor obstacle to doing business.

Figure 26: Electricity

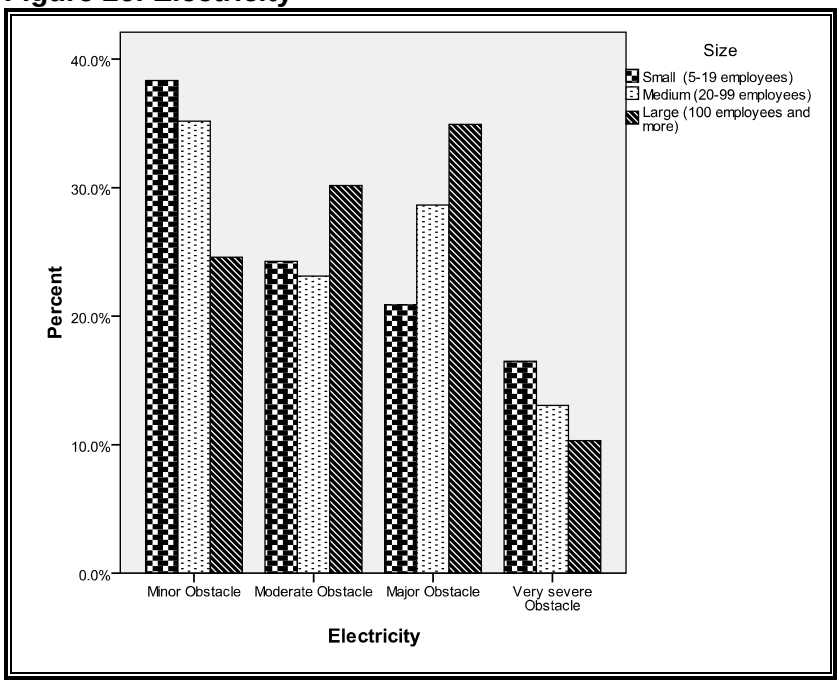
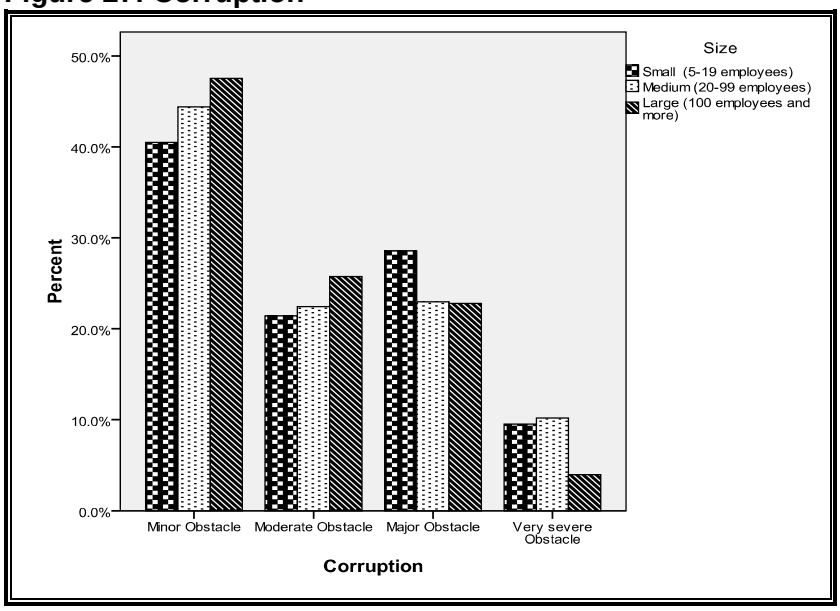


Figure 27 shows that small and medium firms perceive corruption as a severe obstacle to doing business; to a greater extent than do large firms. However, overall the majority of the firms consider corruption to be a minor obstacle to doing business in South Africa.

Figure 27: Corruption



Despite the importance of determining whether the size of a firm causes the perceptions of obstacles to doing business to differ, it is equally important to determine whether the perception of obstacles differ among the four cities. Table 20 illustrates that crime, theft and disorder are considered to be very severe obstacles to doing business by firms located in Johannesburg and Durban. Electricity appears to be a constraint to firms situated in Cape Town, whereas firms in Durban also experience great problems with corruption.

Table 20: Severe obstacles to doing business in South Africa – comparison of the four cities

Cities:	Crime, theft and disorder	Corruption	Electricity
Johannesburg	**12.3**	3.7	6.0
Cape Town	6.9	2.8	**13.8**
Port Elizabeth	10.6	3.0	1.5
Durban	**27.6**	**10.2**	7.9

In summary, this brief overview of the characteristics of the firms in the dataset showed that the majority of the firms are small and medium firms located in Johannesburg. The overall main market is local with a greater share of sales to markets in close proximity. The firms maintain an average capacity utilisation of 79.03 per cent, with an average of 50.72 operating hours per week. Firms experience certain obstacles to doing business in South Africa. Crime, theft and disorder, electricity, and corruption are the three most severe obstacles perceived by firms to doing business in South Africa.

The next step is to examine the firms' perceptions of the infrastructure available to them, specifically electricity and water supply, available internet connection as well as transport.

3.3 Data on infrastructure

The focus of this study is specifically on the interface between private firms and public goods, or infrastructure. This section examines indicators of firms' experiences of the available infrastructure from the enterprise survey dataset.

3.3.1 Electricity

With the question as to whether firms have an electricity connection, only the Johannesburg firms responded. From the 120 firms in Johannesburg, 79 responded positively to an electricity connection on their premises and 41 responded negatively. However, with the question as to whether firms own a generator, the response was greater. Table 21 shows the results.

Table 21: Firms that own or share a generator per city

			own/share generator		Total
			Yes	No	
City	Cape Town	Count	31	84	115
		% within City	27.00%	73.00%	100.00%
		% within own/share generator	20.70%	12.90%	14.40%
	Durban	Count	7	77	84
		% within City	8.30%	91.70%	100.00%
		% within own/share generator	4.70%	11.80%	10.50%
	Johannesburg	Count	108	440	548
		% within City	19.70%	80.30%	100.00%
		% within own/share generator	72.00%	67.70%	68.50%
	Port Elizabeth	Count	4	49	53
		% within City	7.50%	92.50%	100.00%
		% within own/share generator	2.70%	7.50%	6.60%

From the firms that do own or share a generator, 20.70 per cent is in Cape Town, 4.70 per cent in Durban, while 72.00 per cent and 2.70 per cent are firms in Johannesburg and Port Elizabeth respectively. When the firms in each city are considered, 27.00 per cent of the firms in Cape Town own or share a generator, while 8.30 per cent of the firms in Durban share or own a generator. In Johannesburg, 19.70 per cent of the firms share or own a generator and in Port Elizabeth 7.50 per cent of the firms share or own a generator. Table 21 indicates that although the majority of the firms that share or own a

generator are located in Johannesburg (72 per cent), the city within which the most firms own or share a generator, is Cape Town.

Table 22 indicates the percentage of electricity generated by the 18.80 per cent of firms that did own a generator during 2006.

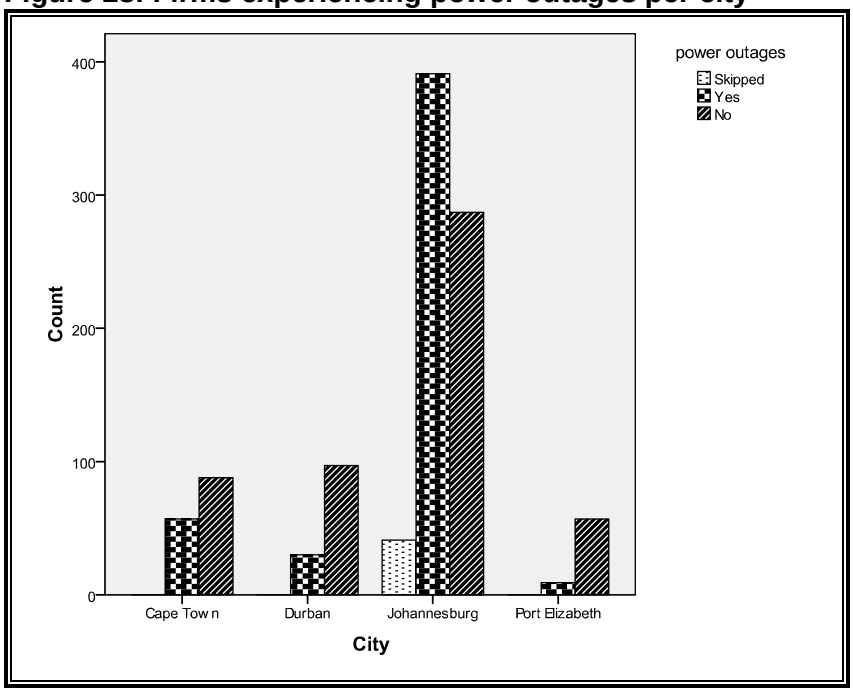
Table 22: Percentage of electricity generated during 2006 from owned generator

		Frequency	Per cent	Valid per cent	Cumulative per cent
Valid	Skipped	650	61.5	81.3	81.30
	0.00	**23**	**2.2**	**2.9**	84.10
	0.10	**13**	**1.2**	**1.6**	85.80
	0.20	4	0.4	0.5	86.30
	0.40	1	0.1	0.1	86.40
	0.50	7	0.7	0.9	87.30
	0.70	1	0.1	0.1	87.40
	1.00	**13**	**1.2**	**1.6**	89.00
	2.00	**12**	**1.1**	**1.5**	90.50
	3.00	3	0.3	0.4	90.90
	4.00	2	1.2	0.3	91.10
	5.00	**21**	**2.0**	**2.6**	93.80
	8.00	1	0.1	0.1	93.90
	10.00	**10**	**0.9**	**1.3**	95.10
	12.00	1	0.1	0.1	95.30
	15.00	5	0.5	0.6	95.90
	16.00	1	0.1	0.1	96.00
	20.00	8	0.8	1.0	97.00
	25.00	1	0.1	0.1	97.10
	30.00	3	0.3	0.4	97.50
	33.00	1	0.1	0.1	97.60
	35.00	1	0.1	0.1	97.80
	40.00	4	0.4	0.5	98.30
	50.00	3	0.3	0.4	98.60
	55.00	1	0.1	0.1	98.80
	60.00	2	0.2	0.3	99.00
	65.00	1	0.1	0.1	99.10
	75.00	1	0.1	0.1	99.30
	100.00	6	0.6	0.8	100.00
	Total	800	75.7	100	
Missing	**System**	257	24.3		
Total		1057	100		

From Table 22 it is shown that 1.6 per cent of the firms generated 0.10 per cent of their electricity from their own generator, with 1.5 per cent and 1.3 per cent generating two per cent and 10 per cent respectively. The highest number of firms, which is 2.6 per cent of the firms, generated five per cent of their electricity from a generator.

Therefore, it is clear that the generators are mainly used as a backup during power outages. Power outages are an obstacle that has influenced South African firms significantly since 2006, due to the increase in electricity demand and even more limited supply capacity. Figure 28 shows whether firms in the respective cities have experienced power outages during 2006.

Figure 28: Firms experiencing power outages per city



In Johannesburg, the majority of the firms indicated that they did experience power outages, while in Cape Town 57 firms responded positively and 88 negatively. In Durban and Port Elizabeth, the majority of firms did not experience power outages. Table 23 shows whether or not firms experienced power outages relative to the city as well as the firm size. It shows that the majority of small firms in all four of the cities did not indicate that they experienced power outages. This situation differed in Cape Town and Johannesburg with respect to the medium and large firms. At both locations, the medium and large firms that did experience power outages outnumbered the firms that did not experience any power outages. In Durban and Port Elizabeth, the majority of small, medium and large firms did not experience power outages.

Table 23: Power outages relative to cities and firm size

Size			Power outages		Total
			Yes	*No*	
Small	City	Cape Town	11	49	60
		Durban	10	32	42
		Johannesburg	115	128	243
		Port Elizabeth	1	29	30
	Total		137	238	375
Medium	City	Cape Town	29	24	53
		Durban	12	51	63
		Johannesburg	144	87	231
		Port Elizabeth	2	17	19
	Total		187	179	366
Large	City	Cape Town	17	15	32
		Durban	8	14	22
		Johannesburg	92	33	125
		Port Elizabeth	6	11	17
	Total		123	73	196

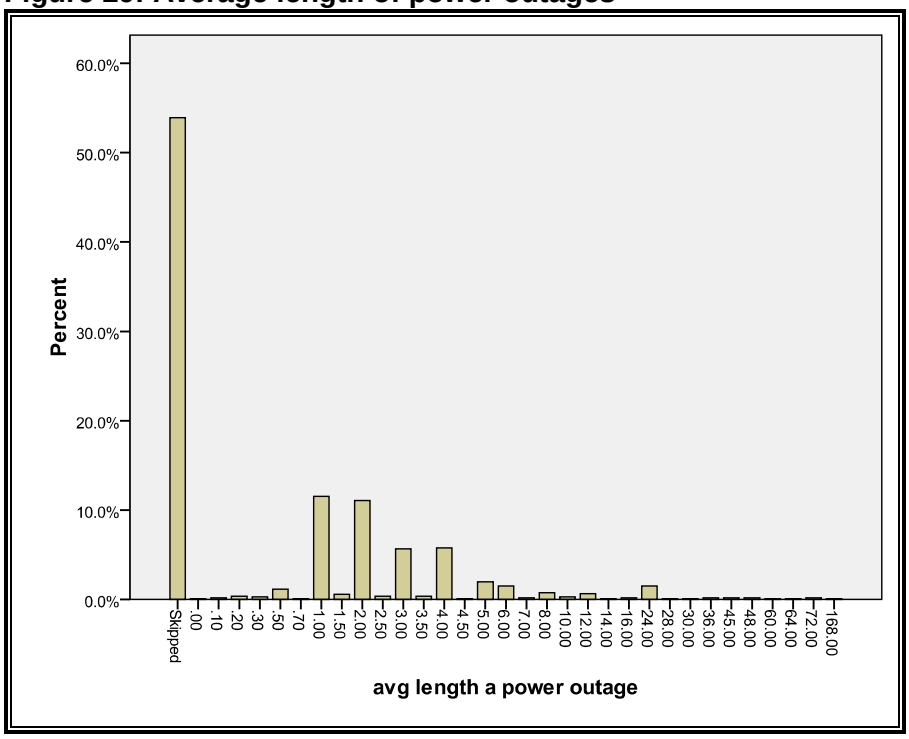
When a firm experiences power outages, it is important to know the average number of outages that occur during a month as well as the average number of hours the power outage lasts in order to determine the loss in production or sales for that month, due to power outages. Table 24 shows that on average power outages occurred between once and four times per month. There are 222 firms, which make up 21 per cent of the respondent firms, which had an average of one power outage per month, during 2006. An average of two power outages occurred at 11.8 per cent of the respondent firms, while three and four power outages occurred at 5.9 per cent and 3.8 per cent of the respondent firms, respectively. Only one of the firms in the survey experienced, on average, 30 power outages in a month, during 2006.

Table 24: Average power outages per month

		Frequency	Per cent	Valid per cent	Cumulative per cent
Valid	Skipped	571	54	54.1	54.1
	0	1	0.1	0.1	54.2
	1	**222**	21	**21**	75.3
	2	**124**	11.7	**11.8**	87.0
	3	**62**	5.9	**5.9**	92.9
	4	**40**	3.8	**3.8**	96.7
	5	11	1.0	1.0	97.7
	6	10	0.9	0.9	98.7
	7	4	0.4	0.4	99.1
	8	1	0.1	0.1	99.1
	9	1	0.1	0.1	99.2
	10	1	0.1	0.1	99.3
	12	4	0.4	0.4	99.7
	15	2	0.2	0.2	99.9
	30	1	0.1	0.1	100
	Total	1055	99.8	100	
Missing	System	2	0.2		
Total		1057	100		

Along with the average number of power outages per month, the average number of hours of a power outage is also important to know. Figure 29 shows that the average length of a power outage during 2006 was approximately one to four hours.

Figure 29: Average length of power outages



Now that the average number of power outages and the average length of power outages have been discussed, it is important to look at the average percentage of sales that a firm lost during 2006, due to power outages. Table 25 gives an indication of the percentage sales that the firms lost due to the power outages, during 2006. Ninety firms in the survey, which is 8.5 per cent of the respondent firms, lost one per cent of their sales, during 2006, due to the power outages. Sixty-one firms lost two per cent of their sales, while forty-one firms lost five per cent of their sales. It is also clear from Table 25 that 87 of the firms, or 8.2 per cent of the respondent firms, did not lose any of their sales due to the power outages. Therefore, from Table 25, the average loss in sales due to power outages is approximately between zero and five per cent of the sales.

Table 25: Percentage of sales lost due to power outages

		Frequency	Per cent	Valid per cent	Cumulative per cent
Valid	Missing	652	61.7	61.8	61.8
	0.0	**87**	8.2	**8.2**	70.0
	0.1	38	3.6	3.6	73.6
	0.2	10	0.9	0.9	74.6
	0.3	1	0.1	0.1	74.7
	0.4	1	0.1	0.1	74.8
	0.5	22	2.1	2.1	76.9
	0.7	1	0.1	0.1	77.0
	1.0	**90**	8.5	**8.5**	85.5
	1.5	1	0.1	0.1	85.6
	2.0	**61**	5.8	**5.8**	91.4
	3.0	14	1.3	1.3	92.7
	4.0	7	0.7	0.7	93.4
	5.0	**41**	3.9	**3.9**	97.3
	6.0	1	0.1	0.1	97.3
	8.0	3	0.3	0.3	97.6
	10.0	14	1.3	1.3	99.0
	11.0	1	0.1	0.1	99.1
	12.0	1	0.1	0.1	99.1
	14.0	1	0.1	0.1	99.2
	15.0	3	0.3	0.3	99.5
	20.0	2	0.2	0.2	99.7
	25.0	1	0.1	0.1	99.8
	30.0	2	0.2	0.2	100
	Total	1055	99.8	100	
Missing	**System**	2	0.2		
Total		1057	100		

In this sub-section, various aspects of electricity and the experience of private firms in the four metropolitan cities of South Africa have been discussed. These aspects included whether firms have electricity connections, use generators to generate electricity for production as well as issues concerning power outages. The next sub-section will discuss water supply to private firms in South Africa

3.3.2 Water supply

Almost every production firm uses water at some point in the production process. The 800 respondent firms indicated that an average of 71.2 per cent of water for production is provided by a public source. The majority of the respondent firms do not find water supply for production to be insufficient. Table 26 shows firms' responses to the question as to whether water supply is insufficient for production in relation to the city in which they are located. A total of 671 firms out of 800 find the water supply for production to be sufficient. This equals 83.88 per cent of firms that are satisfied with water supply.

Table 26: Sufficiency of water supply for production per city

	Insufficient water supply for production				**Total**
	Not applicable	*Skipped*	*Yes*	*No*	
City					
Cape Town	0	0	4	111	115
Durban	12	0	3	69	84
Johannesburg	26	38	46	438	548
Port Elizabeth	0	0	0	53	53
Total	38	38	53	671	800

It is also interesting to see whether the level of satisfaction varies per firm size. Table 27 illustrates whether firms find water supply for production to be insufficient by firm size and city. The results show that 94.50 per cent of small firms are satisfied with water supply for production, while 88.10 per cent of medium firms and 90.34 per cent of large firms are also satisfied with water supply for production in South Africa. Therefore, it can be said that the majority of private firms, regardless of the size of the firm, is satisfied with the water supply for production. In terms of location, more firms in Johannesburg indicated that the water supply is insufficient for production, but the number is small.

Table 27: Insufficient water supply for production relative to firm size and cities

Size		Insufficient water supply for production			Total
		Not applicable	*Yes*	*No*	
Small	City				
	Cape Town	0	1	41	42
	Durban	2	0	16	18
	Johannesburg	1	9	146	156
	Port Elizabeth	0	0	19	19
	Total	3	10	222	235
Medium	City				
	Cape Town	0	1	44	45
	Durban	9	3	34	46
	Johannesburg	4	15	142	161
	Port Elizabeth	0	0	17	17
	Total	13	19	237	269
Large	City				
	Cape Town	0	2	26	28
	Durban	1	0	19	20
	Johannesburg	7	7	97	111
	Port Elizabeth	0	0	17	17
	Total	8	9	159	176

The survey went on to determine what the average incidence of insufficient water supply for production per month is and the average length thereof. According to the output, insufficient water supply for production occurred on average once or twice a month and lasted for an average time of one to three hours.

From the water supply section in the survey, it can be concluded that firms in South Africa are relatively satisfied with the water supply for production and when insufficient water supply occurs, the majority of firms experience it once or twice a month and it rarely lasts longer than three hours.

3.3.3 Internet connection

For many firms a high speed internet connection is vital, due to their internet operations such as communication with clients, research as well as purchases from suppliers. Figure 30 indicates whether firms have high speed internet connections and their location in the different cities. Only 143 firms in the survey responded to this question.

Figure 30: High speed internet connection per city

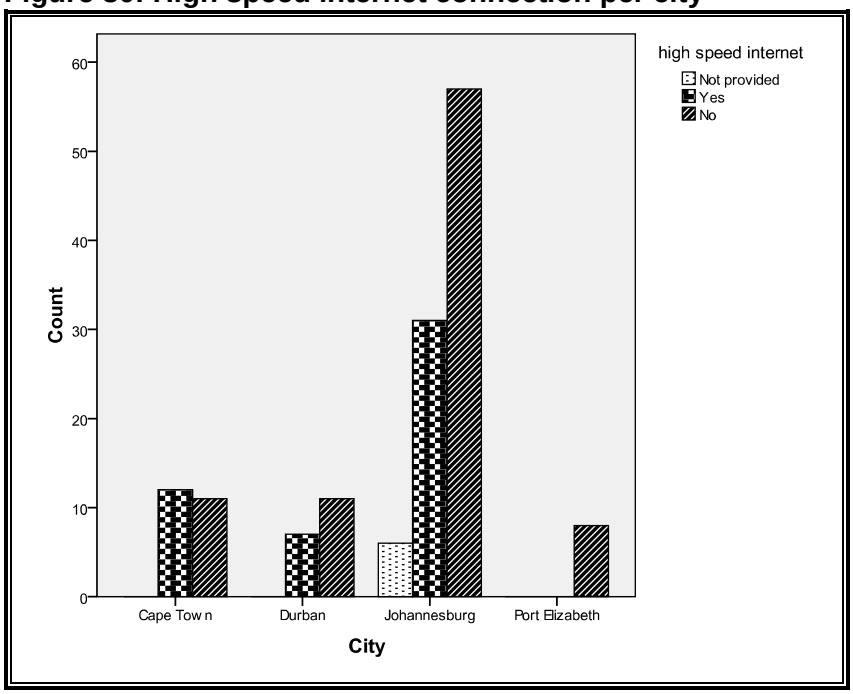


Figure 30 shows that only in Cape Town do more firms have high speed internet connections than firms that do not. Not one firm in Port Elizabeth indicated that they have access to high speed internet connections. In Johannesburg, approximately 57 firms do not have high speed internet connections, relative to the 31 firms that do. From this it seems as though the lack of high speed internet connection may be a constraint to firms in South Africa.

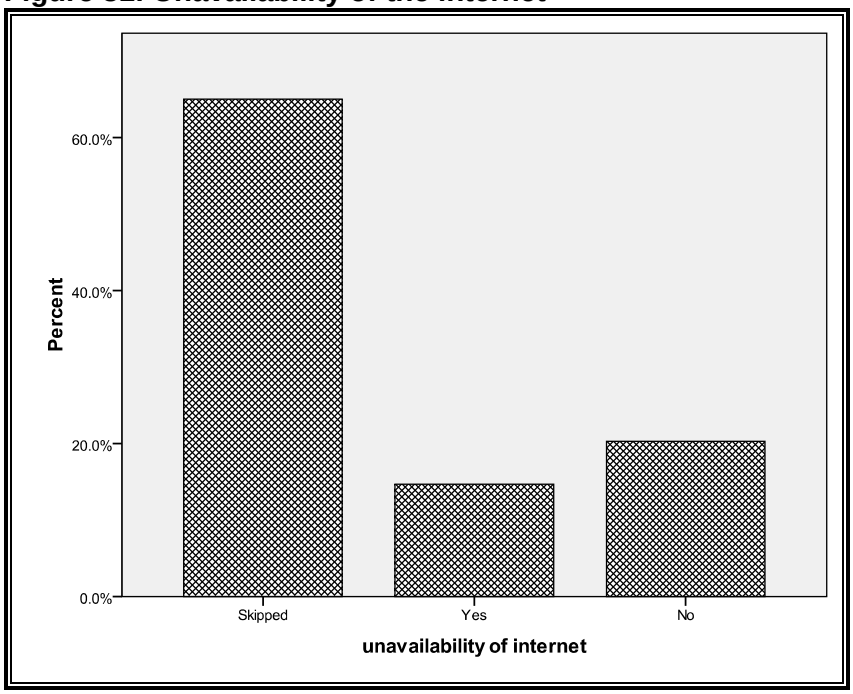
When the usage of the internet connection is considered, a good summary is given by Table 28. The four ways in which firms may use the internet are communication, purchases from suppliers, research and client service delivery. It is clear that only 143 firms responded to this section of the questionnaire, of which 65 per cent skipped this question. However, of the 50 firms that did respond, 32.2 per cent of the firms used the internet for communication, while 29.4 per cent used it for research. Approximately 25.9 per cent and 21.7 per cent of the firms use the internet connection to purchase from suppliers and to deliver client services, respectively.

Table 28: Usage of internet connection

	Frequency	Per cent	Valid per cent
Communication			
Skipped	93	8.8	65.0
Yes	46	4.4	32.2
No	4	0.4	2.8
Total	143	13.5	100
Purchases from suppliers			
Skipped	93	8.8	65.0
Yes	37	3.5	25.9
No	13	1.2	9.1
Total	143	13.5	100
Research			
Skipped	93	8.8	65.0
Yes	42	4	29.4
No	8	0.8	5.6
Total	143	13.5	100
Delivery client services			
Skipped	93	8.8	65.0
Yes	31	2.9	21.7
No	19	1.8	13.3
Total	143	13.5	100

It is also important to know whether the firms experience problems with unavailable internet connections and how this unavailability affects them. Figure 31 illustrates the response of 143 firms as to whether or not they experience unavailability of the internet.

Figure 31: Unavailability of the internet



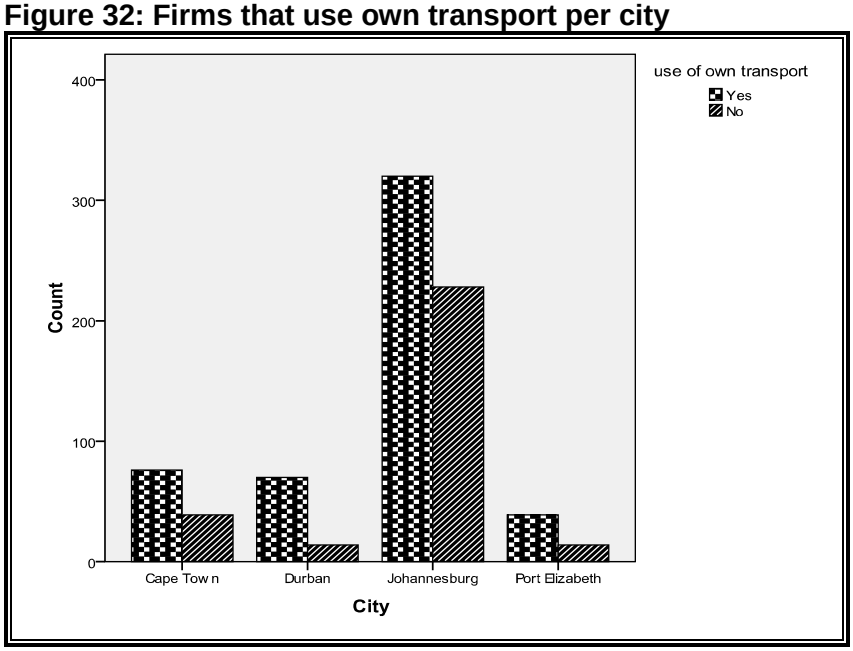
Approximately 65 per cent of the firms skipped this question, meaning that only 50 firms responded. Of these 50 firms, 14.7 per cent indicated that they did experience unavailable internet connections, while 20.3 per cent did not experience problems of unavailability. When determining the average number of times per month that the firms experience unavailable internet connections and the average length of this unavailability, it shows to be very high.

Therefore, it can be concluded from the small number of firms that did respond to this section in the questionnaire, that the majority does not have high speed internet connections. When an internet connection is available, it is used for communication, research, purchases from suppliers and service delivery to clients. Although the majority of firms do not experience unavailable internet connections, those that do, experience it up to an average of 90 times per month, with an average length of two to five hours.

3.3.4 Transport

The information regarding transport from this database is limited. Figure 32 shows that the majority of the firms use their own transport to carry their products to the next destination. In each city, the firms that use their own transport outnumber the firms that do not.

Figure 32: Firms that use own transport per city



To evaluate the situation in greater detail, Table 29 shows the percentage of firms that use their own transport per city as well as the number of firms in each city that use their

own transport. It can be concluded that from the firms that do use their own transport, 15.0 per cent is located in Cape Town, 13.9 per cent in Durban, with 63.4 per cent and 7.7 per cent of the firms located in Johannesburg and Port Elizabeth respectively. Of the firms in Cape Town, 66.1 per cent use their own transport, while 83.3 per cent of the firms in Durban use their own transport. In Johannesburg and Port Elizabeth, 58.4 per cent and 73.6 per cent of the firms use their own transport, respectively. Although the majority of the firms that use their own transport are located in Johannesburg (63.4 per cent), the majority of the firms within Durban use their own transport (83.3 per cent).

Table 29: Firms that use their own transport per city

			Use of own transport		Total
			Yes	No	
City	Cape Town	Count	76	39	115
		% within City	66.1%	33.9%	100.0%
		% within use of own transport	15.0%	13.2%	14.4%
	Durban	Count	70	14	84
		% within City	83.3%	16.7%	100.0%
		% within use of own transport	13.9%	4.7%	10.5%
	Johannesburg	Count	320	228	548
		% within City	58.4%	41.6%	100.0%
		% within use of own transport	63.4%	77.3%	68.5%
	Port Elizabeth	Count	39	14	53
		% within City	73.6%	26.4%	100.0%
		% within use of own transport	7.7%	4.7%	6.6%
Total		Count	505	295	800
		% within City	63.1%	36.9%	100.0%
		% within use of own transport	100.0%	100.0%	100.0%

The information on transport also shows that on average firms lose 1.3 per cent of the value of their domestic shipment to clients while in transport, due to breakage or spoilage and an average 1.02 per cent of the value is lost due to theft.

3.4 Summary and conclusions

This brief overview of the characteristics of the firms in the 2007 World Bank Enterprise survey dataset and the data on infrastructure paves the way for further analysis of the link between private firms and public goods in Chapter 4. The key facts from Chapter 3 include:

- The majority of firms are small and medium privately-held firms, located in Johannesburg.
- Large firms are on average the oldest in the survey.
- A great number of firms operate in the retail and manufacturing industries.
- The main market for the majority of the firms is local.
- The average capacity utilisation is 79.03 per cent, and the average operating hours per week are 50.72 hours.
- Crime, theft and disorder, electricity and corruption are the top three major and most severe obstacles perceived by firms to doing business in South Africa. In Johannesburg, crime, theft and disorder are considered to be the most severe obstacles to doing business, while in Cape Town it is electricity and in both Port Elizabeth and Durban corruption is considered as the greatest obstacle to doing business in South Africa.
- From the infrastructure data it was found that the majority of firms that share or own a generator are located in Johannesburg, while Cape Town is the city in which the most firms own or share a generator. Firms experienced an average of one to four power outages in a month, which lasted an average of one to four hours. This caused the firms to lose an average of zero to five per cent of their sales, due to power outages.
- From the water infrastructure data, it can be concluded that the majority of firms find water supply for production sufficient.
- With regard to internet connections, the majority of firms indicated that they do not experience a problem with internet connection availability. Those firms that did indicate unavailability, experience it on average 90 times per month and it lasts up to an average of two to five hours.
- In each city, the majority of firms use their own transport.

In Chapter 4, the aim will be to compile a composite public goods and services delivery indicator by means of Principle Component Analysis and to identify the differences in the delivery index between the various firms located in the four major cities.

CHAPTER 4: SERVICE DELIVERY INDICATOR

4.1 Principle component analysis

Chapter 4 will present an infrastructure service delivery indicator constructed by means of Principle Component Analysis (PCA) using SPSS and the 2007 World Bank Enterprise survey data. PCA is a method used to construct a composite indicator in which linear components exist within the data and to establish whether a particular variable contributes to that component (Field, 2005: 631). The idea with this indicator is to determine which factors or variables in the dataset can serve as a measure of aggregate service delivery to private firms in South Africa.

The first step to constructing an infrastructure service delivery indicator is to generate an R-matrix, which is a table that presents the correlation coefficients of the variables. The idea is to include variables in the model that are correlated fairly well with each other. To avoid multicollinearity of the data, the variables should not be perfectly correlated. Therefore, one of the variables should be eliminated from the model should variables be correlated greater than 0.9. When the correlation between variables is too little, for example less than 0.2, one of the variables should also be eliminated from the model.

All the relevant data were selected to generate the R-matrix. This included infrastructure variables reflecting firms' experience of the delivery of transport, electricity, water and communication services. However, SPSS found a problem in generating the R-matrix. To locate the problem, an R-matrix was generated for each infrastructure type separately. During this process, it was discovered that the water infrastructure data have too little variance and caused the problem in creating an R-matrix. Therefore, all the data on water supply to firms were eliminated from the analysis. To generate significant R-matrixes of the various infrastructure types, variables that were correlated too high or too little were eliminated. The included variables in the various significant R-matrixes were then used to generate an aggregate R-matrix. After eliminating the variables with too high or too little correlation, the final R-matrix was generated. This R-matrix is illustrated in Table 30.

Table 30: Correlation matrix

		Email	Website	Exports average days - customs	Cost to clear port	Imports average days - customs	Lost - breakage/spoilage during transport	Lost - Theft during transport	Imports longest days - customs	Average power outages per month	Average length of a power outage	% Sales loss due to power outages
Correlation	Email	1.00	0.46	-0.21	-0.18	-0.11	-0.16	-0.24	-0.12	-0.05	-0.09	-0.10
	Website	0.46	1.00	-0.35	-0.31	-0.11	-0.28	-0.38	-0.11	-0.15	-0.15	-0.15
	Exports average days – customs	-0.21	-0.35	1.00	0.69	0.22	0.53	0.81	0.19	0.10	0.16	0.10
	Cost to clear port	-0.18	-0.31	0.69	1.00	0.17	0.51	0.73	0.21	0.12	0.21	0.14
	Imports average days – customs	-0.11	-0.11	0.22	0.17	1.00	0.30	0.19	0.86	0.12	0.10	0.11
	Lost – breakage/spoilage during transport	-0.16	-0.28	0.53	0.51	0.30	1.00	0.65	0.24	0.07	0.10	0.14
	Lost – theft during transport	-0.24	-0.38	0.81	0.73	0.19	0.65	1.00	0.19	0.08	0.16	0.10
	Imports longest days – customs	-0.12	-0.11	0.19	0.21	0.86	0.24	0.19	1.00	0.11	0.11	0.12
	Average power outages per month	-0.05	-0.15	0.10	0.12	0.12	0.07	0.08	0.11	1.00	0.52	0.66
	Average length of a power outage	-0.09	-0.15	0.16	0.21	0.10	0.10	0.16	0.11	0.52	1.00	0.48
	% sales loss due to power outages	-0.10	-0.15	0.10	0.14	0.11	0.14	0.10	0.12	0.66	0.48	1.00
Sig. (1-tailed)	Email		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.01	0.01
	Website	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Exports average days – customs	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	Cost to clear port	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Imports average days – customs	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.01	0.00
	Lost – breakage/spoilage during transport	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.04	0.01	0.00
	Lost – theft during transport	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.02	0.00	0.01
	Imports longest days – customs	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
	Average power outages per month	0.10	0.00	0.00	0.00	0.00	0.04	0.02	0.00		0.00	0.00
	Average length of a power outage	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00		0.00
	% sales loss due to power outages	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	
a. Determinant = .004												

The top half of this table contains the Pearson correlation coefficient between all variables, while the bottom half contains the one-tailed significance of these coefficients. Table 30 shows that the average number of days it takes firms to clear products through customs for export is highly and positively correlated to percentage losses during export due to theft. It also indicated that apart from communication infrastructure that has a positive relationship with aggregate service delivery, the remaining variables in the model are all negatively related to the service delivery construct. Therefore, when the average number of days to clear customs for export increases, service delivery is less sufficient. The determinant, illustrated at the bottom of Table 30, equals 0.004, which is

greater than the necessary value of 0.00001, indicating confidence of no multicollinearity in this data.

To be confident that PCA is appropriate for this data, the KMO and Bartlett's test of sphericity is done. According to Kaiser (1974), it is recommended that the KMO statistic equals a bare minimum of 0.5. Values between 0.5 and 0.7 will be average, while values between 0.7 and 0.8 are good. Values between 0.8 and 0.9 are great, with values above 0.9 being excellent (Field, 2005:640). Table 31 illustrates the KMO and Bartlett's test for this data.

Table 31: KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.728
Bartlett's Test of Sphericity	Approx. Chi-Square	3628.084
	df	55
	Sig.	0.00

With an adequacy value of 0.728, the KMO statistic is acceptable. The null hypothesis of the Bartlett measure is that the original correlation matrix is an identity matrix. Table 31 shows that the test is significant, indicating that the R-matrix is not an identity matrix, which means that there are variables that can be included in the analysis. Therefore, due to the KMO statistic and the significance of the Bartlett test, the conclusion is drawn that PCA is appropriate for the data.

Table 31 illustrates the KMO of multiple variables. The anti-image correlation matrix is used to illustrate the KMO of individual variables. The diagonal elements of the anti-image correlation matrix should be evaluated. All the values should be above the bare minimum of 0.5 and preferably higher. Table 32 shows the anti-image correlation matrix.

Table 32: Anti-image matrix

		Email	Website	exports average days - customs	Cost to clear port	imports average days - customs	Lost - breakage/spoilage during transport	Lost - Theft during transport	imports longest days - customs	average power outages per month	average length of a power outage	% sales loss due to power outages
Anti-image Correlation	Email	**.697**[a]	-0.41	-0.01	-0.02	0.02	-0.03	0.06	0.02	-0.07	0.03	0.05
	Website	-0.41	**.799**[a]	0.07	0.02	-0.02	0.05	0.08	0.01	0.07	0.02	0.02
	Exports average days – customs	-0.01	0.07	**.802**[a]	-0.25	-0.15	0.06	-0.56	0.11	-0.02	0.00	0.02
	Cost to clear port	-0.02	0.02	-0.25	**.872**[a]	0.13	-0.07	-0.33	-0.15	0.01	-0.10	-0.03
	Imports average days – customs	0.02	-0.02	-0.15	0.13	**.549**[a]	-0.21	0.09	-0.85	-0.05	0.00	0.03
	Lost – breakage/spoilage during transport	-0.03	0.05	0.06	-0.07	-0.21	**.831**[a]	-0.41	0.10	0.06	0.06	-0.12
	Lost – theft during transport	0.06	0.08	-0.56	-0.33	0.09	-0.41	**.757**[a]	-0.05	0.00	-0.02	0.05
	Imports longest days - customs	0.02	0.01	0.11	-0.15	-0.85	0.10	-0.05	**.557**[a]	0.02	-0.01	-0.04
	Average power outages per month	-0.07	0.07	-0.02	0.01	-0.05	0.06	0.00	0.02	**.662**[a]	-0.31	-0.55
	Average length of a power outage	0.03	0.02	0.00	-0.10	0.00	0.06	-0.02	-0.01	-0.31	**.816**[a]	-0.20
	% sales loss due to power outages	0.05	0.02	0.02	-0.03	0.03	-0.12	0.05	-0.04	-0.55	-0.20	**.684**[a]

a. Measures of Sampling Adequacy(MSA)

From Table 32 it can be seen that the individual KMO statistics are also acceptable. All the values are above the bare minimum of 0.5, indicating that PCA is appropriate for all the variables in the model, and none of the variables need to be eliminated from the model. The off-diagonal elements represent the partial correlation between variables. In Table 32, these values are small, further indicating that PCA is appropriate for this data.

The next step to generating a service delivery index is factor extraction. Firstly, SPSS determines the linear components within the dataset by calculating the eigen-values[5] of the R-matrix. The importance of a component is displayed in the magnitude of the associated eigen-values. Table 33 lists the eigen-values with each linear component before extraction, after extraction and after rotation.

[5] The scatter-plot of two variables that are correlated forms an ellipse. This ellipse has a height and length dimension, which are known as eigenvectors of the original correlation matrix and are independent from each other. The height and length of an eigenvector are called eigen-values. Therefore, the eigen-values explain the dimensions of the data. In other words, the even distribution of the matrix variance is shown by an eigen-value (Field, 2005:197).

Table 33: Total variance explained

Component	Initial Eigen-values			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.732	33.928	33.928	3.732	33.928	33.928	3.004	27.309	27.309
2	1.951	17.738	51.666	1.951	17.738	51.666	2.132	19.378	46.687
3	1.623	14.759	66.424	1.623	14.759	66.424	1.87	17.002	63.689
4	1.154	10.487	76.911	1.154	10.487	76.911	1.454	13.222	76.911
5	0.594	5.398	82.31						
6	0.522	4.749	87.059						
7	0.483	4.387	91.447						
8	0.342	3.11	94.557						
9	0.306	2.783	97.339						
10	0.169	1.538	98.877						
11	0.123	1.123	100.000						

Extraction Method: Principal Component Analysis.

Each factor's eigen-value illustrates the variance explained by that particular linear component, for example factor 1 explains 33.99 per cent of the total variance. SPSS extracts all the factors with eigen-values greater than 1. Therefore, factors one to four are shown in the second column. In the final part of the table, the eigen-values of the factors after rotation are illustrated. Rotation has the effect of optimising the factor structure and equalising the relative importance of the four factors. It is now shown that before the rotation, factor one accounted for 33.99 per cent of the explained variance, while after rotation, factor one only accounts for 27.31 per cent of the total variance.

Table 34 shows the communalities[6] before and after extraction. The initial assumption with PCA is that the variance is common, thus, before extraction the communalities are all 1 (Field, 2005:653). Only after extraction is it clear how much variance is actuality common. The extraction column in Table 34 reflects the common variance of each variable after extraction. Therefore, 78.9 per cent of the variance in email is shared variance. In terms of the variance of the average days of custom clearance when importing and the longest days of custom clearance when importing, the shared

[6] A particular variable will have two components to its total variance. Some of the variance of the variable will be shared with other variables (common variance) and some of the variance will be specific to that measure (unique variance). The proportion of common variance that is present in a variable is known as the communality. Therefore, the communality is a measure of the proportion of variance explained by the extracted factors (Field, 2005:630).

variance is 93.2 per cent and 92.2 per cent respectively. Losses due to breakage or spoilage at custom clearance during export are the variable that has the lowest shared variance, namely 59.7 per cent of its total variance.

Table 34: Communalities

	Initial	Extraction
Email	1	0.789
Website	1	0.700
Exports average days – customs	1	0.786
Cost to clear port	1	0.739
Imports average days – customs	1	0.932
Lost – breakage/spoilage during export	1	0.597
Lost – theft during export	1	0.875
Imports longest days – customs	1	0.922
Average power outages per month	1	0.773
Average length of a power outage	1	0.613
% sales loss due to power outages	1	0.734
Extraction Method: Principal Component Analysis.		

The final step in the analysis is to look at the component matrix that contains the loadings of each of the four factors that were identified through the PCA. Table 35 shows the rotated component matrix that contains the same information as the component matrix except that it is calculated after rotation. Field (2005:644) states that the rotated matrix maximises the loading of each variable on one of the extracted factors, while at the same time minimising the loading on all other factors. This causes the rotation matrix to present a greater understanding with regard to which variable relates to which factor.

The results from Table 35 should be interpreted with caution. The aim is to measure the underlying construct of aggregate infrastructure service delivery. For example, a high level of average days to clear customs when exporting would be negatively associated with good service delivery, while a high level of email availability for communication would be positively related to good service delivery.

Table 35: Rotated component matrix

	Component			
	1	2	3	4
Lost – theft during export	0.918			
Exports average days – customs	0.869			
Cost to clear port	0.845			
Lost – breakage/spoilage during export	0.739			
Average power outages per month		0.876		
% sales loss due to power outages		0.850		
Average length of a power outage		0.771		
Imports average days – customs			0.951	
Imports longest days – customs			0.948	
Email				0.882
Website				0.775

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

Factor 1 measures transport infrastructure and includes losses during exporting due to both theft and breakage or spoilage, the average number of days to clear customs when exporting as well as the cost to clear customs. If it takes more days to clear customs, it increases the time in which firms export products. This negatively influences the cost and productivity of the firms and causes firms' profit to fall due to the lower amount of output the firm delivers to the importer. The cost to clear ports rises due to the high number of days the products are in storage at the ports waiting for customs to clear the products. This is a result of poor service delivery. The level of losses due to theft and breakage or spoilage while in transport to ports is also an indicator of poor service delivery, for the theft or breakage will only occur when service delivery is not reliable. According to the literature, this will increase the cost of firms due to the loss of products. The values in Table 35 for these variables are high, ranging between 73.9 per cent and 91.8 per cent. Therefore, when service delivery of transport infrastructure is poor, firms experience problems with productivity and costs, which negatively influences their performance to create economic growth.

Factor 2 captures firms' experience with electricity infrastructure when including the average number of power outages per month, the average length of a power outage as well as the percentage of sales lost due to power outages. These indicators of power outages relate negatively to service delivery. The higher the average number of power outages and the longer the length of a power outage, the greater the production loss of

the firm will be. This will affect the productivity of firms and thus the output level will fall. Therefore, poor electricity availability reflects poor service delivery and firms suffer consequences of lower productivity, lower output and limited growth.

Factor 3 seems to present the administration of imports, when the average number of days to clear customs and the longest days to clear customs, when importing, are included. This is not only a clear case of physical infrastructure, but also represents processes provided by the public sector. Many firms rely on imported supplies in their production processes. As the average number of days to clear customs for imported goods increases, firms are influenced negatively. The production process is hindered causing productivity and output to fall. Therefore, good service delivery to administration of imports will improve the productivity of firms and lead to increased economic activity.

Factor 4 represents communication when taking account of email availability and website usage. The higher the level of firm communication the more functional the firm will be. Firms need to communicate with suppliers as well as with clients. The availability of email and a website helps firms to be more connected to suppliers and clients and increase their productivity and possibility of potential future transactions. With good communication service delivery firms can grow and enhance economic performance.

In this section of Chapter 4, PCA was undertaken to understand the factors that make up firms' experience of aggregate infrastructure service delivery. Four factors were extracted, namely transport, electricity, administration of imports and communication. Therefore, available and efficient transport, electricity, communication and administration of imports will benefit aggregate service delivery.

4.2 Service delivery and the four identified factors

Transport, electricity, administration of imports and communication are the four factors that make up aggregate infrastructure service delivery, as identified by PCA. Now consideration is given to these four factors relative to the four major metropolitan cities included in the survey, firm size and the various industries. The aim is to determine how these factors differ when making up aggregate infrastructure service delivery to firms in

terms of geographical location, firm size and industry. To facilitate the comparison, the factor scores have been categorised as above average, average and below average.

4.2.1 Factors relative to cities and firm size

The focus will first be on location and firm size. Table 36 shows the experience of small, medium and large firms located in Cape Town and Durban, with the delivery of transport services. Table 36 reveals that in Cape Town, 65.80 per cent of firms receive above average transport services. A total of 28.90 per cent of the firms experience transport services to be average, with 5.30 per cent of firms experiencing it as below average. It is, however, also important to determine whether this situation changes relative to firm size. When all the firms in Cape Town are considered, Table 36 shows that the majority of small and medium firms experience transport to be above average at 90.50 per cent and 57.80 per cent, respectively. The majority of large firms, however, find transport to be average.

Table 36: Transport services relative to city and firm size - Cape Town

City				Transport			Total
				Above average	Average	Below average	
Cape Town	Size	Small (5-19 employees)	Count	38	4	0	42
			% within Size	90.50%	9.50%	0.00%	100.00%
			% within Transport	50.70%	12.10%	0.00%	36.80%
		Medium (20-99 employees)	Count	26	14	5	45
			% within Size	57.80%	31.10%	11.10%	100.00%
			% within Transport	34.70%	42.40%	83.30%	39.50%
		Large (100 employees and more)	Count	11	15	1	27
			% within Size	40.70%	55.60%	3.70%	100.00%
			% within Transport	14.70%	45.50%	16.70%	23.70%
	Total		Count	75	33	6	114
			% within Size	65.80%	28.90%	5.30%	100.00%
			% within Transport	100.00%	100.00%	100.00%	100.00%

Firms in Durban are illustrated in Table 37. It is clear that 85.50 per cent of all the firms in Durban experience transport to be above average, with 12 per cent and 2.4 per cent of firms experiencing transport services to be average and below average, respectively. In terms of firm size, an overwhelming majority of small (88.90 per cent), medium (91.10 per cent) and large (70.00 per cent) firms receive above average transport services.

Table 37: Transport services relative to city and firm size - Durban

City				Transport			Total
				Above average	Average	Below average	
Durban	Size	Small (5-19 employees)	Count	16	2	0	18
			% within Size	88.90%	11.10%	0.00%	100.00%
			% within Transport	22.50%	20.00%	0.00%	21.70%
		Medium (20-99 employees)	Count	41	4	0	45
			% within Size	91.10%	8.90%	0.00%	100.00%
			% within Transport	57.70%	40.00%	0.00%	54.20%
		Large (100 employees and more)	Count	14	4	2	20
			% within Size	70.00%	20.00%	10.00%	100.00%
			% within Transport	19.70%	40.00%	100.00%	24.10%
	Total		Count	71	10	2	83
			% within Size	85.50%	12.00%	2.40%	100.00%
			% within Transport	100.00%	100.00%	100.00%	100.00%

Table 38 shows the experience of small, medium and large firms located in Johannesburg, with the delivery of transport-related infrastructure. A total of 77 per cent of firms in Johannesburg experience transport to be above average, with 18.70 per cent and 4.3 per cent of the firms experiencing transport services average and below average. When the size of the firm is considered, it is clear that the majority of small and medium firms receive above average transport services. With large firms, the situation is different. Within large firms, 49.10 per cent of firms experience above average transport services, which accounts for 54 firms in Johannesburg. A count of 42 large firms experience transport services to be average, which is 38.20 per cent of the firms in Johannesburg. Therefore, with large firms the difference between average transport services and above average transport services is less than that of the small and medium firms.

Table 38: Transport services relative to city and firm size – Johannesburg

City				Transport			Total
				Above average	Average	Below average	
Johannesburg	Size	Small (5-19 employees)	Count	148	6	0	154
			% within Size	96.10%	3.90%	0.00%	100.00%
			% within Transport	45.50%	7.60%	0.00%	36.50%
		Medium (20-99 employees)	Count	123	31	4	158
			% within Size	77.80%	19.60%	2.50%	100.00%
			% within Transport	37.80%	39.20%	22.20%	37.40%
		Large (100 employees and more)	Count	54	42	14	110
			% within Size	49.10%	38.20%	12.70%	100.00%
			% within Transport	16.60%	53.20%	77.80%	26.10%
	Total		Count	325	79	18	422
			% within Size	77.00%	18.70%	4.30%	100.00%
			% within Transport	100.00%	100.00%	100.00%	100.00%

The experience of firms in Port Elizabeth is illustrated in Table 39. When all the firms in Port Elizabeth are considered, it is clear that 84.90 per cent of the firms experience transport services as above average, with 15.10 per cent of the firms receiving only average transport services. Table 37 also indicates that the vast majority of small (89.50), medium (94.10 per cent) and large (70.60 per cent) firms experience above average transport services.

Table 39: Transport services relative to city and firm size - Port Elizabeth

City				Transport			Total
				Above average	Average	Below average	
Port Elizabeth	Size	Small (5-19 employees)	Count	17	2		19
			% within Size	89.50%	10.50%		100.00%
			% within Transport	37.80%	25.00%		35.80%
		Medium (20-99 employees)	Count	16	1		17
			% within Size	94.10%	5.90%		100.00%
			% within Transport	35.60%	12.50%		32.10%
		Large (100 employees and more)	Count	12	5		17
			% within Size	70.60%	29.40%		100.00%
			% within Transport	26.70%	62.50%		32.10%
	Total		Count	45	8		53
			% within Size	84.90%	15.10%		100.00%
			% within Transport	100.00%	100.00%		100.00%

When taking the above information into consideration, it can be concluded that in general firms in Cape Town, Durban, Johannesburg and Port Elizabeth experience transport services to be above average. The majority of small and medium firms receive above average transport services, while a significant number of large firms experience the service of transport to be average. Of all the respondent firms, the majority of firms that experience above average transport services are medium-sized firms located in Durban, with large firms located in Port Elizabeth being the majority of firms that receive only average transport services.

The second factor that needs to be considered relative to cities and firm size is electricity. Table 40 shows that in Cape Town, 59.10 per cent of firms experience electricity services to be above average, with 36.5 per cent and 4.3 per cent of firms experiencing average and below average electricity services, respectively. Considering firm size, Table 40 shows that the vast majority of small firms (85.70 per cent) in Cape Town experience electricity services to be above average. This situation differs when considering medium and large firms. The slight majority of both medium and large firms receive average electricity services, with numerous firms receiving above average electricity services.

Table 40: Electricity services relative to city and firm size - Cape Town

City				Electricity			Total
				Above average	Average	Below average	
Cape Town	Size	Small (5-19 employees)	Count	36	5	1	42
			% within Size	85.70%	11.90%	2.40%	100.00%
			% within Electricity	52.90%	11.90%	20.00%	36.50%
		Medium (20-99 employees)	Count	20	22	3	45
			% within Size	44.40%	48.90%	6.70%	100.00%
			% within Electricity	29.40%	52.40%	60.00%	39.10%
		Large (100 employees and more)	Count	12	15	1	28
			% within Size	42.90%	53.60%	3.60%	100.00%
			% within Electricity	17.60%	35.70%	20.00%	24.30%
	Total		Count	68	42	5	115
			% within Size	59.10%	36.50%	4.30%	100.00%
			% within Electricity	100.00%	100.00%	100.00%	100.00%

As shown in Table 41, 80.50 per cent of firms, in Durban, experience the service of electricity to be above average, while 15.90 per cent and 3.70 per cent of the firms

experience average and below average electricity services, respectively. When considering the size of the firms, a large number of small (88.20 per cent), medium (82.20 per cent) and large (70.00 per cent) firms receive above average electricity services. There are, however, six large firms in Durban that experience the service of electricity to be below average. This accounts for 30.00 per cent of the firms in Durban.

Table 41: Electricity services relative to city and firm size - Durban

City				Electricity			Total
				Above average	Average	Below average	
Durban	Size	Small (5-19 employees)	Count	15	2	0	17
			% within Size	88.20%	11.80%	0.00%	100.00%
			% within Electricity	22.70%	15.40%	0.00%	20.70%
		Medium (20-99 employees)	Count	37	5	3	45
			% within Size	82.20%	11.10%	6.70%	100.00%
			% within Electricity	56.10%	38.50%	100.00%	54.90%
		Large (100 employees and more)	Count	14	6	0	20
			% within Size	70.00%	30.00%	0.00%	100.00%
			% within Electricity	21.20%	46.20%	0.00%	24.40%
	Total		Count	66	13	3	82
			% within Size	80.50%	15.90%	3.70%	100.00%
			% within Electricity	100.00%	100.00%	100.00%	100.00%

When considering electricity services in Johannesburg, Table 42 shows that, 55.20 per cent of the firms experience average electricity services, with 41.30 per cent of firms receiving above average electricity services. This is the first situation in which the majority of firms in a city experience a service to be average. Considering firm size, Table 42 shows that the majority of small firms (54.80 per cent) receive above average electricity services, with the majority of medium (60.40 per cent) and large (64.50 per cent) firms experiencing the service of electricity to be only average.

Table 42: Electricity services relative to city and firm size - Johannesburg

City				Electricity			Total
				Above Average	Average	Below Average	
Johannesburg	Size	Small (5-19 employees)	Count	85	67	3	155
			% within Size	54.80%	43.20%	1.90%	100.00%
			% within Electricity	48.60%	28.60%	20.00%	36.60%
		Medium (20-99 employees)	Count	60	96	3	159
			% within Size	37.70%	60.40%	1.90%	100.00%
			% within Electricity	34.30%	41.00%	20.00%	37.50%
		Large (100 employees and more)	Count	30	71	9	110
			% within Size	27.30%	64.50%	8.20%	100.00%
			% within Electricity	17.10%	30.30%	60.00%	25.90%
	Total		Count	175	234	15	424
			% within Size	41.30%	55.20%	3.50%	100.00%
			% within Electricity	100.00%	100.00%	100.00%	100.00%

In Port Elizabeth, the situation changes back again. Table 43 shows that the majority of firms (83 per cent) in Port Elizabeth experience above average electricity services, with 15.10 per cent of the firms receiving average electricity services. This result is also reflected when firm size is taken into consideration. In general, small (94.70 per cent), medium (88.20 per cent) and large (64.70 per cent) firms experience electricity services as above average.

Table 43: Electricity services relative to city and firm size - Port Elizabeth

City				Electricity			Total
				Above Average	Average	Below Average	
Port Elizabeth	Size	Small (5-19 employees)	Count	18	1	0	19
			% within Size	94.70%	5.30%	0.00%	100.00%
			% within Electricity	40.90%	12.50%	0.00%	35.80%
		Medium (20-99 employees)	Count	15	2	0	17
			% within Size	88.20%	11.80%	0.00%	100.00%
			% within Electricity	34.10%	25.00%	0.00%	32.10%
		Large (100 employees and more)	Count	11	5	1	17
			% within Size	64.70%	29.40%	5.90%	100.00%
			% within Electricity	25.00%	62.50%	100.00%	32.10%
	Total		Count	44	8	1	53
			% within Size	83.00%	15.10%	1.90%	100.00%
			% within Electricity	100.00%	100.00%	100.00%	100.00%

To conclude the information from the experience of electricity, it is found that in Cape Town, Durban and Port Elizabeth the majority of firms experience above average electricity services. It is, however, in Johannesburg that most of the firms experience electricity to be average. From all four cities it is clear that small firms experience the least problems and in general receive above average electricity services. A great number of large firms receive average electricity services, especially in Johannesburg. It is also found that from all the firms that experience the service of electricity to be above average, the majority is medium-sized firms located in Durban. And from all the firms that receive average electricity services, the majority is large firms located in Port Elizabeth.

Administration of imports is the next factor that needs to be considered in terms of location and firm size. Table 44 shows that in Cape Town, 61.40 per cent of the firms experience the administration of import services as above average. Furthermore, 35.10 per cent and 3.5 per cent of the firms experience the administration services of imports as average and below average, respectively. With regard to firm size, Table 44 shows that the vast majority of small firms experience import administration services as above average, whereas medium and large firms are almost equally divided in their experience of import administration services as being average and below average.

Table 44: Administration of import services relative to city and firm size - Cape Town

City				Import administration			Total
				Above Average	Average	Below Average	
Cape Town	Size	Small (5-19 employees)	Count	34	7	1	42
			% within Size	81.00%	16.70%	2.40%	100.00%
			% within administration	48.60%	17.50%	25.00%	36.80%
		Medium (20-99 employees)	Count	21	20	3	44
			% within Size	47.70%	45.50%	6.80%	100.00%
			% within administration	30.00%	50.00%	75.00%	38.60%
		Large (100 employees and more)	Count	15	13	0	28
			% within Size	53.60%	46.40%	0.00%	100.00%
			% within administration	21.40%	32.50%	0.00%	24.60%
	Total		Count	70	40	4	114
			% within Size	61.40%	35.10%	3.50%	100.00%
			% within administration	100.00%	100.00%	100.00%	100.00%

With the focus on Durban, Table 45 shows that the greater number of firms in Durban experiences the administration of imports to be above average (79.80 per cent). From the remaining respondent firms, 19.0 per cent experience import administration as average. None of the firms in Durban indicated that import administration is below average. Considering firm size, it is clear that the vast majority of small (88.90 per cent), medium (78.30 per cent) and large (75.00 per cent) firms experience the administration of imports as above average.

Table 45: Administration of import services relative to city and firm size - Durban

City				Import administration			Total
				Above Average	Average	Below Average	
Durban	Size	Small (5-19 employees)	Count	16	2	0	18
			% within Size	88.90%	11.10%	0.00%	100.00%
			% within administration	23.90%	12.50%	0.00%	21.40%
		Medium (20-99 employees)	Count	36	9	1	46
			% within Size	78.30%	19.60%	2.20%	100.00%
			% within administration	53.70%	56.30%	100.00%	54.80%
		Large (100 employees and more)	Count	15	5	0	20
			% within Size	75.00%	25.00%	0.00%	100.00%
			% within administration	22.40%	31.30%	0.00%	23.80%
	Total		Count	67	16	1	84
			% within Size	79.80%	19.00%	1.20%	100.00%
			% within administration	100.00%	100.00%	100.00%	100.00%

Table 46 shows the experiences of firms located in Johannesburg pertaining to the administration of import services. Of all the firms in Johannesburg, 78.00 per cent experience import administration to be above average, with 18.00 per cent and 4.00 per cent of firms experiencing import administration as average and below average. As found in Cape Town and Durban, the vast majority of small (92.90 per cent), medium (78.00 per cent) and large (56.90 per cent) firms experience above average import administration services. There are, however, 40 large firms, which accounts for 36.70 per cent of the respondent firms in Johannesburg, which experience import administration services as average.

Table 46: Administration of import services relative to city and firm size – Johannesburg

City				Import administration			Total
				Above average	Average	Below average	
Johannesburg	Size	Small (5-19 employees)	Count	144	9	2	155
			% within Size	92.90%	5.80%	1.30%	100.00%
			% within administration	43.60%	11.80%	11.80%	36.60%
		Medium (20-99 employees)	Count	124	27	8	159
			% within Size	78.00%	17.00%	5.00%	100.00%
			% within administration	37.60%	35.50%	47.10%	37.60%
		Large (100 employees and more)	Count	62	40	7	109
			% within Size	56.90%	36.70%	6.40%	100.00%
			% within administration	18.80%	52.60%	41.20%	25.80%
	Total		Count	330	76	17	423
			% within Size	78.00%	18.00%	4.00%	100.00%
			% within administration	100.00%	100.00%	100.00%	100.00%

In Port Elizabeth, none of the respondent firms indicated that they experience import administration services as below average. Table 47 shows that 79.20 per cent of the firms in Port Elizabeth experience above average import administration services, with 20.80 per cent of the firms experiencing import administration services as average. With small and medium firms, the vast majority experiences the administration of import services as above average, with 94.70 per cent and 82.40 per cent respectively. The response from large firms was more equally distributed between above average and average import administration services. From Table 47, 58.80 per cent of the large firms experience import administration to be above average with 41.20 per cent of the firms experiencing average import administration services.

Table 47: Administration of import services relative to city and firm size - Port Elizabeth

City				Import administration			Total
				Above average	Average	Below average	
Port Elizabeth	Size	Small (5-19 employees)	Count	18	1		19
			% within Size	94.70%	5.30%		100.00%
			% within administration	42.90%	9.10%		35.80%
		Medium (20-99 employees)	Count	14	3		17
			% within Size	82.40%	17.60%		100.00%
			% within administration	33.30%	27.30%		32.10%
		Large (100 employees and more)	Count	10	7		17
			% within Size	58.80%	41.20%		100.00%
			% within administration	23.80%	63.60%		32.10%
	Total		Count	42	11		53
			% within Size	79.20%	20.80%		100.00%
			% within administration	100.00%	100.00%		100.00%

To conclude the information on import administration services, it was found that in general the firms experience import administration services to be above average. The vast majority of small and medium firms experience above average administration services of imports, whereas large firms are more equally distributed in their experiences on import administration as being above average or average. From all the firms that find the service of import administration to be above average, the majority is medium-sized firms located in Durban, whereas the majority of firms that experience average import administration services are large firms located in Port Elizabeth.

The final factor to be considered in terms of city and firm size is communication. Table 48 shows the outcome of small, medium and large firms located in Cape Town. It is evident from Table 48 that the majority of firms in Cape Town experience communication services to be average (51.00 per cent) and below average (48.10 per cent). Only one medium-sized firm in Cape Town receives above average communication services. When considering firm size, 86.50 per cent of small firms receive average communication services, with 13.50 per cent of the small firms receiving below average communication services. None of the small firms experience above average communication services. The majority of both medium and large firms experience communication services to be below average, with 62.50 per cent and 74.10 per cent respectively.

Table 48: Communication services relative to city and firm size - Cape Town

City				Communication			Total
				Below average	Average	Above average	
Cape Town	Size	Small (5-19 employees)	Count	5	32	0	37
			% within Size	13.50%	86.50%	0.00%	100.00%
			% within Communication	10.00%	60.40%	0.00%	35.60%
		Medium (20-99 employees)	Count	25	14	1	40
			% within Size	62.50%	35.00%	2.50%	100.00%
			% within Communication	50.00%	26.40%	100.00%	38.50%
		Large (100 employees and more)	Count	20	7	0	27
			% within Size	74.10%	25.90%	0.00%	100.00%
			% within Communication	40.00%	13.20%	0.00%	26.00%
	Total		Count	50	53	1	104
			% within Size	48.10%	51.00%	1.00%	100.00%
			% within Communication	100.00%	100.00%	100.00%	100.00%

Table 49 shows that in Durban, 66.70 per cent of firms receive average communication services, with 33.30 per cent receiving communication services that are below average. The majority of both small (88.20 per cent) and medium (71.90 per cent) firms experience average communication services, with the majority of large (71.40 per cent) firms experiencing communication services that are below average. None of the firms in Durban experience above average communication services.

Table 49: Communication services relative to city and firm size - Durban

City				Communication			Total
				Below average	Average	Above average	
Durban	Size	Small (5-19 employees)	Count	2	15		17
			% within Size	11.80%	88.20%		100.00%
			% within Communication	9.50%	35.70%		27.00%
		Medium (20-99 employees)	Count	9	23		32
			% within Size	28.10%	71.90%		100.00%
			% within Communication	42.90%	54.80%		50.80%
		Large (100 employees and more)	Count	10	4		14
			% within Size	71.40%	28.60%		100.00%
			% within Communication	47.60%	9.50%		22.20%
	Total		Count	21	42		63
			% within Size	33.30%	66.70%		100.00%
			% within Communication	100.00%	100.00%		100.00%

Table 50 shows that 59.10 per cent of the firms in Johannesburg experience communication services that are average, with 40.4 per cent of the firms experiencing below average communication services. Only two firms in Johannesburg receive communication services that are above average, namely one small firm and one large firm. Taking firm size into account, Table 50 shows that the vast majority of small firms (89.90 per cent) receive average communication services, while medium firms are almost equally distributed between receiving below average (45.10 per cent) communication services and average (54.20 per cent) communication services. With large firms, the vast majority (80.60 per cent) of the firms receive communication services that are below average.

Table 50: Communication services relative to city and firm size – Johannesburg

City				Communication			Total
				Below average	Average	Above average	
Johannesburg	Size	Small (5-19 employees)	Count	14	134	1	149
			% within Size	9.40%	89.90%	0.70%	100.00%
			% within Communication	8.90%	58.30%	50.00%	38.30%
		Medium (20-99 employees)	Count	64	77	1	142
			% within Size	45.10%	54.20%	0.70%	100.00%
			% within Communication	40.80%	33.50%	50.00%	36.50%
		Large (100 employees and more)	Count	79	19	0	98
			% within Size	80.60%	19.40%	0.00%	100.00%
			% within Communication	50.30%	8.30%	0.00%	25.20%
	Total		Count	157	230	2	389
			% within Size	40.40%	59.10%	0.50%	100.00%
			% within Communication	100.00%	100.00%	100.00%	100.00%

In Port Elizabeth, the situation is much the same as in Durban. Table 51 shows that of all the respondent firms in Port Elizabeth, 62.50 per cent experience average communication services, while 37.50 per cent of the firms experience communication services that are below average. The majority of both small and medium firms (92.30 per cent and 72.70 per cent) receive average communication services. Most large firms, on the other hand, receive below average communication services. No firms in Port Elizabeth were found to experience communication services that are above average.

Table 51: Communication services relative to city and firm size - Port Elizabeth

City				Communication			Total
				Below average	Average	Above average	
Port Elizabeth	Size	Small (5-19 employees)	Count	1	12		13
			% within Size	7.70%	92.30%		100.00%
			% within Communication	6.70%	48.00%		32.50%
		Medium (20-99 employees)	Count	3	8		11
			% within Size	27.30%	72.70%		100.00%
			% within Communication	20.00%	32.00%		27.50%
		Large (100 employees and more)	Count	11	5		16
			% within Size	68.80%	31.30%		100.00%
			% within Communication	73.30%	20.00%		40.00%
	Total		Count	15	25		40
			% within Size	37.50%	62.50%		100.00%
			% within Communication	100.00%	100.00%		100.00%

To conclude firms' experiences of communication services, it follows that in general the respondent firms experience average communication services. Many firms also experience communication services that are below average, while very few experience above average communication services. The majority of small firms receive average communication services. Most medium-sized firms are equally distributed in their experience of communication services as being average and below average, while large firms in general experience below average communication services. Of all the firms that experience average communication services, the majority is small firms located in Cape Town, and of all the firms that receive communication services below average, the majority is large firms located in Port Elizabeth.

4.2.2 Factors relative to industries

The aim of this sub-section is to interpret the four factors, namely transport services, electricity services, import administration services and communication services, relative to the industries in the survey in order to see how these industries experience the public services of transport, electricity, import administration and communication that make up aggregate service delivery in this analysis.

Table 52 shows the outcome of how the firms in the various industries in the survey experience transport services in South Africa. Of all the firms that receive above average transport services, 28.7 per cent operate in manufacturing, 17.85 per cent in

the food industry and 17.1 per cent in the garments industry. When the focus is on the specific industries, it is clear that an average of between 60 per cent and 80 per cent of the firms in the industries of manufacturing, food, textiles, garments, chemicals, plastic and rubber, non-metallic mineral products and fabricated metal products receive above average transport services. Of the 34 and 22 firms operating in the machinery and equipment and electronics industries respectively, 44.1 per cent and 54.4 per cent experience above average transport services, while 40.1 per cent and 40.9 per cent experience average transport services respectively. Within the basic metals industries, there are only two firms included in the survey. These two firms experience average transport services, explaining the 100 per cent shown in Table 52.

Table 52: Crosstabulation of transport services and industries

			Industry											Total
			Other manufacturing	Food	Textiles	Garments	Chemicals	Plastics and rubber	Non-metallic mineral products	Basic metals	Fabricated metal products	Machinery and equipment	Electronics (31 & 32)	
Transport	Above average	Count	148	92	7	88	57	15	7	0	75	15	12	516
		% within Transport	28.7%	17.8%	1.4%	17.1%	11.0%	2.9%	1.4%	.0%	14.5%	2.9%	2.3%	100.0%
		% within Industry	84.6%	82.9%	77.8%	88.0%	68.7%	68.2%	87.5%	.0%	70.8%	44.1%	54.5%	76.8%
	Average	Count	24	16	1	10	20	7	0	2	27	14	9	130
		% within Transport	18.5%	12.3%	.8%	7.7%	15.4%	5.4%	.0%	1.5%	20.8%	10.8%	6.9%	100.0%
		% within Industry	13.7%	14.4%	11.1%	10.0%	24.1%	31.8%	.0%	100.0%	25.5%	41.2%	40.9%	19.3%
	Below average	Count	3	3	1	2	6	0	1	0	4	5	1	26
		% within Transport	11.5%	11.5%	3.8%	7.7%	23.1%	.0%	3.8%	.0%	15.4%	19.2%	3.8%	100.0%
		% within Industry	1.7%	2.7%	11.1%	2.0%	7.2%	.0%	12.5%	.0%	3.8%	14.7%	4.5%	3.9%
Total		Count	175	111	9	100	83	22	8	2	106	34	22	672
		% within Transport	26.0%	16.5%	1.3%	14.9%	12.4%	3.3%	1.2%	.3%	15.8%	5.1%	3.3%	100.0%
		% within Industry	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Electricity services received by firms in the various industries are shown in Table 53. In the textile industry, 77.8 per cent of the firms experience above average electricity services, with 62.4 per cent of firms in the garments industry also experiencing above

average electricity services. Apart from the electronics and basic metals industries, firms within the remaining industries all have almost equal experiences of above average and average electricity services, with the above average being the slight majority in every industry. In the basic metals industry, one firm receives above average electricity services and the other below average electricity services. It is only the electronics industry in which the majority of firms (59.1 per cent) receive average electricity services.

Table 53: Crosstabulation of electricity services and industries

			Industry											Total
			Other manufacturing	Food	Textiles	Garments	Chemicals	Plastics and rubber	Non-metallic mineral products	Basic metals	Fabricated metal products	Machinery and equipment	Electronics (31 & 32)	
Electricity	Above average	Count	94	57	7	63	40	12	4	1	51	17	7	353
		% within Electricity	26.6%	16.1%	2.0%	17.8%	11.3%	3.4%	1.1%	.3%	14.4%	4.8%	2.0%	100.0%
		% within Industry	53.4%	51.4%	77.8%	62.4%	48.2%	54.5%	50.0%	50.0%	48.1%	50.0%	31.8%	52.4%
	Average	Count	79	50	1	36	38	9	3	0	51	17	13	297
		% within Electricity	26.6%	16.8%	0.3%	12.1%	12.8%	3.0%	1.0%	0.0%	17.2%	5.7%	4.4%	100.0%
		% within Industry	44.9%	45.0%	11.1%	35.6%	45.8%	40.9%	37.5%	0.0%	48.1%	50.0%	59.1%	44.1%
	Below average	Count	3	4	1	2	5	1	1	1	4	0	2	24
		% within Electricity	12.5%	16.7%	4.2%	8.3%	20.8%	4.2%	4.2%	4.2%	16.7%	0.0%	8.3%	100.0%
		% within Industry	1.7%	3.6%	11.1%	2.0%	6.0%	4.5%	12.5%	50.0%	3.8%	0.0%	9.1%	3.6%
Total		Count	176	111	9	101	83	22	8	2	106	34	22	674
		% within Electricity	26.1%	16.5%	1.3%	15.0%	12.3%	3.3%	1.2%	.3%	15.7%	5.0%	3.3%	100.0%
		% within Industry	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The administration services of imports are the next factor to be discussed in terms of the various industries. Table 54 shows the outcome. In all the industries, apart from the electronics industries, an average of between 65 per cent and 100 per cent of the firms experience above average import administration services. It is the firms operating in the industries of non-metallic mineral products and basic metals that all receive above average import administration services. In the electronics industry, only 40.9 per cent of

the firms experience above average import administration services, with 54.4 per cent of the firms receiving only average import administration services. There is only a very small number of firms that receive below average import administration services.

Table 54: Crosstabulation of import administration services and industries

			Industry											Total
			Other manufacturing	Food	Textiles	Garments	Chemicals	Plastics and rubber	Non-metallic mineral products	Basic metals	Fabricated metal products	Machinery and equipment	Electronics	
Import administration	Above average	Count	142	81	7	79	57	18	8	2	83	23	9	509
		% within administration	27.9%	15.9%	1.4%	15.5%	11.2%	3.5%	1.6%	0.4%	16.3%	4.5%	1.8%	100.0%
		% within Industry	80.7%	73.0%	87.5%	78.2%	68.7%	81.8%	100.0%	100.0%	77.6%	67.6%	40.9%	75.5%
	Average	Count	24	29	1	22	22	3	0	0	22	8	12	143
		% within administration	16.8%	20.3%	0.7%	15.4%	15.4%	2.1%	0.0%	0.0%	15.4%	5.6%	8.4%	100.0%
		% within Industry	13.6%	26.1%	12.5%	21.8%	26.5%	13.6%	0.0%	0.0%	20.6%	23.5%	54.5%	21.2%
	Below average	Count	10	1	0	0	4	1	0	0	2	3	1	22
		% within administration	45.5%	4.5%	0.0%	0.0%	18.2%	4.5%	0.0%	0.0%	9.1%	13.6%	4.5%	100.0%
		% within Industry	5.7%	0.9%	0.0%	0.0%	4.8%	4.5%	0.0%	0.0%	1.9%	8.8%	4.5%	3.3%
Total		Count	176	111	8	101	83	22	8	2	107	34	22	674
		% within administration	26.1%	16.5%	1.2%	15.0%	12.3%	3.3%	1.2%	0.3%	15.9%	5.0%	3.3%	100.0%
		% within Industry	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The last factor to consider is communication services. Table 55 shows the level of communication services experienced by the firms in the various industries. In the industries of chemicals (61.1 per cent), non-metallic mineral products (83.3 per cent), basic metals (100 per cent), machinery and equipments (63.6 per cent) and electronics (60.0 per cent), the majority of firms receive below average communication services. Whereas in the industries of manufacturing (64.6 per cent), food (64.3 per cent), textile (57.1 per cent), garments (76.7 per cent), plastics and rubber (55.6 per cent) and fabricated metal products (59.4 per cent), the majority of firms experience average communication services. An exceptionally small number of firms receive above average communication services.

Table 55: Cross-tabulation of communication services and industries

			Industry											Total
			Other manufacturing	Food	Textiles	Garments	Chemicals	Plastics and rubber	Non-metallic mineral products	Basic metals	Fabricated metal products	Machinery and equipment	Electronics (31 & 32)	
Communication	Below average	Count	55	35	3	19	44	8	5	2	39	21	12	243
		% within Communication	22.6%	14.4%	1.2%	7.8%	18.1%	3.3%	2.1%	.8%	16.0%	8.6%	4.9%	100%
		% within Industry	34.8%	35.7%	42.9%	22.1%	61.1%	44.4%	83.3%	100%	40.6%	63.6%	60.0%	40.8%
	Average	Count	102	63	4	66	27	10	1	0	57	12	8	350
		% within Communication	29.1%	18.0%	1.1%	18.9%	7.7%	2.9%	0.3%	0.0%	16.3%	3.4%	2.3%	100%
		% within Industry	64.6%	64.3%	57.1%	76.7%	37.5%	55.6%	16.7%	0.0%	59.4%	36.4%	40.0%	58.7%
	Above average	Count	1	0	0	1	1	0	0	0	0	0	0	3
		% within Communication	33.3%	0.0%	0.0%	33.3%	33.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%
		% within Industry	0.6%	0.0%	0.0%	1.2%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%
Total		Count	158	98	7	86	72	18	6	2	96	33	20	596
		% within Communication	26.5%	16.4%	1.2%	14.4%	12.1%	3.0%	1.0%	0.3%	16.1%	5.5%	3.4%	100%
		% within Industry	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

To conclude, the above tables indicate that the majority of firms in the various industries, apart from the firms in the basic metals, machinery and equipment and electronics industries, receive above average transport services. Firms operating in the industries of machinery and equipment and electronics are divided between above average and average transport services. The two firms in the survey operating in the basic metals industry, both receive average transport services. The majority of firms in the textile and garments industries experience above average electricity services, whereas firms in the remaining industries are evenly distributed in their experience of above average and average electricity services. When considering the services of import administration, the majority of the firms in the various industries, apart from the electronics industry, receive above average import administration services. The majority of firms operating in the industry of electronics receive average import administration services. A very small number of the firms receive above average communication

services. It seems as though communication services experienced by the firms in the various industries vary between below average and average.

4.3 Summary and conclusions

In this chapter, PCA was used by means of SPSS to construct an infrastructure service delivery indicator. Transport, electricity, import administration and communication services are the four main factors that make up aggregate infrastructure service delivery to the firms in this survey. Each of these factors was discussed with regard to both city and firm size.

- In the four cities, firms experience above average transport services. The majority of small and medium-sized firms experience above average transport services, while the majority of large firms receive average transport services.
- Considering electricity services, firms located in Cape Town, Durban and Port Elizabeth receive above average electricity services, with Johannesburg firms experiencing average electricity services. Large-sized firms account for the majority that experience average electricity services, while small firms in general receive above average electricity services.
- In general, the firms experience the administration of import services to be above average.
- The majority of the firms experience average communication services, especially small-sized firms and some medium-sized firms. The greatest concern is the large-sized firms, since the vast majority experience below average communication services.

In general, the results are more satisfying than expected. Transport, electricity, import administration and communication services were also considered with regard to the various industries. The results show the following:

- Apart from the firms in the basic metals, machinery and equipment and electronics industries, the majority of firms in the various industries receive above average transport services. The firms operating in the industries of machinery

and equipment and electronics are divided between above average and average transport services.

- The majority of firms in the textile and garments industries experience above average electricity services, whereas firms in the remaining industries are evenly distributed in their experience of above average and average electricity services.
- When considering the services of import administration, the majority of the firms in the various industries, apart from the electronics industry, receive above average import administration services. The majority of firms operating in the industry of electronics receive average import administration services.
- A small number of the firms receive above average communication services. The majority of firms in the various industries experience communication services to be between below average and average.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

Since 1994, the South African Government has accomplished greater economic growth, a reduction in the fiscal deficit, lower inflation as well as tax relief for corporates and individuals. Regardless of these accomplishments, South Africa as a country is still struggling with a number of difficulties, including high unemployment, unequal income distributions as well as extreme poverty and crime. To overcome these problems, the majority of studies show that sustainable job creation is essential. It is the responsibility of the Government to take active steps that will guarantee favourable economic and social conditions through which employment opportunities can be created. Part of these steps that the Government can take, and has been taking, is the provision of public goods and services, specifically the provision of infrastructure that has been seen as key to creating an environment conducive to growth and development. The issue of service delivery in the academic literature and popular press is focussed on households and delivery of basic services, while limited research has been done on the level of firms and basic service delivery. This dissertation aimed to reduce this gap in literature and link the public goods to the private firms generating the economic growth and employment opportunities for development. More specifically, this dissertation aimed to determine what private firms' experiences of public service delivery are, whether it differs between the major cities in South Africa and whether firm size matters.

Chapter 2 discussed various parts of the literature regarding infrastructure. Economic growth models date back to the 1940s; however, it was only after the 1970s in the United States that the significance of public infrastructure investment to the economic growth model was investigated. Since then, many studies have followed and the results show that good public infrastructure, such as water, electricity and transport, generates greater productivity and output, which leads to economic growth and development. The channels through which this growth is generated can be direct or indirect. In a direct manner, infrastructure is regarded as an input in the production process, where an increase in the infrastructure stock increases the output directly, generating economic growth. Through the indirect channel, infrastructure is regarded as a complement to the other inputs in the production process in two ways. Firstly, infrastructure investment lowers the production costs and secondly it improves the productivity as well as the

accumulation of other input factors. Apart from these channels, infrastructure investment also generates certain positive externalities, including an enhanced international trade performance as well as increased competitiveness of the country due to higher productivity and lower prices. This shows that public service delivery in specific infrastructure, such as water, electricity and transport, is essential to overcome the difficulties faced by South Africa by creating greater economic growth and development.

This public infrastructure investment will, however, not be sufficient if the ratio on infrastructure quality quantity is not optimal and the existing infrastructure is not being maintained. Literature highlights the statistically significant and positive effect of quality infrastructure on the productivity and production costs of private firms. However, even if the quantity and quality of the infrastructure are sufficient and effective, without maintenance this positive relationship does not hold. Poor infrastructure maintenance leads to reduced service quality, increased costs and reduced supply of goods. This leads us to the important role of the government in providing public services. The debate on government intervention in the economy is ongoing; however, the arguments that the market will fail to provide sufficient infrastructure are still strong and suggest that Government intervention to a certain extent is required. With regard to the important role of supplied, quality infrastructure to a country's economic growth and development, the role of the government in the delivery of public goods and services should not even be questioned.

In addition to its public-goods nature, infrastructure also has particular spatial characteristics. Porter (1990) and Krugman (1991) highlighted the fact that economic growth and performance are influenced by geography. The characteristics of an urban area create a number of potential economic opportunities in each of these areas. The advantages that derive from economic activities that are spatially concentrated are known as agglomeration economies. While the literature on the effect of agglomeration economies and public infrastructure has received significant attention, these two subjects have rarely been studied together. From the research that has been done it is shown that public infrastructure does have a positive and statistically significant effect on a firm's productivity in metropolitan areas, thus creating a situation in which agglomeration economies exist.

When focussing on South Africa, it was shown that the public infrastructure investment per capita has declined by 72 per cent during the period 1976 to 2002. Investment as a percentage of GDP has also decreased from 8.1 per cent to 2.4 per cent over the same period. According to Fedderke *et al*. (2006:1037), it appears that economic growth in South Africa is led by infrastructure investment. This highlights the importance of determining how firms in South Africa experience public infrastructure services. In a study of certain infrastructure types, specifically transport, electricity and water in South Africa, the literature shows that compared to its benchmark of upper middle-income countries there are certain areas in which South Africa's transport sector under-performs. This includes transport infrastructure of road and rail line density in terms of land, travel time to work in main cities and the percentage of paved roads. When it comes to the commercial perceptions of services of the Roads Department and air transport, South Africa exceeds the benchmark considerably. The perceptions of railroad services and port facilities are also above the benchmark, although not as much as roads and air transport. In terms of electricity, literature shows that several problems have recently emerged with regard to the efficiency and functioning of ESKOM, which undermines its utility. The distribution of electricity is inefficient and financial difficulties have emerged. Together with this, South Africa's electricity reserve margins, which were once considered as one of the highest in the world, have fallen to such an extent that it threatens the adequacy and reliability of electricity provision by ESKOM. This crucial situation led ESKOM to a number of interventions during 2008, including national awareness campaigns and load-shedding. At present, both medium- and long-term programmes are being developed by the government in an attempt to enable South Africa to manage the future electricity demand. Water scarcity in South Africa has increased significantly, creating a situation in which the need for water management is imperative. The main drivers for the changing water resources are the changing climate together with changing land use and degradation. Management of all these factors is essential in order to avoid the future impacts thereof on production and economic growth generation in South Africa.

Therefore, through the literature review it was found that public service delivery, specifically transport, electricity and water, has statistically significant effects on productivity and output, creating economic growth and development that are needed to

overcome the difficulties, such as unemployment, inequality, poverty and crime that are still faced by South Africa.

Chapter 3 gave a broad overview of the 2007 World Bank Enterprise survey data, relevant to the study. The data included place identifiers for firms in South Africa's four major urban agglomerations: Cape Town, Port Elizabeth, Durban and the greater Gauteng economy that groups together Johannesburg, the East Rand and Pretoria. The data comprises of information collected from 1057 small (5-19 employees), medium (20-99 employees) and large (100 employees and more) firms operating in various industries. The majority of the firms' main market is local with an average capacity utilisation of 79.03 per cent and average operating hours per week of 50.72 per cent. Crime, theft and disorder, electricity and corruption are the three most severe obstacles perceived by the respondent firms for doing business in South Africa. From the descriptive statistics on infrastructure, including information on electricity, water, internet connections and transport, it was found that the majority of firms that share or own a generator are located in Johannesburg, while Cape Town is the city in which the most firms own or share a generator. Firms experienced an average of one to four power outages in a month, which lasted an average of one to four hours. This caused the firms to lose an average of zero to five per cent of their sales, due to power outages. From the water infrastructure data, it is concluded that the majority of firms find water supply for production sufficient and with regard to internet connections, the majority of firms indicate that they do not experience a problem with internet connection availability. Those firms that do indicate unavailability, experience it on average 90 times per month and it lasts up to an average of two to five hours. Finally, in terms of transport, the majority of firms in each city use their own transport.

Chapter 4 presented an infrastructure service delivery indicator constructed by means of Principle Component Analysis using SPSS and the 2007 World Bank Enterprise Survey data. Transport, electricity, import administration and communication services were the four factors identified through PCA as the factors generating aggregate service delivery in South Africa. When considering the four identified factors relative to cities, firm size and industries, it was found that in general firms experience above average to average transport, electricity and import administration services, while receiving average to below average communication services. With all four factors, the services received by large firms raise the greatest concern.

Apart from the firms in the basic metals, machinery and equipment and electronics industries, the majority of firms in the various industries receive above average transport services. The firms operating in the industries of machinery and equipment and electronics are divided between above average and average transport services. The majority of firms in the textile and garments industries experience above average electricity services, whereas firms in the remaining industries are evenly distributed in their experience of above average and average electricity services. When considering the services of import administration, the majority of the firms in the various industries, apart from the electronics industry, receive above average import administration services. The majority of firms operating in the industry of electronics receive average import administration services. A small number of the firms receive above average communication services. The majority of firms in the various industries experience communication services to be between below average and average. The results are thus more satisfying than expected.

5.2 Conclusion

South Africa is still facing difficulties of high unemployment, inequality, extreme poverty as well as crime. In light of these predicaments, the aim of this study was to identify the role of infrastructure in a growth-enabling environment at the aggregate, economic-wide level. In specific, the primary goal was to determine what private firms' experiences of public service delivery are, whether the situation differs between firms situated in Johannesburg, Cape Town, Port Elizabeth and Durban and whether firm size matters.

Through the literature study, the important role of infrastructure to generate faster economic growth and development was highlighted. It is clear that efficient infrastructure, such as transport, electricity and water, has a statistically significant effect on both firm productivity and output. These are factors that contribute to better firm performance and eventually firm growth.

When considering the results from the data analysis, it was found that the perception of public infrastructure in South Africa does not always reflect the experience. According to the 2007 World Bank Enterprise survey data, firms in the four major metropolitan cities in South Africa experience public infrastructure much more acceptable than expected. In general, firms receive above average to average transport, electricity and import administration services and below average to average communication services in South

Africa. It was also found that small and medium-sized firms in general experience above average services, whereas large firms experience only average services. This situation does not differ significantly between the four cities.

It might be that the firms adapt to the market situations. For example, if a firm experiences poor transport services, the firm might buy its own vehicle in order to be more productive and in this sense does not consider transport services to be poor, due to their ability to adapt. A similar conclusion might be drawn in terms of electricity, where a firm adapts to the situation of power-outages by purchasing a generator. Therefore, the results differ from the perceptions, but it might be due to the adaptation ability of the firms in South Africa.

There is always room for improvement and the South African Government should look into greater infrastructure investment, since good infrastructure has such a significant impact on firm growth and economic development. However, it can be said that it seems that current public infrastructure services are not a burden to firms' performance and economic growth in South Africa.

5.3 Recommendation

The significant importance of supplied and efficient public infrastructure services to private firms in South Africa has been highlighted through this dissertation. It is important that further research is done on each specific public infrastructure type in South Africa and that the magnitude of importance of these infrastructure types to firms is determined. We need to know more about the links between public goods and private firms at the firm level. From there, policymakers should review policies on public services delivery and ensure that each infrastructure type receives the necessary attention in determining the ratio of quantity vs. quality as well as maintenance. With the understanding of the importance of public service delivery to firms in generating economic growth and development by policymakers, researchers and economists, the difficulties still faced by South Africa and South Africans can be addressed and will be prevailed upon.

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