Some policy proposals for future infrastructure investment in South Africa

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ABSTRACT

The South African government has begun to ramp up economic infrastructure investment. This is an important policy shift and in line with the government's aim of increasing economic growth to 6% and halving poverty by 2014. It follows that we are left with the question: What are the most important areas for infrastructure investment, both type and location? This paper provides a short review of the essential characteristics of infrastructure as well as a guide to the past and present features of South Africa's infrastructure stock. Three main policy proposals are made: provide basic infrastructure to all, improve the quality of existing infrastructure, and provide transnational infrastructure. Since 1994, the government has increased the access to basic services of a large part of the population, although there is still room for improvement. However, a lack of institutional and managerial capacity at the local level seems to be a constraint on delivering basic infrastructure services. Furthermore, comparative analysis reveals that the country's infrastructure quality lag those of other countries. However, politicians may prefer to provide new infrastructure rather than improving existing infrastructure, as it provides a wider support base. This could lead to significant inefficiencies, especially with the politically sensitive 2010 Soccer World Cup approaching. Regional integration is an important long-term requirement to ensure sustainable economic growth and prosperity for the countries of southern Africa. Currently, South Africa is poorly integrated into the rest of Africa. The current transnational institutions – SACU, SADC, NEPAD – do not have the institutional and financial capacity to provide such infrastructure. A strong emphasis on providing transnational infrastructure – specifically transport, energy and ICT infrastructure – is proposed.

Keywords: infrastructure, South Africa, basic services, transnational
JEL codes: H54, N77, R53, L90

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INTRODUCTION

The South African government has begun to ramp up economic infrastructure investment. This is an important policy shift and in line with the government's aim of increasing economic growth to 6% and halving poverty by 2014. It follows that we are left with the question: What are the most important areas for infrastructure investment, both type and location?

To answer this, a good understanding of the past and present characteristics of South Africa's infrastructure stock is needed. Mostly because of large investments during the 1960s and 1970s, the quantity of infrastructure in South Africa is still good. Since 1994, the government has also increased the access to basic services of a large part of the population, although there is still room for improvement. However, a lack of institutional and managerial capacity at the local level seems to be a constraint on delivering basic infrastructure services.

Furthermore, comparative analysis reveals that the country's infrastructure quality lag those of other countries. Because future growth will follow a relatively static spatial pattern[2], improving the quality of the existing infrastructure and the quality of the infrastructure services in current areas of economic growth (mainly the metropolitan and some urban areas) is fundamental in attaining higher growth. However, politicians may prefer to provide new infrastructure rather than improving existing infrastructure, as it provides a wider support base. This could lead to significant inefficiencies, especially with the politically sensitive 2010 Soccer World Cup approaching.

Regional integration is an important long-term requirement to ensure sustainable economic growth and prosperity for the countries of southern Africa. Furthermore, the trend of globalisation and technological improvements, which creates positive externalities, shifts many national level infrastructure into the realms of transnational infrastructure. Currently, South Africa is poorly integrated into the rest of Africa. The current transnational institutions – SACU, SADC, NEPAD – do not have the institutional and financial capacity to provide such infrastructure. If countries do not cooperate, too little infrastructure will be provided and the positive externalities will not be created. A strong emphasis on providing transnational infrastructure – specifically transport, energy and ICT infrastructure – is proposed.

BACKGROUND

Hirschmann (1958) defines infrastructure as "capital goods that provide public services". His definition implies that there are public capital goods that are not infrastructure – such as military equipment – and non-public capital goods that are infrastructure – such as privately-owned telecommunications infrastructure. Apart from Hirschmann's succinct definition, which has been accepted widely in the literature, an area of greater debate is the distinction between economic and social infrastructure. Economic infrastructure is defined as infrastructure that promotes economic activity, including roads, electrical lines and water pipes. Social infrastructure promotes health, educational and cultural standards of the population, which include schools, clinics, parks and statues (DBSA 1998:4). Of course, economic and social infrastructure overlap. Sanitation services would add to people's health, as well as promote economic activity. Housing is an even more contentious issue. Given these various overlaps, this paper only concerns the case for economic infrastructure in South Africa. Social infrastructure is not discussed.

A difference exists between infrastructure and the services it provides. Infrastructure can be classified as the actual telephone lines, power plants and inter-city railway. Infrastructure services are the

[2] National Spatial Development Perspective (2003:10)

telephone calls, the power generated and the inter-city trains. It is an important distinction that will become clear in later sections.

Economic infrastructure impacts on economic growth in three ways. Firstly, infrastructure investment brings about the ability to render infrastructure services. These services are inputs in the production process of many products. Better infrastructure means better services (either cheaper or better quality, i.e. better value for money). Infrastructure investment therefore leads to economic growth. This is known as the direct effect. Economic infrastructure also has an indirect impact on economic growth. Infrastructure investment raises the productivity of workers. A classic example is that of electricity grid access in the construction industry; whereas previously, workers had to dig a whole manually with shovels and spades, with electricity access, a drilling machine can be used to drill faster and more precisely. Thirdly, infrastructure also benefits the construction industry, and therefore, growth. Although these benefits are mostly pecuniary, is still serves a distributional purpose, shifting growth to the construction industry. Infrastructure investment also creates significant positive externalities in at least four other areas that are related to economic growth: trade, competitiveness, regional integration and tourism. According to Canning (1999:3), infrastructure creates large externalities in the form of positive spillovers, so that their contribution to total output exceeds the private returns to their purchasers.

Although these positive spillovers take on various forms, it does depend on the type of infrastructure. Different types of infrastructure have different impacts. Whereas one type of infrastructure would impact only in the area in which it is built (street lights), another type may have large positive spillovers into other areas (cell phone tower). For simplicity, three levels of infrastructure are distinguished: local, national and transnational infrastructure[3]. The borders of these levels are continually shifting as new technologies come about. International trends, such as globalisation and localisation may also shift the incidence of existing infrastructure.

Urban planners and engineers usually refer to infrastructure at the local level. In economics, cost-benefit analysis or club theory is used to assess the impact of local level infrastructure. Cost-benefit analysis calculates the net present value (NPV) of the proposed project and the project is approved if the NPV is above zero (or the present value of the future stream of benefits exceeds the present value of the future stream of costs). According to Musgrave (1969:799), when calculating the benefits, ideally, purely pecuniary benefits should not be allowed for, while all other benefits (internal and external, direct and indirect, tangible and intangible, anticipated and unanticipated) should be included. Of course, not all these costs and benefits are measurable for all infrastructure types, rendering cost-benefit analysis only viable for infrastructure with limited externalities. Secondly, the theory of clubs also makes a contribution to assessing the impact of local public goods (Buchanan 1965, Olson 1965). Clubs are formed because it may be possible to divide the population into two or more groups, each group enjoying its own public goods, but not that of the other (Oakland 1987:502). Furthermore, clubs may form due to a spatial dimension, as some public goods only provides benefits to those residents of a particular geographic region (Oakland 1987:503). A variation of the theory of clubs is Tiebout's (1956) "voting with the feet"-model which argues that if there were a large number of local government jurisdictions, each offering a different set of local pure public goods, then individuals will reveal their true preferences by choosing the jurisdiction which comes closest to satisfy their preferences. Again, club theory, as with cost-benefit analysis, has little to say about positive spillovers to other jurisdictions.

[3] More levels could be added, such as provincial (in the case of South Africa) or federal (in the case of the US). However, for ease of discussion, only these three levels are used, as the same arguments apply to choosing any number of levels above three.

Apart from infrastructure benefiting a community with little spill-over effects to other regions, some infrastructure goods may, in fact, have regional (provincial) or national benefits. A national highway system connecting the major cities and towns benefit all individuals in a country, and not only those in a specific region, although the benefits might not be shared equally (as it will benefit those with vehicles more than others). Transnational public goods can be split into two polar categories: public goods with its main impact on the country of origin and its neighbours, known as regional public goods (such as an inter-country railway); and public goods with a world-wide impact, affecting the world population, known as global public goods (such as the World Wide Web).[4]

The difference between the positive social benefits from infrastructure and the cost to the purchases (private benefit) makes a case for government intervention. Adam Smith, in his *Wealth of Nations* of 1776, already noted that not all goods will be provided sufficiently by the market. He recognised three roles for the state: that it should protect the citizens from outside invasion, that it should protect citizens from themselves and "that of erecting and maintaining those public institutions and those public works, which, though they may be in the highest degree advantageous to a great society, are, however, of such a nature, that the profit could never repay individuals, and which it therefore cannot be expected that any individual or small number of individuals should erect or maintain" (Smith 1776/1976; Book V, Chapter I: III(I)).

Due to incomplete markets, infrastructure are provided by the government as public goods (Samuelson (1954) showed mathematically why public goods require government intervention) or merit goods (Pigou (1918) showed that some goods have a higher social than private benefit, now known as positive externalities).[5] Coase (1960) offers a solution to these market failures, suggesting that property rights be defined. In the case of infrastructure, however, too many players in the market will result in an inability to reach agreement. Government provision – or regulation to reduce bargaining costs – are the only solutions.

But governments may, in the case of transnational public goods, be the player rather than the observer. Laffont and Martimort (2005) show that due to information asymmetries between countries, the optimal level of transnational infrastructure will be difficult to reach. Therefore, just as five consumers will struggle to find consensus on the price of a street light, so too will countries fail to find a solution on an inter-country railway, except if an transnational institution, such as SACU, SADC or NEPAD in southern Africa, performs the role of government.

However, even though a strong case for government (or institution) intervention in infrastructure investment can be made, according to Musgrave (1985:2), the fundamental problem of fiscal theory, both at local, national and transnational level, is to decide *what* public goods to provide and *how much*. This requires knowing consumer preferences (Musgrave and Musgrave 2003). Although perfect preference revelation is often assumed in theoretical models – such as Samuelson's (1954) omniscient observer – obtaining it "becomes a major challenge when it comes to actual policy" (Musgrave and Musgrave 2003). Wicksell (1884) was the first to focus on the problem of preference revelation in public good theory. He suggested that it can be overcome in democratic societies where consumers vote for politicians that have the most favourable tax and expenditure policies. From this developed

[4] Of course, a continuum of transnational public goods exist, as a regional public good may impact on non-neighbouring countries, or a global public good may impact closer to home.

[5] Mueller (2003:25) extends the Samuelsonian pure public good mathematical model to externalities. A comparison between the models reveals that their Pareto-optimal condition is exactly the same. Mueller (2003:26-27), however, notes that the only difference between public goods and externalities is that, in the case of the public good, all the members of the society consumes the same good, while in the case of the externality, the consumption of the secondary party (or parties) may differ from the consumption of the direct purchaser of the good.

the public choice literature as a sub-discipline, in part to determine the optimal voting behaviour required for efficient provision (Arrow 1951; Buchanan and Tullock 1967; Buchanan 1954).

Fact is: the "science of public finance should always keep political conditions clearly in mind" (Wicksell 1884, quoted in Buchanan 1987:243). Seperating the 'What type of infrastructure?' from the 'Who decides about the infrastructure?' is inevitably impossible.

INFRASTRUCTURE DEVELOPMENT IN SOUTH AFRICA

David Livingston and Henry Morton Stanley, African explorers, noted in their journals the immense difficulties traders and merchants had to overcome in Africa[6]. The poor transport infrastructure that existed in the interior – a few footpaths and waterways not suitable for large watercraft, even though trade in ivory and slaves by mostly Arab traders had existed for centuries – was a result of adverse geographic and environmental conditions – tough terrain, including treacherous jungles, marshes and scorching deserts combined with deadly insect-carrying diseases, such as malaria, yellow fever and bilharzia. Furthermore, fractionalised local kings ruled the land, increasing the costs of transport, as each king had to be paid a fee for crossing his land.

Africa's geographical disadvantages were already noted by Adam Smith (1776/1976, Book I, Chapter III: VIII). He writes: "There are in Africa none of those great inlets, such as the Baltic and Adriatic seas in Europe, the Mediterranean and Euxine seas in both Europe and Asia, and the gulphs of Arabia, Persia, India, Bengal, and Siam, in Asia, to carry maritime commerce into the interior parts of that great continent: and the great rivers of Africa are at too great a distance from one another to give occasion to any considerable inland navigation". The lack of navigable rivers is an important disadvantage in initial development[7].

Geography is an important determinant of development and, specifically, of the type of infrastructure that is required. According to Sachs *et al.* (2004:131), most Africans today live in the interior of the continent, due to better soil quality, more stable rainfall patterns and centuries of slave trade that made it dangerous for Africans to live close to the coast[8]. The landlockedness of the people creates, in addition to the already difficult terrain, exorbitant transport costs, which recent empirical evidence supports (Starkey *et al.* 2002). Furthermore, the problems of isolation are compounded by the small market size of the African countries. According to Jerome (1999:2), efficient infrastructure is particularly important for the many countries that are landlocked. "Nearly all landlocked countries in the world are poor, except a handful in Western Europe that are closely integrated into the EC via an efficient infrastructure which facilitates low-cost trade" (Jerome 1999:2). However, according to Collier and Gunning (1999:101), while Africa suffers from some geographic disadvantage, these are not "sufficient to condemn the continent to continued slow growth".

A number of geopolitical problems also persist in Africa. The centuries of slave trade depopulated the coastal regions of the continent and helped undermine the formation of nation-states (Sachs *et al.*

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[6] See Stanley (1872)

[7] "Since such, therefore, are the advantages of water-carriage, it is natural that the first improvements of art and industry should be made where this convenience opens the whole world for a market to the produce of every sort of labour, and that they should always be much later in extending themselves into the inland parts of the country. The nations that, according to the best authenticated history, appear to have been first civilised, were those that dwelt round the coast of the Mediterranean sea" (Smith 1776/1976, Book I, Chapter III: V and VI).

[8] Although it is true that slaves closer to the coast was initially captured and traded, traders later used the Africans that lived close to the coast as mediators to capture slaves in the interior. It is the protection that Africans received from their kings that determined whether they were exposed to slavery rather than whether they were located to the coast or not.

2004:136). Colonial rule did not fare much better. According to Sachs *et al.* (2004:136), "at the end of the colonial period, most of Africa was left with tragically little infrastructure and education, far less than in postcolonial Asia". Furthermore, most of the infrastructure was built primarily for extractive purposes. Railways, for example, were constructed to carry inland natural resources to harbours, without concern for the transport needs of the local population. Independence from colonial powers was followed by manipulative cold war strategies. Although many African leaders exacerbated these abuses through corrupt and authoritarian conduct, Sachs *et al.* (2004:136) argue that "if it is true that these leaders hanged themselves and their fellow citizens, the rich countries often provided the rope". Both poor geography and poor politics are factors in Africa's poor economic performance. Africa's lack of adequate infrastructure quantity and quality is a visible reminder.

South Africa shares to some extent these African woes. There are in South Africa also no large navigable rivers to ease the costs of trade. Poor soil quality and unfavourable weather patterns in large areas restrict agricultural production possibilities. However, to a large extent South Africa is also unique in sub-Saharan Africa in its geographical characteristics. Although some areas are plagued by malaria, these areas are limited to the eastern parts of the country. Furthermore, South Africa is the only country to be bordered by both the Indian and Atlantic oceans, enabling trade with the outside world without having to cross a political border.

Primarily two geographical determinants hamper infrastructure development in South Africa. First, South Africa's distance from large markets is a big constraint on trade. The low trade between South Africa and other markets in sub-Saharan Africa, even before European arrival, are reminiscent of the geographical difficulties between South Africa and the African interior that create high transport costs. The many tiny African kingdoms added to the high transport costs and the lack of large markets. Secondly, South Africa's topography[9] raises transport costs between the main economic centers in the interior and the ports and harbours on the coast. Because of no navigable rivers, other, more expensive forms of transport had to be provided, increasing the costs of doing business. These geographical and geopolitical constraints remain to this day.

Infrastructure development in South Africa remained restricted to the coastal areas until the discovery, first, of diamonds in the Kimberley-region (1867) and, later, the discovery of gold on the Witwatersrand (1886). The rapid development of the interior following these discoveries meant large investments in infrastructure; Kimberley, for example, was the first town to install electric street lights in the world. As the mines developed and became more profitable due to economies of scale, government revenue (income from taxes) also increased. Initially, the higher revenue was returned in the form of railway infrastructure – Wellington was connected to Kimberley in 1885, and Johannesburg was connected to Cape Town, Port Elizabeth and East London by 1892, and to Durban by 1896 (Perkins, Fedderke and Luiz 2005a:215). Paul Kruger's ideal of a railway linking Johannesburg with the coast through non-British territory as a means of becoming independent from Britain was realised with the completion of the Johannesburg-Lourenço Marques line in 1894 (Perkins, Fedderke and Luiz 2005a:216).

Later on, when railway infrastructure reached a plateau in the 1930s, the income from the mines was then devoted "to improvements to the transport infrastructure, notably the development of new ports and associated railway lines at Saldanha Bay on the west coast and Richards Bay on the east coast. The national road system was also greatly extended and improved during the 1970s" (Feinstein 2005:208).

[9] Specifically we refer to the height above sea-level of the main areas of economic activity, such as the Gauteng region in South Africa.

The twentieth century also brought vast improvements in technology; nowhere more evident than in the development of telecommunications infrastructure[10]. However, it was another factor of the twentieth century that shaped the provision and distribution of infrastructure in South Africa to an even greater extent: politics. Much of the infrastructure in South Africa during the years of Apartheid (1948-1994) was provided to advance the key objective of the Apartheid government, that of racial segregation. For example, the homelands policy would have generated large expenditure in areas that added little economic value (DBSA 1998:13). Of course, as Wicksell points out, the science of public finance should always keep political conditions clearly in mind; political policies and decisions will always influence the allocation and distribution of infrastructure. However, it is possible to assume that infrastructure during this period tended to be provided different from what would have been the case had the severe restrictions of Apartheid not existed. The path dependency of these political decisions also determines to a large degree the effectiveness of quantitative analysis.

To measure infrastructure quantitatively, Perkins (2003) recently collected infrastructure data for South Africa since its early development. The data are explained in the appendix and more elaborately in Perkins (2003). Figure 1 shows indices for the various measures of infrastructure since 1938. Although comparisons between the different measures are not justified, a time comparison is in order. It is clear that railway infrastructure was relatively at the same level in the early 1930s as today, while paved roads, cargo handled at ports and electricity generation grew strongly in the 1970s. Total telephone lines, mostly because of the advent of cellular technology, exploded in the 1990s.

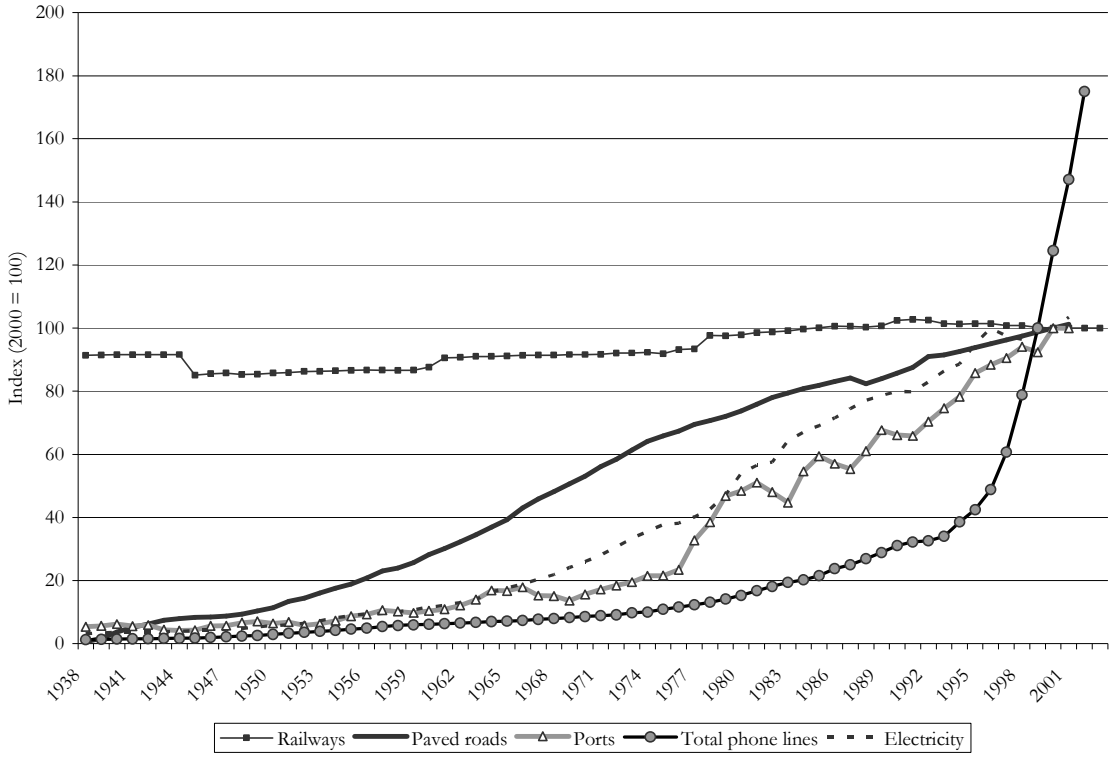

Figure 1. Railway lines, paved roads, cargo handled in ports, total phone lines and electricity generated. All variables indexed.
Source: Perkins (2003).

[10] While the first telegraph transmission between Cape Town and London took place in 1883, a century later, in 1983, the first optic fibre cable system was introduced between in Gauteng (Telkom 2006).

Another way to measure infrastructure quantitatively is to look at the infrastructure indices per capita. Figure 2 shows the results. Railway infrastructure decreased significantly in per capita terms since the early 1930s, paved roads reached a maximum by the 1970s and electricity generation peaked by the late 1980s and again in the 1990s. Port infrastructure per capita tended to vary over time with an increasing trend while telephone lines per capita again showed significant increases in the 1990s.

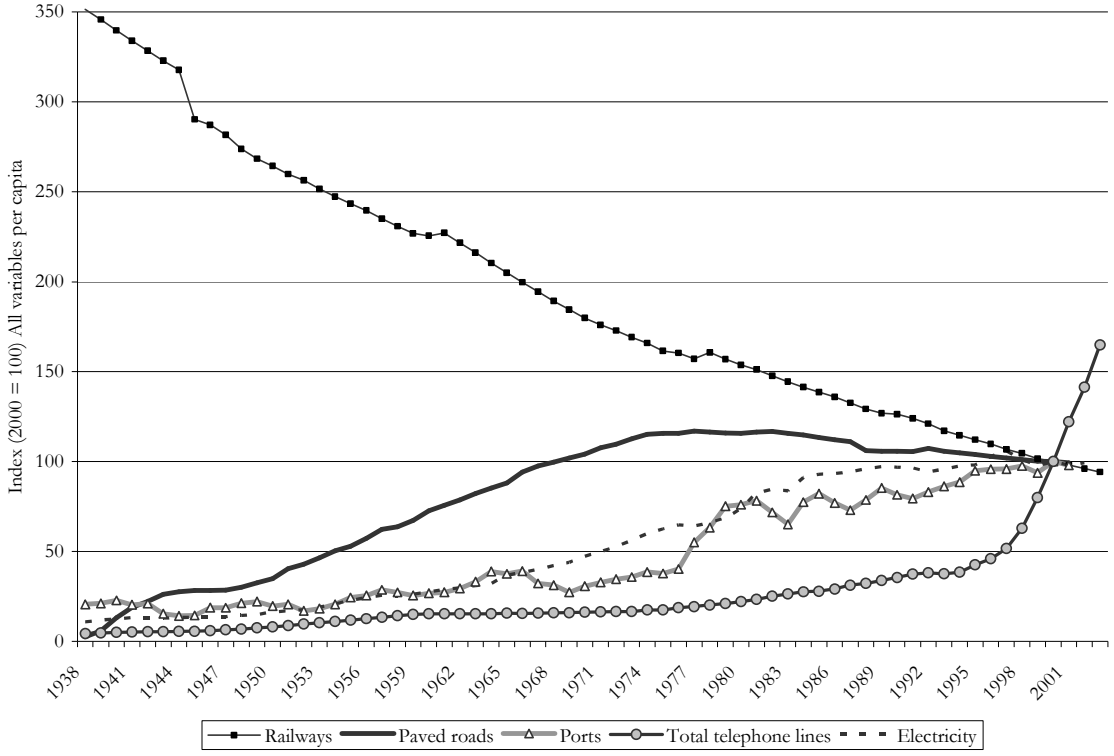

Figure 2. Railway lines, paved roads, cargo handled in ports, total telephone lines and electricity generated. All variables indexed and per capita.
Source: Perkins (2003).

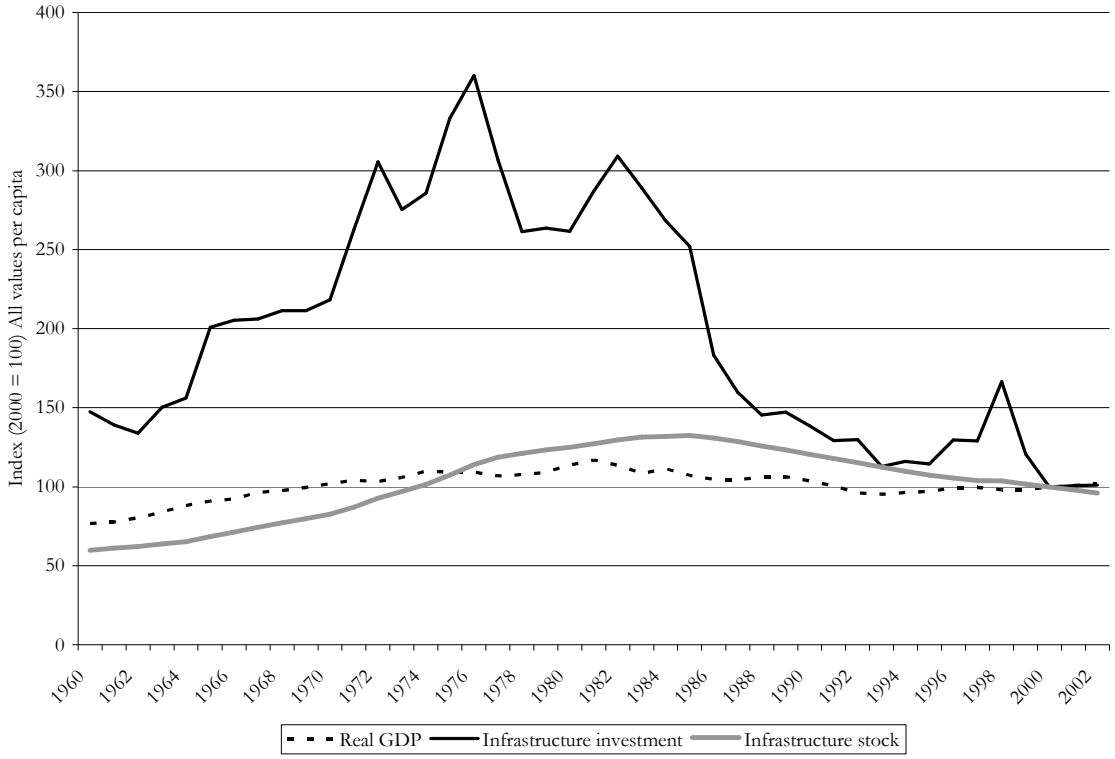

Figure 3. Real GDP, public-sector infrastructure investment per annum and the fixed capital stock in South Africa. Sources: Perkins (2003) and Reserve Bank (2005).

Government infrastructure investment increased significantly from the early 1960s to the late 1970s. However, since 1977, there has been a visible decline in annual infrastructure investment. In real terms, South African per capita spending on infrastructure reached a 40-year minimum in 2000. Table 1 shows annual infrastructure investment per capita for South Africa in the previous four decades. The 10-year averages suggest that infrastructure spending increased significantly to more than 6% of GDP during the 1970's, but declined rapidly to be little more than 3% of GDP during the 1990's. Because of the slowdown in infrastructure investment, the fixed capital stock of economic infrastructure began to decline around 1985. In 2002, South Africa's infrastructure stock was at similar levels to that of 1973.

Time period	Real GDP	10-yr average	% of GDP	Highest	Lowest
1960-1969	12,628	620.57	4.91	744.94	471.83
1970-1979	15,258	1,011.73	6.63	1,268.39	768.77
1980-1989	15,619	811.02	5.19	1,088.90	512.25
1990-1999	14,065	453.08	3.22	586.50	397.54

Table 1. Real GDP per capita and infrastructure investment per capita.
Source: South African Reserve Bank (2005).

The availability of the quantitative infrastructure measures has also enabled economists to determine the impact of infrastructure investment on economic growth. Although the theoretical link was evident, a lack of adequate data and econometric techniques limited researchers' ability to empirically estimate this impact. Since Aschauer's seminal contribution in 1989, however, international research on the topic have gained momentum; although it suggested large positive returns to infrastructure investment initially, more recently, these estimates have been revised to lower but still positive

levels[11]. It is also only recently that empirical evidence for infrastructure's impact on economic growth in South Africa has received attention. Three reasons are suggested. Firstly, the government's objective of achieving high growth has sparked debates about the necessity of infrastructure, leading to greater demand for empirical analysis. Secondly, improved data sources, primarily those of Estache and Giocoechia (2005) and Perkins (2003) have become available. And, thirdly, the availability and use of better econometric and empirical techniques and packages, have resulted in more reliable (and replicable) results.

Table 2 shows rates of return from infrastructure investment. The studies reveal a positive relationship between public sector infrastructure capital and growth in South Africa. However, the three initial studies use relatively basic econometric techniques and are subject to much criticism. For example, additional factors, such as crowding-in or crowding-out are not included in their measurements.

Author	Infrastructure measure (on economic growth)	Econometric technique	Output elasticity	Rate of return
Abedian and Van Seventer (1995)	Public authorities capital stock	OLS	0.33	0.23
	Public sector capital stock	OLS	0.17	0.20
Coetzee and Le Roux (1998)	Public sector infrastructure stock	OLS	0.30	0.24
DBSA (1998)	Public authorities capital stock	OLS	0.25	0.28
		Cointegration	0.30	0.33
	Public sector capital stock	OLS	0.15	0.9
		Cointegration	0.28	0.17
	Public sector infrastructure stock	OLS	0.17	0.11
		Cointegration	0.25	0.17
Fedderke, Perkins and Luiz (2005b)	Electricity generation	VECM	0.10-0.20 but rising to 0.50 when institutions are controlled for	
Bogetic and Fedderke (2005)	Infrastructure measures on labour productivity	VECM	Mostly between 0.20 - 0.40 with some higher outliers	
	Infrastructure measures on Total Factor Productivity	VECM	Very strong negative elasticities (-0.60) with no significant positive elasticities	
Fourie (2006)	Electricity generation	VECM	0.20	
	Electricity generation on a measure of equity performance	VECM	0.38	

Table 2. Comparison of South African estimates of the output elasticities and rates of return on infrastructure/public capital.
Source: DBSA (1998), Fedderke, Perkins and Luiz (2005b), Bogetic and Fedderke (2005) and Fourie (2006).

Bogetic and Fedderke (2005) investigate the impact of infrastructure on labour productivity and on total factor productivity (TFP) in the South African manufacturing sector. They find a large impact from infrastructure on labour productivity, but no (or even negative) impact on total factor productivity. According to Bogetic and Fedderke (2005:42), this is evidence of the large direct effect of infrastructure in South Africa, rather than the, theoretically important, indirect effects. Another explanation may be that the quality of infrastructure has a large indirect effect, whereas the quantity of infrastructure would have a more direct effect.

[11] See Fourie (2006)

Using Perkins's (2003) data, Fourie (2006) measures the impact of infrastructure on both economic growth and a proxy variable for equity in South Africa. He finds that, similar to an earlier study by Fedderke, Perkins and Luiz (2005b), the relationship between economic infrastructure and economic growth in South Africa appears to run in both directions. "Economic growth provides both the need for, and the resources to fund, various types of infrastructure. Provided that infrastructure projects take place in response to appropriate cost-benefit analyses, they are more likely to promote GDP growth than hinder it. Alternatively, the failure to provide appropriate infrastructure services may hamper GDP growth" (Perkins *et al.* 2005a:223). Fourie (2006) also finds large positive returns to infrastructure on equity.

The positive rates of return reveal that infrastructure does add to economic growth. To suggest any policy proposals, however, it is necessary to review the current stock of South Africa's infrastructure. With the improvement in geographical information systems, spatial analysis of infrastructure in South Africa can be used to show deficiencies in the current stock of infrastructure. Figures 6 – 10 in the appendix show maps of South Africa's distribution of infrastructure services according to municipal districts. Figures 4 and 5 (also in the appendix) show the population and income distribution[12]. As is evident from the maps, most indicators of infrastructure, such as access to water, sanitation, telecommunications and electricity services overlap poorly with the dominant areas of population density. KwaZulu-Natal, Limpopo, and the Eastern Cape regions are especially underendowed with access to infrastructure services. The main areas of concern are therefore primarily rural areas, although some services, such as sanitation seem to be underprovided in many urban areas as well.

While spatial analysis is helpful for identifying problem areas in access to infrastructure services, it cannot say much about the quality of these services. Infrastructure quality can be defined as both the quality of the services that infrastructure provide (reliable electricity) or the actual quality of the physical infrastructure (the quality of roads). Furthermore, although empirical analysis does assess the impact of infrastructure on growth, it is path dependent. Comparative analysis provides an indication of the state of infrastructure in South Africa – both quantity and quality – compared to that of other countries. Moreover, it reveals a quasi-counterfactual; what may have happened if other policies were implemented. Bogetic and Fedderke (2005), using a recently compiled dataset by Estache and Goicoechea (2005), compare South African infrastructure to six regions as defined by the World Bank[13], four income-groups for countries[14] and a world average. Their results are shown in the appendix (Table 3).

However, one limitation of comparing infrastructure indicators over a host of different countries is that different countries have different historical, spatial and environmental characteristics. Bogetic and Fedderke (2005:7) make this point too: "(I)nterpretation of comparisons must be made carefully and taken with caution. Some of the variations among the indicators may reflect other factors that may make single indicators comparison less revealing, or even misleading". Therefore, a group of eight countries is selected: Argentina, Australia, Botswana, Egypt, Mexico, Peru, Thailand and Turkey. These countries have been picked to reflect circumstances similar to South Africa, based on land area, population, income level, climate, typography and structure of the economy (see Table 4 in appendix).

Even though some of the quantitative indicators suggest otherwise, South Africa's electricity performance, technical efficiency, pricing and access are not on par with comparator countries. Electricity access, especially and importantly, still lag some of the major comparator countries and

[12] Income is measured as the average personal income only of the working population.
[13] (sub-Saharan Africa (SSA), Middle East and North Africa (ME & NA), South Asia, East Asia and Pacific (EA & P)
[14] (low-income, middle-income, upper middle-income and high-income)

income-groups. This access lag is primarily due to the spatial policies of the previous regime, although the new government has attempted to widen access to the electricity grid at an accelerated pace.

The good results from the relative indicators for technical efficiency, performance perception and pricing can be explained by the large investments in electricity generation capacity in the 1970s. These investments created excess capacity which reduced the need for further expansion of capacity in later years and which ensured that Eskom could focus its attention on maintenance and efficiency. By the late 1990s, a large part of the capital stock was depreciated, which resulted in the low price structure. The strong comparative performance perception indicator suggests that electricity performance in South Africa is of good quality. However, these indicators are for 2002. Since then, the accelerated economic growth in South Africa and the lack of new power generator construction have combined with severe consequences, causing lengthy power cuts in areas of high economic activity, such as the Western Cape and Gauteng. Furthermore, not only are these power failures the result of increased demand and poor planning, but also to a lack of maintenance of the existing electricity grid. Therefore, these performance indicators would without question have shifted over the past four years to lower levels.

When measured in the aggregate, the water indicator (access to an improved water source as per cent of the population) compare well with both the income-groups and the comparator group. However, a large cleavage exists between the rural and urban population, a feature found in other countries sharing South Africa's spatial characteristics. More importantly, South Africans access to sanitation services performs particularly poor, again, especially in rural areas.

A look at comparative telephone infrastructure measures reveals interesting results. South Africa's teledensity is above the median for the group of comparator countries, suggesting that teledensity is rather high for a country with similar spatial characteristics. However, the pricing structure is rather unique; whereas local telephone calls are very expensive (15 US cents compared to the world average of 9 US cents), prices of international calls are significantly below the standard for comparator countries. The reduction in prices over the three years can be ascribed largely to the decline in the exchange rate.

The high cost of local calls is reflected in the perceptions of fixed-line telephone infrastructure which falls below the average of the comparator group. Furthermore, these costs have shifted consumer preferences towards cellular technology. In fact, the perception of availability of cellular telephones is markedly different to fixed-line telephones. South Africa perception of cellular infrastructure performs better than all country groups, except the high-income countries. This better perception of cellular phones translates into higher cellular teledensity: the number of cellular telephone subscribers per 1000 people is markedly higher in South Africa (364) than that of Argentina (178) and Mexico (295).

Although spatial differences may have a minor role to play for other types of infrastructure, the "idiosyncratic territorial distribution of population and economic activity in a large, coastal, resource-rich country such as South Africa" would definitely affect the size and location of transport infrastructure (Bogetic and Fedderke 2005:16). When road density in terms of both population and land area is measured, South Africa performs well benchmarked against the comparator group of countries. Rail density in terms of population also attains a higher average than the middle-income country average. When rail density is measured in terms of land area, South Africa is top of the comparator group, surpassing even Argentina. This seems to suggest that, given South Africa's spatial features, the country is well endowed with a good quantity of rail infrastructure, although little can be deducted about the quality of the infrastructure or the services it provides. One measure

available to measure the quality of transport infrastructure is the travel time to work[15]. South Africa performs relatively weakly on this measure; while it takes 35 minutes to get to work in South Africa, it takes only 23 minutes in Mexico but 45 minutes in Thailand[16] (of all the regions and income-groups, only East Asia and the Pacific region performs worse than 35 minutes). One reason for this poor result is the segregationist policies of the Apartheid regime, which blocked the allocation of land close to city centers to a large part of the population. As a result, South African urban transport infrastructure carries a larger burden, due to the large distances commuters have to travel.

Even though South Africa seems to underperform on quality measures of infrastructure, the performance perception of transport infrastructure in comparison to other countries is relatively good. The perception of services delivered by the road department or public works, the commercial perception of port facilities, the commercial perception of rail-road services and the perception of air transport services all lie well above the world average.

The statistics are therefore paradoxical. While South Africa performs well on the transport infrastructure quantity measures, the country performs poorly when the efficiency of the infrastructure provided is measured. This suggests that either the quantity of infrastructure was not provided in the right areas, or, if provided, that the quality of infrastructure and the services it provides is inadequate. Poor infrastructure quality could be due to inefficient long-term planning, poor construction techniques or material, or poor maintenance of existing infrastructure.

CHANGING TRENDS

Assessing past and comparative infrastructure performance is necessary to understand its present allocation and distribution. However, simply extrapolating these trends into the future is to deny the government objectives, development needs, spatial characteristics, technological changes and increased privatisation that will shape the future allocation and distribution of the country's resources.

The first general elections in 1994 changed the nature of the social welfare function in South Africa. The needs of the newly democratized electorate defined a set of objectives that differed widely from that of the previous regime. The government had a tough job reconciling its priorities with the needs of a country with desperate imbalances in wealth and abilities. The new government objectives were mainly put forward in the 1993 RDP-document, the Reconstruction and Development Programme, emphasising the redistributive role of government, with nationalisation high on the priority list. However, in 1996 GEAR – the Growth, Employment and Redistribution plan – was released, signaling a change of government objective. Although redistribution was still on the agenda, GEAR also emphasised growth creation as top priority. This entailed a shift to macro policies such as privatisation, macroeconomic stability and trade liberalisation.

Although the high growth rates predicted by GEAR did not materialise, GEAR could be considered successful because of the stable economic environment that it did create. A number of policy documents have since emphasised the importance of higher economic growth to combat poverty and inequality. At the beginning of 2006, the South African government launched its latest growth intiative, ASGISA, the Accelerated and Shared Growth Initiative of South Africa, with the aim to halve poverty and unemployment by 2014. In order to achieve this, growth rates that average higher

[15] An important assumption here is that local level infrastructure (which determines the travel time to work) is a good proxy for all transport infrastructure in the country. Another measure, the percentage of paved roads as total roads, also

[16] These travel times were measured for 1998. Since then, these estimates may have changed.

than 4.5% is needed between 2005 and 2009, followed by average growth rates of above 6% between 2010 and 2014.

Although infrastructure investment was an important component of the Apartheid regime (see Figure 3), it was not a main component of earlier policy documents in the democratic government, except in the case where it provided access to basic services (with the emphasis on its redistributive role). However, a number of key policy documents has been released recently that state the importance of infrastructure in attaining the high growth targets set by the government. Infrastructure provision and maintenance is a key growth ingredient of ASGISA. Because ASGISA considers backlogs in infrastructure as one of six binding constraints in South Africa, a number of strategies to expand government and private investment in infrastructure is detailed. According to the document, of the R372 billion government investment in infrastructure, 40% will be spent by public enterprises, mostly Eskom (R84 billion) and Transnet (R47 billion) in order to improve the availability and reliability of infrastructure services (ASGISA 2006)[17]. Although eleven flagship projects are identified by ASGISA, the document does not provide guidance on the way in which future infrastructure projects should or will be chosen.

The National Spatial and Development Perspective (NSDP) released in 2003 is such an attempt to provide a framework for future policy decision-making. According to the NSDP (2003), various geographic, demographic and economic trends shape the existing and future allocation and distribution of infrastructure. These trends include a static pattern for economic growth in South Africa, a large concentration of people in the eastern half of the country, a large metropolitan urban population, divergent growth paths for the various sectors (including poor future agricultural sector growth), high human pressure in the relatively few areas of high natural resources that exist, changes in water availability across the country, climate change and disease. Some key trends relating to current infrastructure provision are also discussed:

- Of all the roads and railway lines in the country, only eight carry almost 50 per cent of the total freight movement, while 40 per cent of the routes carry less than 5 % of the total (NSDP 2003:14). According to the NSDP (2003:14), freight movement by 2020 also indicate very little change from the present pattern, with the main freight movement still taking place between Gauteng and the coastal port cities.
- Large train and bus subsidies drain Government revenues, R6 billion/annum and R1.2 billion/annum respectively (NSDP 2003:14). These subsidies go mainly to metropolitan areas and other large secondary towns and cities.
- According to the NSDP (2003:14), corridor development make public transport more efficient and reduce transport costs, "which may be more suitable due to the present fragmented form of South Africa's cities and towns than any attempt at creating compact cities". These transport corridors may help to integrate peripheral settlements into city centers, which may help to eradicate past spatial policies.
- Urban South Africa is serviced well with the existing electrification grid, while the rural population, although still low, showed marked improvement in access over recent years (NSDP 2003:15). However, according to the NSDP (2003:15), further electrification of rural areas is about twice as expensive due to the high associated costs and low levels of consumption, "suggesting that off-grid provision may be the better option in these areas".

[17] Apart from the investment in power generation, power distribution, rail transport, harbours an oil pipelines, ASGISA also notes other "key areas of expenditure", incorporating both local and provincial government, to be roads, bulk water infrastructure and water supply networks, energy distribution, housing, schools and clinics, business centres, sports facilities and multipurpose government service centres, including police stations, courts and correctional facilities. Furthermore, electronic communications is considered as "key commercial and social infrastructure" (ASGISA 2006:4).

- Certain centers in southern Africa are expected to play more specialised roles in the future (NSDP 2003:15). Therefore, as soon as a regional NSDP-type documented is released, these regional trends can be analysed and recommendations made. Specifically, such a document can then be "expected to be progressively extended and to incorporate a southern African perspective in the identification of areas of potential and in identifying transportation and communication links that will ensure a better integration of the regional economy" (NSDP 2003:15).

Given the changing spatial trends and government objectives of high economic growth and poverty reduction, the document describe the "hard choices" faced by government in terms of its impact on infrastructure investment and development planning. In short, the NSDP "seeks to focus the bulk of fixed investment (both economic and social infrastructure) of government on those areas with the potential for sustainable economic development". According to the NSDP (2003:4), it can be shown that it is in these areas that the "(g)overnment's objectives of both promoting economic growth and alleviating poverty will best be achieved. In areas of limited potential, it is recommended that, beyond a level of basic services which all citizens are entitled, government should concentrate primarily on social investment such as human resource development, labour market intelligence and social transfers, so as to give people in these areas better information and opportunities to gravitate towards areas with greater economic potential" [18]. These conclusions are based on a number of assumptions, many of them discussed in the document[19]. But given these assumptions and limitations, the NSDP (2003) has put in place a framework within which future infrastructure investment decisions will be closer aligned with government objectives.

Improvements in technology are also an important consideration when choosing the type and location of infrastructure investment. New technologies may turn a public or mixed good into a private good (lighthouses to GPS systems), eliminate negative externalities (high-polluting coal power plants to clean wind-powered plants) or create positive externalities (new highway bridge may lead to more tourists or adventure-seekers).

New technologies have furthermore reduced the costs of access to infrastructure services in geographic difficult locations. In the telecommunications industry, especially, vast improvements in technology have changed the way we think about infrastructure – the shift from fixed-line telephone lines to cellular technology make it much more possible for areas with underdeveloped infrastructure to rapidly expand these infrastructure services at a lower cost than was previously been possible. Sun-powered and wind-powered generators are also reducing the costs of providing access to rural households. This change in technology is leading to a shift in the level of infrastructure incidence; whereas the electricity grid was previously managed at national level, local electricity generation capacity is enabling provincial and even local level government to ordain infrastructure. Similarly, improvements in technology may shift some infrastructure from national to transnational level. For example, whereas television networks was previously managed at national level, satellite technology has enabled private firms (shift from public to private) to serve a much wider audience (the whole of Africa) without having to invest in expensive infrastructure on the continent.

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[18] It is assumed, and international experience is provided as evidence of proof, that people will move to areas with higher growth potential, as Tiebout's "voting with their feet"-theory suggests.

[19] A further assumption is that areas that attained high growth potential in the past, will in the future have similar growth potential (or comparative advantage). This assumption, therefore, take path dependency as the optimal outcome. Is this true? Without any knowledge of the counterfactual, it is not possible to know whether one area's comparative advantage (due to some mishap political decision) may, in the future, still be a comparative advantage, given the changing world we live in.

A new approach to infrastructure investment, other than government intervention, is that of private-public partnerships[20]. According to Jerome and Ariyo (2004:2), infrastructure sectors have traditionally been monopolies, owned and managed by the public sector. However, since the early 1990s there has been a change in how infrastructure should be owned, operated and regulated. According to Alexander and Estache (1999:2), this change occurred because governments found that their own resources were insufficient to meet the growing infrastructure demands, that they were under pressure to use their scarce resources for other government services such as welfare, and that the private sector operators will bring about greater efficiency. However, Kessides (2004:22) suggests that reforms need to be considered carefully before plunging into action. Although the new emphasis on private infrastructure has brought numerous benefits, financial crises, corporate scandals and stock market collapses, primarily in developing economies, have shown that a religious affinity to private investment does bring its own perils. With infrastructure privatisation, a host of secondary reforms (institutional and regulatory) are also required to ensure success. These factors all integrate to make the decision of policy-makers all the more complex.

POLICY PROPOSALS

Given the allocation and distribution of South Africa's current infrastructure stock, and the impact of changing factors and trends, where to from here? Put differently: How should South Africa spend the R372 billion budgeted for the next three years? Three main policy proposals can be identified from the analysis: building infrastructure that provides basic services to all, improving the quality of infrastructure and infrastructure services through maintenance, rehabilitation and upgrading, and building transnational infrastructure that improve regional integration into southern Africa.

It is the aim of the government to provide basic services to all. Apart from its political objective to redress past injustices (and every South African citizen's constitutional right), basic services contribute to economic growth in especially the poorer areas, creating externalities in the form of better health, education and less environmental degradation. Although the new democratic government has achieved success at delivering these services, South Africa still lags behind in rural water provision, rural and urban sewer services and rural electrification programmes.

However, according to the NSDP (2003), areas of high growth should receive the bulk of economic infrastructure investment, with low-growth areas receiving higher social infrastructure investment to increase the human capital and social mobility of the poor in these areas[21]. Although the NSDP state that basic services should be provided to all, the document fails to incorporate the positive externalities created by economic infrastructure investment in poor areas. What is the use of schools or clinics if there is no adequate road to travel to school, no electricity or no clean water and sanitation services? Many areas in South Africa (especially rural) have high population density with little infrastructure services as seen in Figures 6 – 10. Even though a case can be made that infrastructure projects with large positive externalities not be located in areas with poor growth potential, local level economic infrastructure is vital for both economic efficiency and equity. Furthermore, whereas providing infrastructure in rural areas used to be costly, new technologies, such as sun- or wind-powered electrical generators, can assist in lowering the costs of rural infrastructure delivery.

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[20] Kessides (2004) is an especially good read on recent trends of infrastructure privatization.

[21] "The second broad principle … seeks to capture a view that future government spending on infrastructure and development programmes should not be in localities that would ultimately become 'poverty traps'. As far as possible, the investment should occur in localities that display dynamic social and economic growth…" (NSDP 2003:25).

Unfortunately, the lack of institutional capacity at the local level in South Africa limits the ability of local level government to provide infrastructure. Basic infrastructure requires adequate engineering and town planning capacity at the local level, and especially in rural areas. Evidence of this capacity deficit is found in the low expenditure levels on infrastructure investment, even though national government has emphasised (and budgeted for) such investment. The recent local government election campaigns also focused on service delivery, implying a lack of present capacity.

A second policy aim should be, rather than increasing the quantity of infrastructure, to improve the quality of infrastructure in South Africa. Comparative country analysis reveals that South Africa are on par with most comparator countries regarding the quantity of infrastructure, but lags significantly when the quality of infrastructure is assessed. To rectify the problem, much more emphasis should be placed on the maintenance, rehabilitation and upgrading of existing infrastructure stock; a large part of the funds budgeted for infrastructure investment should be used for the improvement of existing stock rather than to provide new infrastructure which will only require maintenance in the future.

Through smart regulation such as privatisation or privately-managed infrastructure, government can ensure that the services provided by railway, port and ICT infrastructure[22] improve. Urban and metropolitan rail infrastructure can deliver much better services than those currently functioning[23]. Furthermore, national rail infrastructure should be rehabilitated in order to accommodate more freight transport along the major transport routes[24]. Easier pricing policies and efficient service delivery by Transnet will ensure that a right mix between road and rail freight transport is achieved[25]. Although the quality of ICT infrastructure and the services it provides are relative good in terms of telephone and cellular phone users, the quality and magnitude of electronic bandwidth available is small. Because of South Africa's geographic distance from world markets, high-speed connectivity to the U.S., Europe and Asia is indeed a necessity in order to remain competitive. Again, government regulation may be needed to ensure that such services are provided. Recent shortfalls in the supply of electricity further increase the quality gap between South Africa and other countries.

However, there are political economy problems attached to the emphasis on quality rather than quantity. It is politically more feasible to construct new infrastructure, than improve the quality of existing infrastructure, as shown by Robinson and Torvik (2005) in a recent study[26]. Therefore, politicians would tend to focus more on new infrastructure projects, even though it may be inefficient, than improving existing projects, especially if such infrastructure was provided by a previous political regime (as was the case for South Africa). The 2010 Soccer World Cup may be another area where political pressure force politicians to provide infrastructure even though it is relative inefficient compared to other expenditure[27].

Finally, transnational infrastructure investment should be the third policy objective. Regional integration in an awakening Africa can be of great benefit to both South Africa and her neighbouring

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[22] For example, Telkom's horizontal and vertical market integration in the internet industry requires regulation to reduce the high prices of internet users (Theron 2005).

[23] This includes not only improving the physical infrastructure of the rails and the trains, but also the services rendered on these trains, such as safety and security.

[24] The plans announced by Transnet recently seems to suggest that such rehabilitation will begin shortly

[25] See Erero and Van Heerden (2005)

[26] Robinson and Torvik (2005) have recently emphasised the role of politicians in the choice of infrastructure investment. They argue that some infrastructure projects might be undertaken *because* they are unproductive, as only the politicians that build such infrastructure will get elected. Therefore, in some cases, the overexpansion of infrastructure or the construction of unproductive infrastructure (with a negative net present value), called white elephants, may result from the political economy.

[27] For example, see Helen Zille's comments on Green Point stadium (Cape Argus 2006)

countries. International trends suggest that regional cooperation initiatives will become increasingly important in the global economy. However, in Africa, past policies have tended to isolate countries from each other. Regional infrastructure, primarily transport and electricity infrastructure, is, therefore, of critical importance. Transport links between economic growth nuclei are becoming more important as it creates numerous positive externalities which benefit countries more than it would have independently.

Due to geographical determinants, current high cross-country transport costs is still a severe constraint to promoting economic integration. Therefore, the provision of infrastructure to facilitate trade beyond South Africa's borders – transnational infrastructure – has become a necessity for regional growth. Attempts have been made by South Africa to establish development corridors where infrastructure is provided between two centers of economic activity, such as the Maputo Corridor connecting Gauteng with the port city and capital of Mozambique. More of such developments are required, across more countries and stretching deeper into Africa.

Unfortunately, a lack of institutional capacity at transnational level – in SACU, SADC and NEPAD, to name a few – limits the abilities of national governments to contribute to the provision of transnational infrastructure. Although it is easier to arrange a contract between only two parties, such as the Maputo Corridor, transnational infrastructure require the cooperation of a number of countries in order to maximise the positive externalities created. Without coordination by a transnational institution, country's will choose to provide the second best alternative, giving up large potential positive externalities in the process. Financial capacity also seems to be a constraint for these transnational institutions. However, international institutions, such as the World Bank, can assist financially in such ventures, provided that the funds can be spent efficiently. Only when adequate institutional capacity exists at transnational level, will the serious shortage of regional infrastructure in Sub-Saharan Africa be addressed.

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APPENDIX

Table 3. Four types of infrastructure indicators over various regions and income-groups.

	Safrica	*SSA*	*ME & NA*	*Sasia*	*EA & P*	*LA & C*	*Eur & CA*	*LI*	*MI*	*UMI*	*HI*	*World*
Energy												
Access to Electricity Network (% of Population)	66	15	88	31	54	79	99	31	85	87	-	60
Households reporting access to electricity (% of Households)	65	23	80	39	62	72	99	32	79	74	-	45
Energy use per PPP GDP	259	364	249	184	212	207	375	374	246	249	188	275
Commercial perception of electricity services (1=worst 7=best)	5.8	4.3	5.1	2.6	4.3	4.2	4.8	2.8	4.7	5.2	6.3	5
Commercial perception of public agency electricity provider	6	4.3	6	3.8	5	4.8	4.8	4	5.2	5.3	5.3	4.8
Electric transmission and distribution losses (% of total output)	8	19	14	22	12	18	18	22	15	14	6	14
Water												
Access to improved water sources (% of population)	87	64	85	72	75	90	87	65	89	93	99	80
Access to improved sanitation (% of population)	67	37	77	48	60	77	78	41	79	86	100	64
Commercial perception of water source	5.7	4.2	5.6	4.1	4.8	4.7	4.6	4	4.9	5	5.2	4.7
ICT												
Teledensity (total telephone subscribers/1000 people)	408	99	292	72	172	433	547	64	468	635	1393	501
Mainlines Teledensity (mainlines subsribers/1000 people)	107	31	129	35	76	192	224	29	193	261	572	213
Cellular Teledensity (cellular subscribers/1000 people)	364	73	167	37	96	249	325	37	280	381	827	396
Housholds with own telephone (% of households)	28	4	24	4	9	23	43	6	22	13	-	13
Cost of local call (US cents/3 minutes)	15	10	6	4	5	7	7	8	7	9	15	9
Cost of phone call to the US (US cents/3 minutes)	58	497	281	536	450	325	325	504	309	305	128	335
Cost of cellular local call (UC cents/3 off-peak minutes)	25	42	52	17	42	57	40	40	49	54	57	49
Commercial perception of telephone/fax infrastructure quality	5.1	4.3	5.8	4.3	5.2	4.6	5.3	3.4	5.3	5.6	6.6	5.5
Commercial perception of availability of cellular telephone	6.3	5.7	5.9	5.9	5.7	5.5	6	5	5.9	6	6.7	6.1
Commercial perception of internet access in schools	3.6	2.8	3.5	2.7	3.4	2.8	3.7	2.1	3.4	3.8	5.4	4
Commercial perception of postal efficiency	3.3	3.7	4.9	3.3	4.2	3.1	4.3	3.1	3.9	4.4	6.2	4.6
Phone faults (reported 100/mainlines)	48	57	23	97	39	24	34	64	25	18	11	37
Unmet demand (% of main telephone lines in operation)	1	50	26	24	13	17	8	47	12	4	0	21

Source: Bogetic and Fedderke (2005), Estache and Goicoechea (2005)

Table 3. Four types of infrastructure indicators over various regions and income-groups (continued).

	Safrica	*SSA*	*ME & NA*	*Sasia*	*EA & P*	*LA & C*	*Eur & CA*	*LI*	*MI*	*UMI*	*HI*	*World*
Transport												
Road density in terms of population (road-km/1000 people)	6.1	3.3	4.8	2.4	4.2	5.7	8.6	3	7	9.2	17.3	6.7
Road density in terms of land (road-km/1000 sq km)	227.2	155.7	608.9	544.6	276.4	712.7	580.3	181	702	1076	1340	841
Rail density in terms of population (rail-km/1000 people)	0.44	0.18	0.1	0.05	0.14	0.33	0.47	0.13	0.4	0.51	0.53	0.33
Rail density in terms of land (rail-km/1000 people)	16.5	3.65	5.5	18.79	8.85	14.78	33.22	9.33	23.26	31.33	46.2	23.1
Travel time to work, main cities (minutes/one way work trip)	35	34	25	27	36	29	29	33	29	29	32	31
Commercial perception of services delivered by road department/public works	5.3	3.7	5.5	3.9	4.4	4	3.6	3.4	4.1	4.1	4.3	4
Commercial perception of port facilities	4.7	3.8	4.1	3.4	3.6	3.1	3.6	2.6	3.6	3.8	5.4	4.2
Commercial perception of rail-road services	4.3	3.2	3.5	3.6	3.1	1.5	3.7	2.7	2.7	2.9	4.8	3.4
Commercial perception of air transport services	5.6	4.5	4.9	4.2	4.4	4.2	3.9	3.6	4.4	4.5	5.7	4.8
Paved roads (% of total roads)	21	25	56	38	32	36	76	30	52	57	82	50

Source: Bogetic and Fedderke (2005), Estache and Goicoechea (2005)

Table 4. Statistics of select comparator countries.

	Total land area (sq km)	Coastline (km)	Climate	Land use - arable land (per cent)	Natural resources	Population size
Argentina	2766890	4989	Mostly temperate; arid in southeast; subantarctic in soutwest	12.31	Fertile plains of the pampas, lead, zinc, tin, copper, iron ore, manganese, petroleum, uranium	39537943
Australia	7686850	25760	Generally arid to semiarid; temperate in south and east; tropical in north	6.55	Bauxite, coal, iron ore, copper, tin, gold, silver, uranium, nickel, tungsten, lead, zinc, diamonds, natrual gas, petroleum	20090437
Botswana	600370	landlocked	Semiarid; warm winters and hot summers	0.65	Diamonds, copper, nickel, salt, soda ash, potash, coal, iron ore, silver	1640115
Egypt	1001450	2450	Desert; hot, dry summers with moderate winters	2.87	Petroleum, natural gas, iron ore, phosphates, manganese, limestone, gypsum, asbestos, lead, zinc	77505756
Mexico	1972550	9330	Varies from tropical to desert	12.99	Petroleum, silver, copper, gold, lead, zinc, natural gas, timber	106202903
Peru	1285220	2414	Varies from tropical in east to dry desert in west; temparate to frigid in Andes	2.89	Copper, silver, gold, petroleum, timber, fish, iron ore, coal, phosphate, potash, hydropower, natural gas	27925628
South Africa	1219912	2798	Mostly semiarid; subtropical along east coast; sunny days, cool nights	12.08	Gold, chromium, antimony, coal, iron ore, manganese, nickol, phosphates, tin, uranium, gem diamonds, platinum, copper, vanadium, salt, natural gas	44344136
Thailand	514000	3219	Tropical; rainy, war, cloudy southwest monsoon, dryer cool northeast monsoon	29.36	Tin, rubber, natural gas, tungsten, tantalum, timber, lead, fish, gypsum, cluorite, arable land	65444371
Turkey	780580	7200	Temperate, hot, dry summers, wet winters, harsher in interior	30.93	Coal, iron ore, copper, chromium, antimony, mercury, gold, barite, borate, celestite, marble, clay, arable land, hydropower	69660559

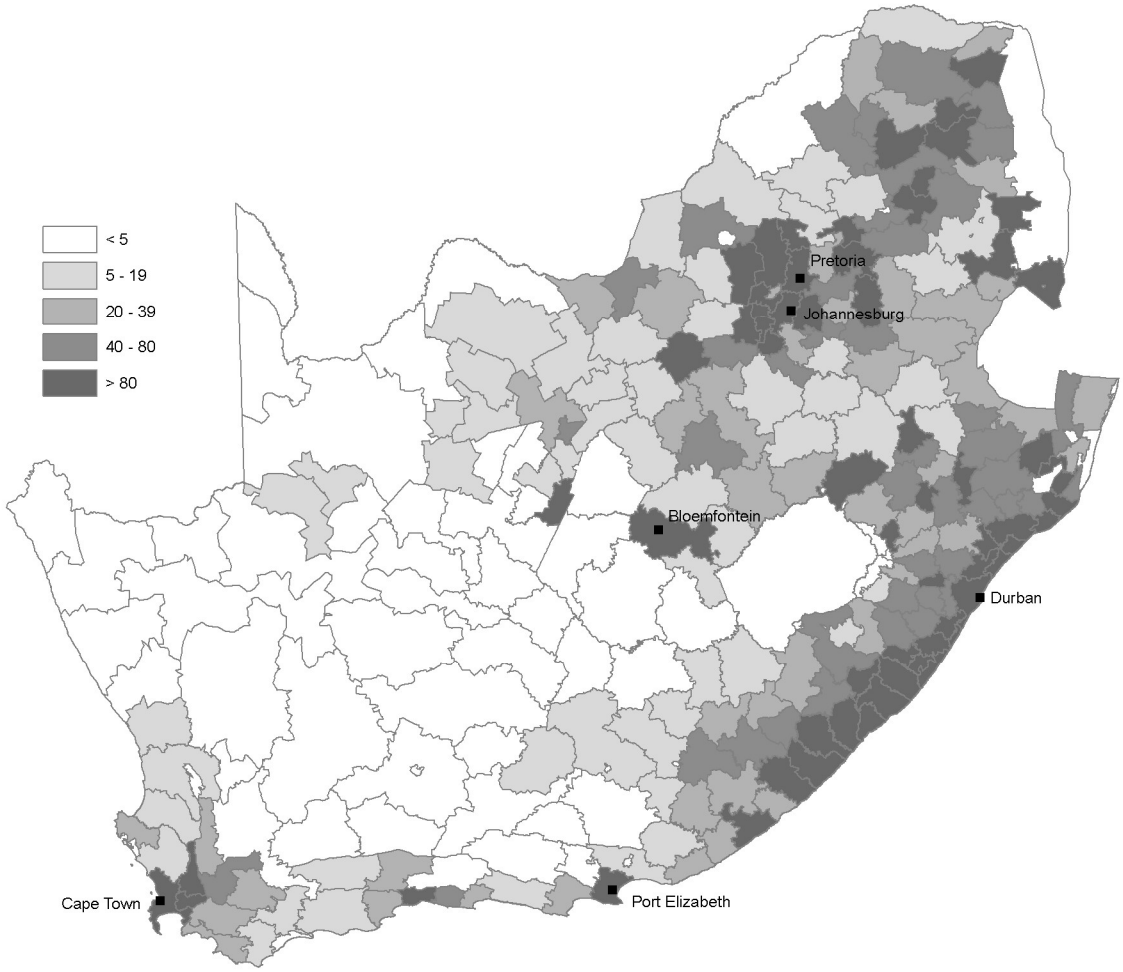
Source: CIA World Factbook (2005)

Table 4. Statistics of select comparator countries (continued).

	GDP per capita (purchasing power parity dollar)	Unemployment rate (per cent)	Electricity production (kWh)	Exports (f.o.b.)	Fixed-line telephones	Cellular telephones	Railways (km)	Highways (km)	Waterways (km)	Airports (paved)
Argentina	12400	14.8	81.39 billion	33.78 billion	8009400	6500000	34091	215471	11000	144
Australia	30700	5.1	210.3 billion	86.89 billion	10815000	14347000	54439	811603	2000	305
Botswana	9200	23.8	930 million	2.94 billion	142400	435000	888	10217	none	10
Egypt	4200	10.9	81.27 billion	11 billion	9600000	8583940	5063	64000	3500	72
Mexico	9600	3.2	203.6 billion	182.4 billion	15958700	28125000	17634	329532	2900	233
Peru	5600	9.6	22.88 billion	12.3 billion	1839200	2908800	3462	78230	8808	52
South Africa	11100	26.2	202.6 billion	41.97 billion	4844000	16860000	20872	275971	none	144
Thailand	8100	1.5	118.9 billion	87.91 billion	6617400	26500000	4071	57403	4000	65
Turkey	7400	9.3	139.7 billion	69.46 billion	18916700	27887500	8697	354421	1200	87

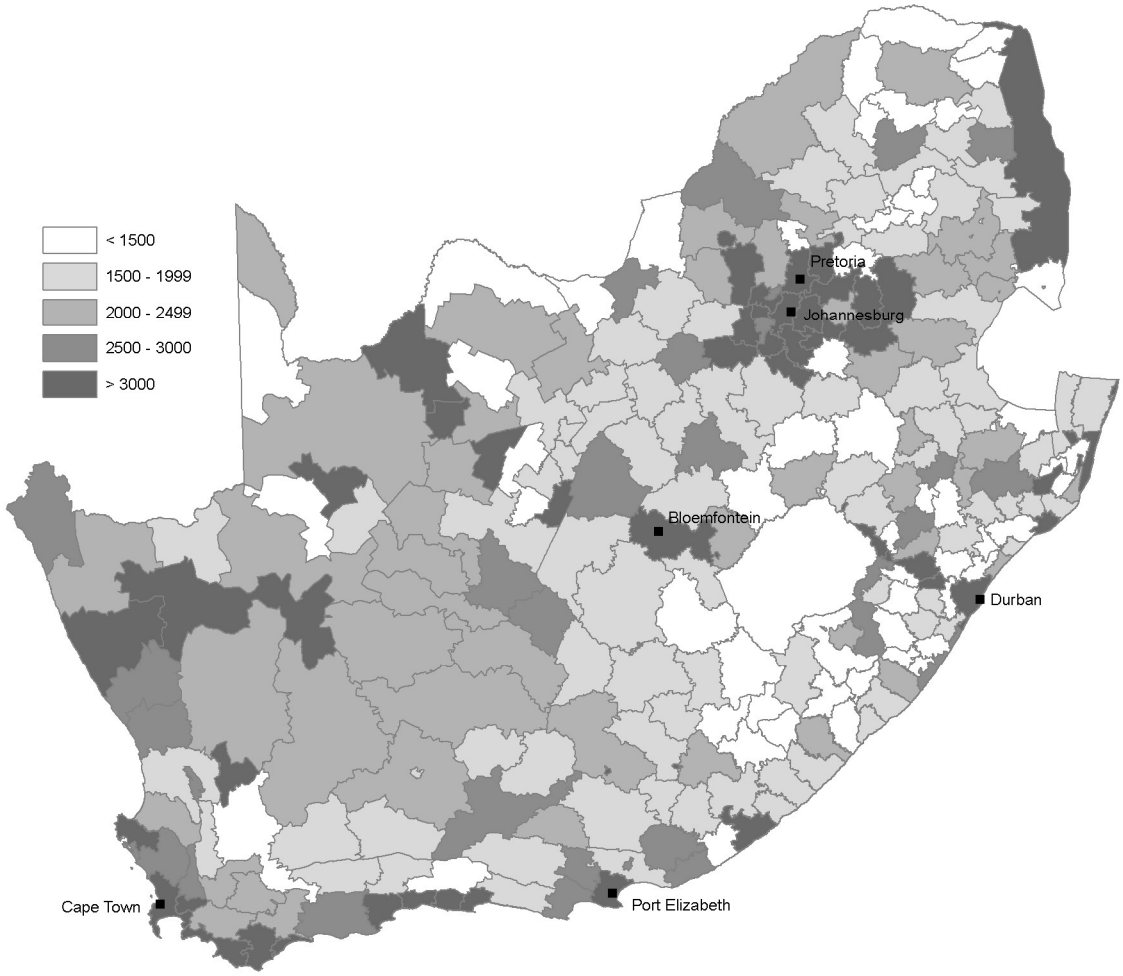
Source: CIA World Factbook (2005)

Figure 4. Number of persons per square kilometre.



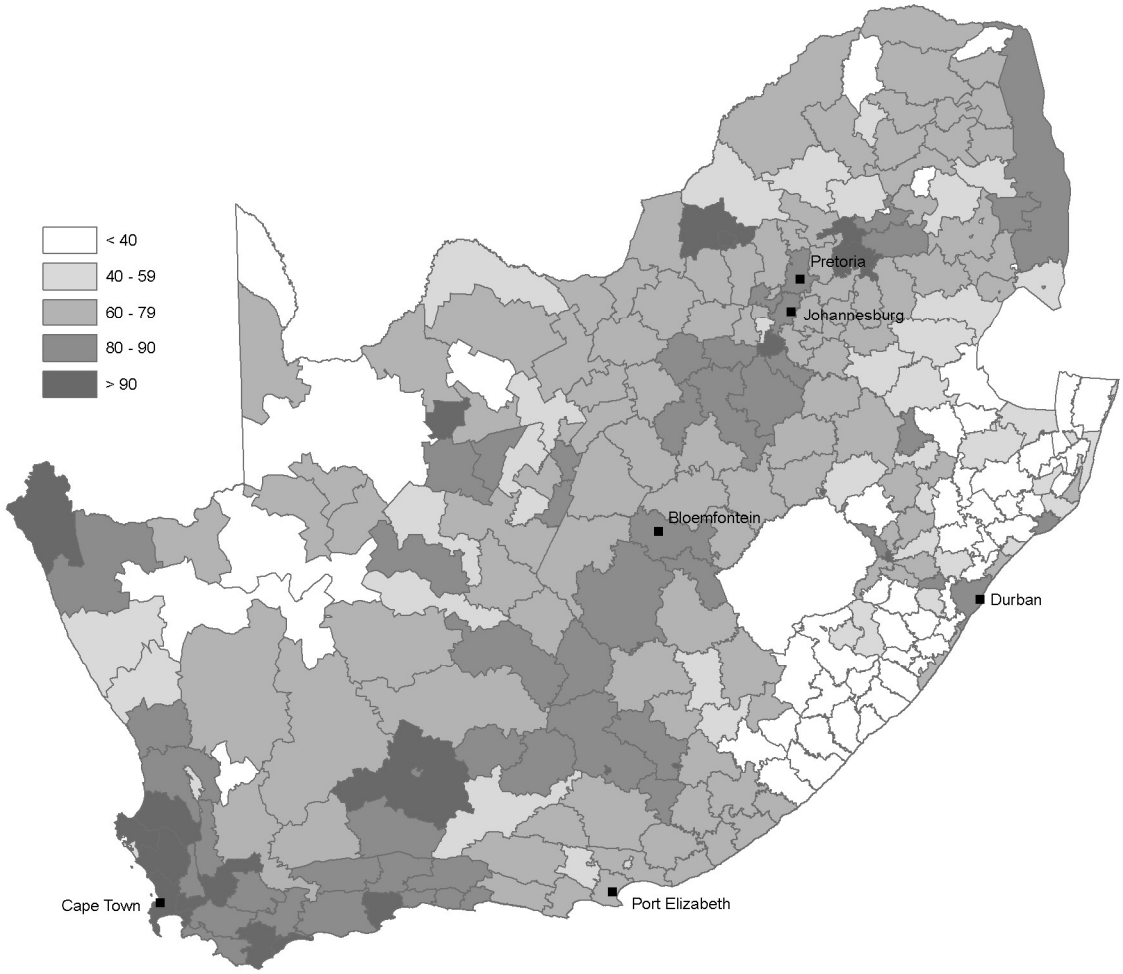
Source: 2001 Census (2004).

Figure 5. Average personal income (only of population working).



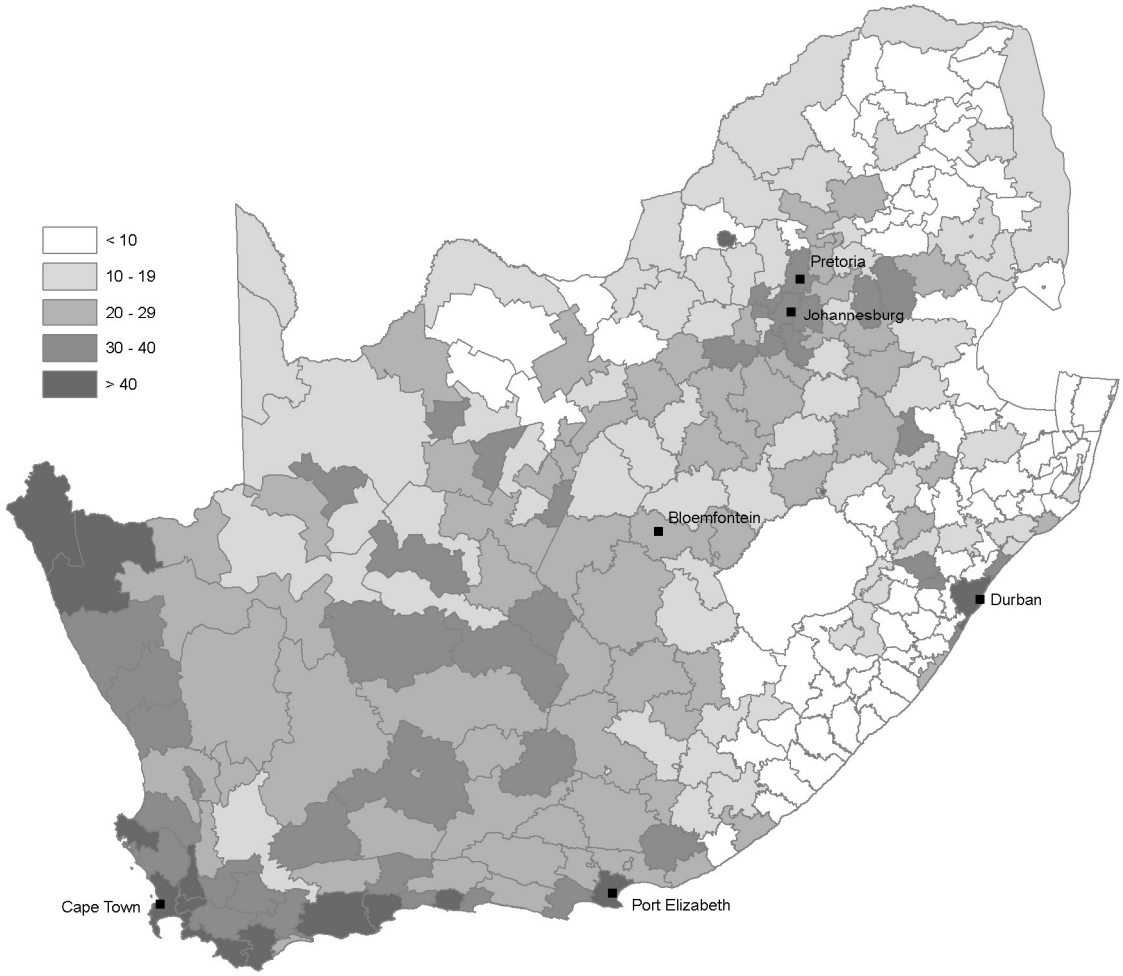
Source: 2001 Census (2004).

Figure 6. Percentage of total population that use electricity as fuel for lighting.



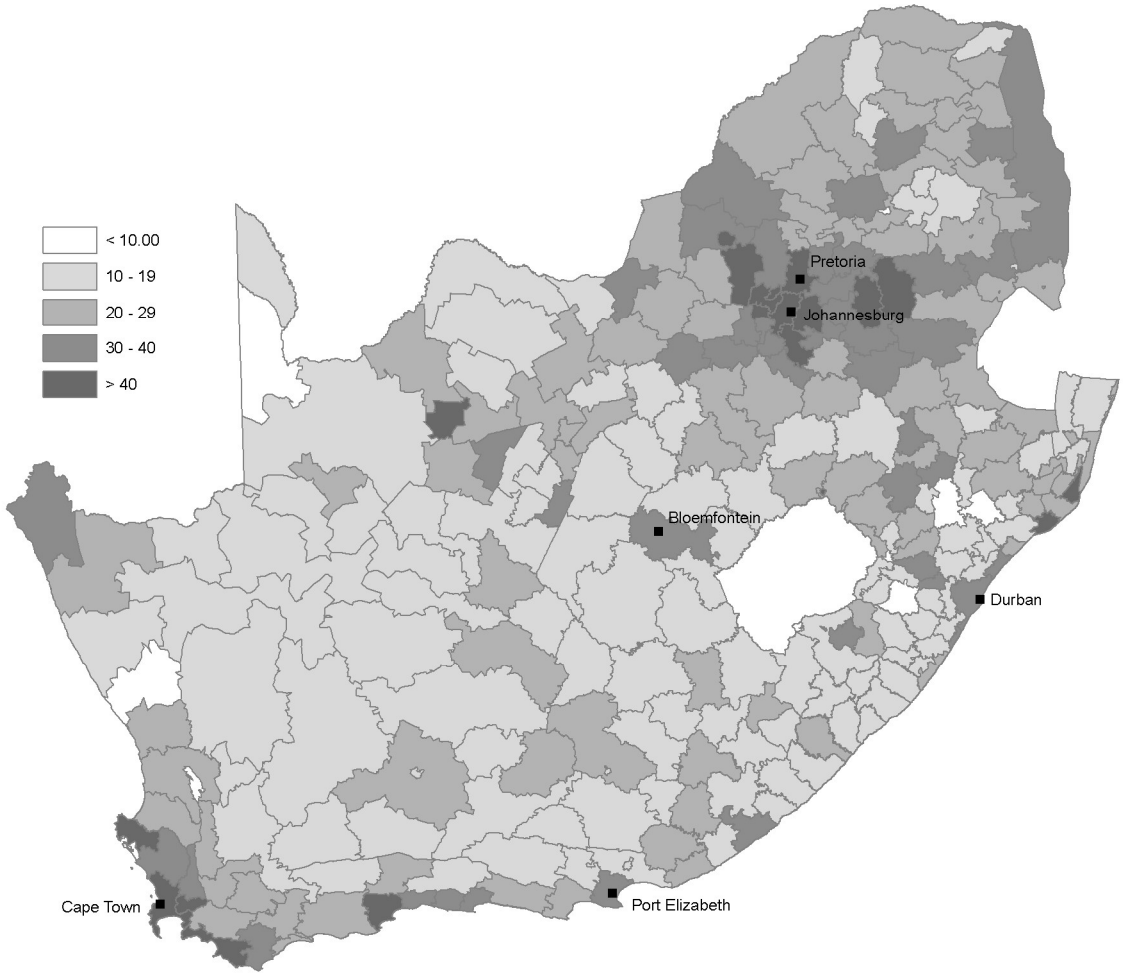
Source: 2001 Census (2004).

Figure 7. Percentage of total population that has access to landlines inside dwelling.



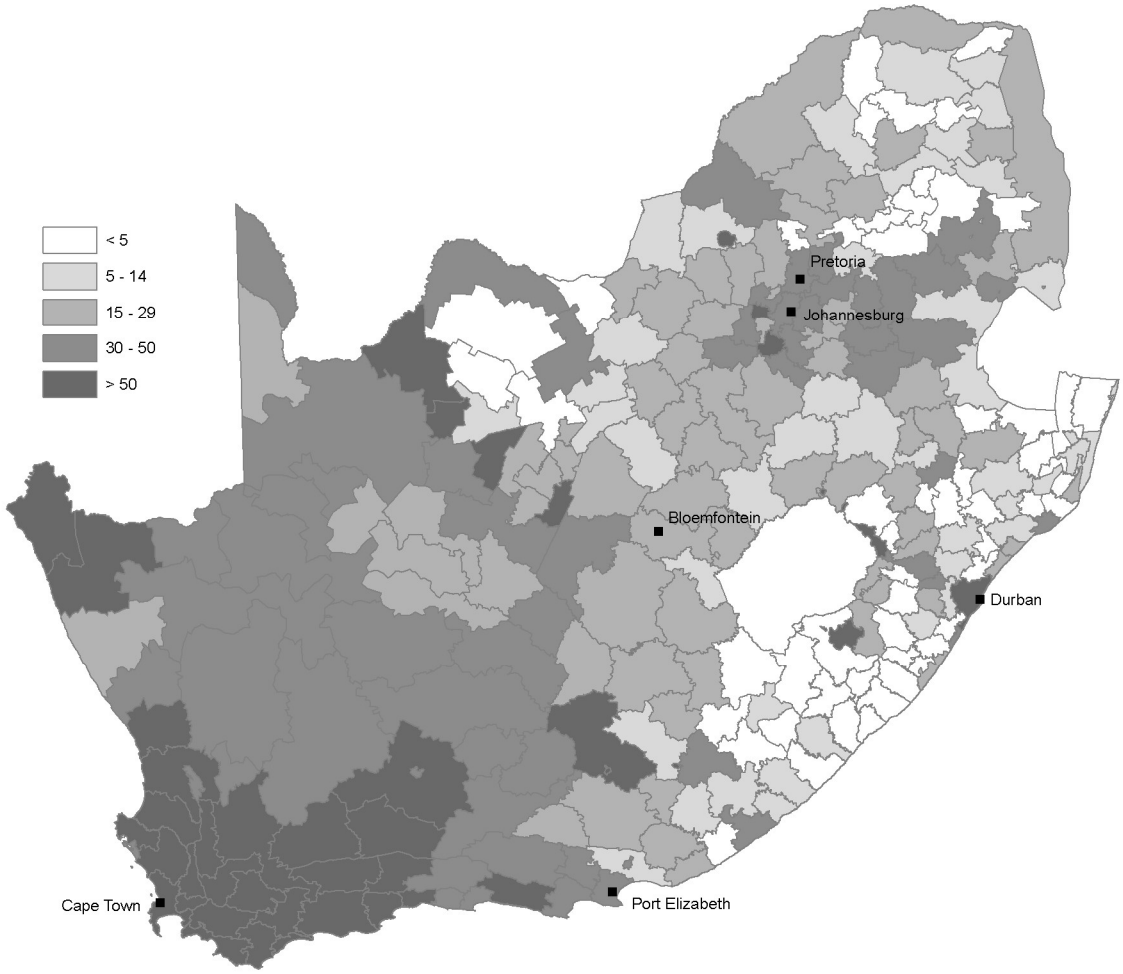
Source: 2001 Census (2004).

Figure 8. Percentage of total population that has access to cellphones inside dwelling.



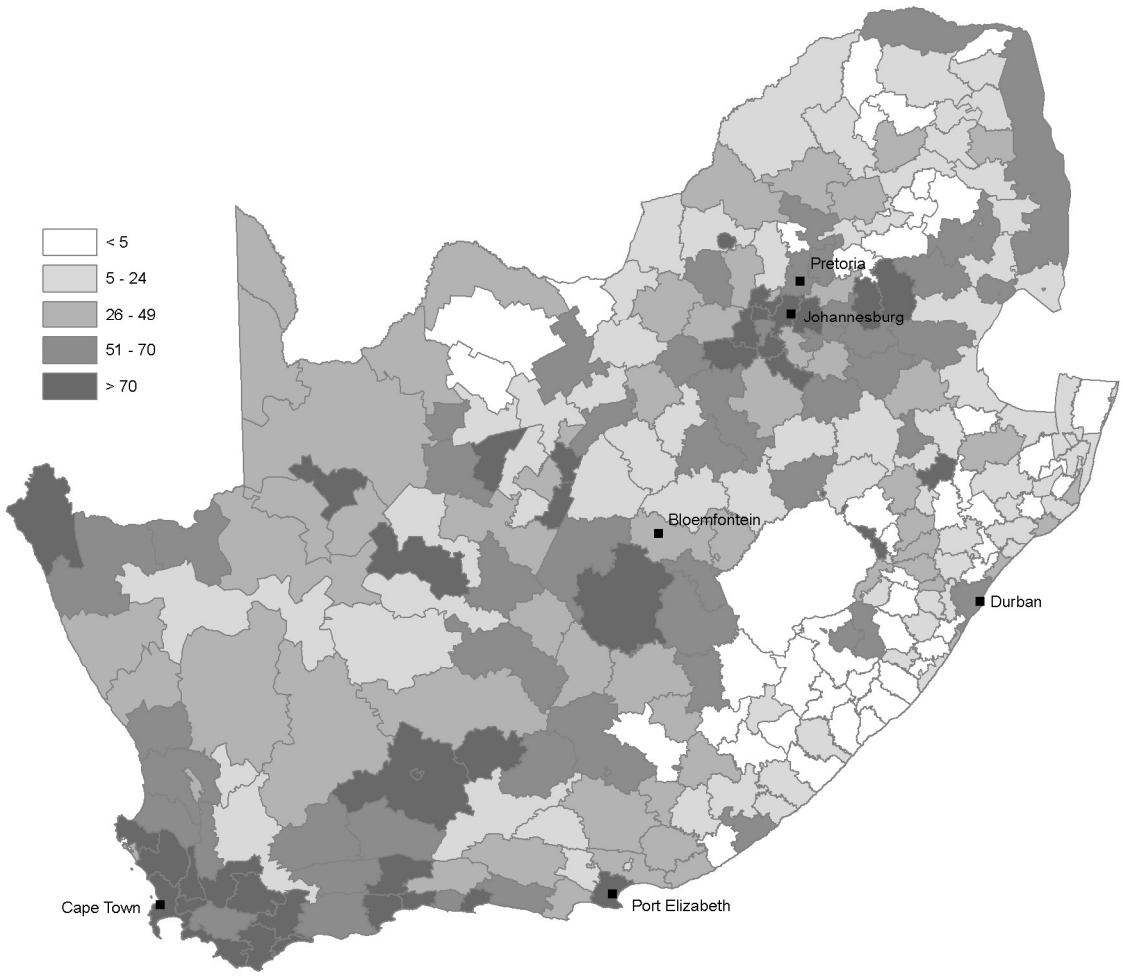
Source: 2001 Census (2004).

Figure 9. Percentage of total population that has access to water inside dwelling.



Source: 2001 Census (2004).

Figure 10. Percentage of total population that has access to flush toilets (connected to sewage system) inside or outside dwelling.



Source: 2001 Census (2004).