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The Growth Implications of Agglomeration in South Africa, 1996-2010

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A mini dissertation partially fulfilling the requirements for the Degree of

MASTERS IN APPLIED ECONOMICS (ECONOMICS STREAM)

In the School of Economics

UNIVERSITY OF CAPE TOWN

August 2012



DECLARATION

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ACKNOWLEDGEMENTS

It is a pleasure to thank the many people who made this dissertation possible.

Foremost, I would like to express my sincere gratitude to my supervisor, Prof. Anthony Black, for his constant encouragement and exceptional advice throughout my time as his student at UCT. I acknowledge, with great thanks, the funding he extended to me from the South Africa Netherlands Research Programme on Alternatives in Development.

I would also like to thank my co-supervisor, Prof. Ivan Turok, for his patient guidance through processes of trial and error. Working with him, at the Human Sciences Research Council (HSRC), taught me the importance of being timely and paying attention to detail in research. This will certainly prove invaluable in my life's work.

To Prof. Paul Dunne, I extend special thanks for carefully reading the drafts I sent him. His insightful suggestions have made this dissertation more complete. Through consultations with him I have grown to appreciate the value of a narrative when communicating research findings.

I have gained deep respect for academic and applied research through the interactions I have had with all three supervisors, as well as with Dr Peter Jacobs of the HSRC. I feel extremely privileged that at this early stage of my career, I have been given the tools and extensive guidance which have enabled me to apply theoretical perspectives to real-world policy problems.

I am grateful to the staff of the School of Economics at UCT and to my former colleagues at the HSRC for their continued support. I am also grateful to Dr Patrick Goldstone for proofreading my work, and to Lore Sereetsi and Asanga Mehana for teaching me how to use Quantam GIS mapping software.

Finally, I thank my family and friends for their support and patience during my time at UCT. I am eternally indebted to my father, Khambi, who has always stressed the importance of 'seeing the bigger picture'; my mother, Rosemary, for her selflessness and to my siblings, Baraka and Subira, whose love and encouragement makes all the difference.

Rehema Msulwa
August 2012

ABSTRACT

There is a growing awareness that the spatial distribution of population and economic activity is important for growth and development. Geography matters when it comes to economic performance in various ways; and the proximity between economic actors ('density') is one of these. Increasing evidence demonstrates that places of higher density are associated with higher levels of productivity and growth. The World Bank (2008) makes an influential contribution to policy debates on this subject and strongly argues that the concentration of economic activity encourages economic growth.

This thesis investigates the applicability of this idea in South Africa using the municipality as the basic unit of analysis. The period under consideration is 1996-2010. Following a review of the relevant literature, the analysis begins with a description of the spatial distribution of density in South Africa and highlights the striking differences in population, employment and GVA density at the top and bottom of the hierarchy.

Following this description of the density hierarchy, regression analysis is used to assess whether there is a causal relationship between density and growth. Holding all else constant, does 'density drive development' in South Africa? From the regression results, a robust causal relationship between density and growth cannot be inferred.

Finally, the paper investigates whether the spatial distribution of economic activity in South Africa is static or evolving. Testing Gibrat's Law to determine this, results suggest growth patterns in South Africa have been divergent over the period 1996-2010. The share of population, employment and GVA in the largest municipalities has been increasing relative to the shares in smaller municipalities. These growth patterns could imply that larger municipalities are experiencing economic development. On the contrary, they could also imply that human, capital, and spatial development patterns are in broad continuity with those under apartheid.

An important message from this analysis is that spatial proximity is not a sufficient condition for growth. While agglomeration may matter, it is not sufficient to create positive externalities. This is not adequately put forward by the World Bank (2008) which asserts that places must promote higher densities to encourage growth. Factors such as available networks, governing institutions and social dynamics, not explicitly considered by the World Bank (2008), can impact the quality and significance of density for growth. This consideration is especially relevant for South Africa given the country's unique economic geography as a result of the spatial engineering that was implemented under apartheid.

Keywords: Density, agglomeration, regional development, spatial development, economic growth, population growth, employment growth

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LIST OF ACRONYMS

CBD	Central Business District
GI	Global Insight
GVA	Gross Value Added
MAR	Marshall-Arrow-Romer
NPC	National Planning Commission
OLS	Ordinary Least Squares
TFP	Total Factor Productivity
UK	United Kingdom
US	United States (of America)
WDR	World Development Report

Section 1 Introduction

There is a growing awareness that the spatial distribution of population and economic activity are important for economic development. Geography matters when it comes to economic performance in various ways; and the proximity between economic actors ('density') is one of these. Increasing evidence demonstrates that places of higher density are associated with higher levels of productivity and growth. The World Bank's 2009 World Development Report (WDR), entitled 'Reshaping Economic Geography', makes an influential contribution to policy debates on this subject. This report strongly argues that the concentration of economic activity is inevitable – and encourages – national economic growth.

The concept of external scale economies, together with the related concept of increasing returns to scale, underpin the proposition that 'density drives development'. A positive association between density and growth arises because firms benefit from positive externalities available in large concentrations of population and economic activity. These externalities include: (i) The *sharing* of capital inputs, information, and employment; (ii) the *matching* of production requirements, such as: types of land, employment and intermediate inputs; and (iii) *learning* about new techniques and products by workers and entrepreneurs, through knowledge spillovers.

An isolated firm can benefit from internal scale economies (by increasing the scale of production to better exploit fixed costs), but this firm would be constrained, by a lack of interaction, from exploiting the benefits of such external scale economies (World Bank, 2008).

External scale economies associated with density are known in the literature as agglomeration economies. The higher the concentration of workers, suppliers and consumer demands, the greater the scope for producers to gain from each other, and for agglomeration economies to be realized. Because different places facilitate agglomeration economies at different propensities, economic activity will inevitably be more concentrated in some places than in others. This gives rise to a hierarchy of density: an enduring feature of the economic landscape.

At the top of the hierarchy is the primary city, which can facilitate economies of scale better than other areas; while at the bottom are agricultural or rural areas. Between them, there is a continuum of settlements of varying density.

These spatial patterns of population and economic activity can impact the outcome economic processes. Factors such as socio-spatial realities, the embeddedness of economic activities in specific locations, networks, livelihood strategies and industrial communities influence how such processes play out in different contexts (Murphy, 2011).

Understanding regional spatial dynamics is crucial for economic development. This is especially important for South Africa, given the country's peculiar economic geography – as a result of the spatial engineering that was implemented under apartheid.

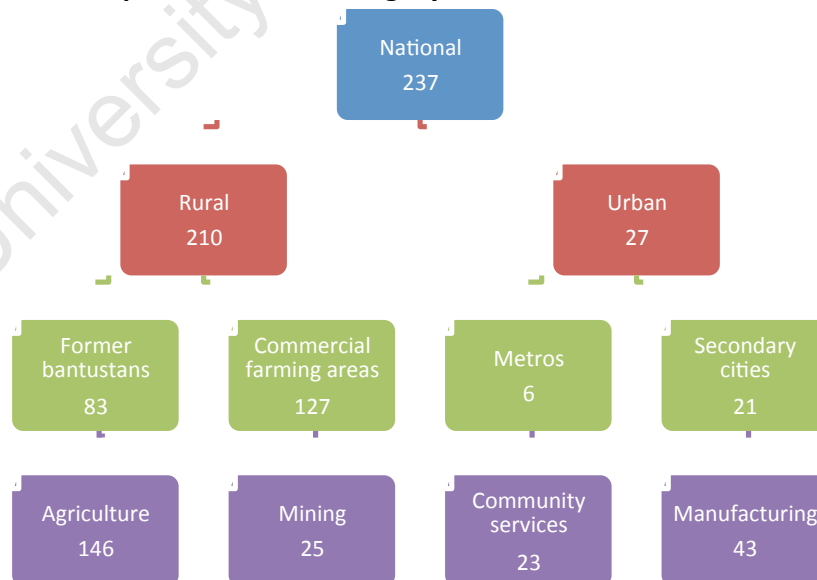
To that end, the purpose of this thesis is to review the role of agglomeration in growth, to examine some evidence, and to assess whether 'density drives development' in the South African context. In particular, the paper

- i. Presents an analysis of the spatial distribution of economic activity in South Africa.
- ii. Examines whether there is a causal relationship between density and growth in the country.
- iii. Determines whether population, employment and GVA growth patterns in the country are convergent, divergent or static.

In examining the role of agglomeration in growth, modelled data obtained from the service provider Global Insight (GI) is used; and the time frame under consideration is 1996-2010. The South African local municipality is the basic unit of analysis throughout the study.

To take into account those locational characteristics, which could potentially influence the development trajectory of places, municipalities are categorized, according to their historical administrative classification and dominant tradeable sectors. Figure 1 shows the number of municipalities in each category.

Figure 1: The number of municipalities in each category



The relationship between density and growth is assessed across and within the categories in Figure 1. The strength of the association may vary between each category because of their

quite different economic and physical characteristics, and their different historical experiences. For example, one would expect to find unusually high population densities in the former Bantustans (and relatively poor-performing economies) compared with commercial farming areas, because of the Apartheid policies of forced relocation, and restrictions on mobility.

While a number of international studies have explored agglomeration effects, as far as can be established, no research of this kind has been conducted in South Africa to date. This study, therefore, fills a gap in the literature by providing a better understanding of whether, and to what extent, the concentration of economic mass matters for development in this country.

This thesis contributes to two strands of literature, the first being the economic geography literature as it investigates factors that may contribute to unequal spatial development. Secondly, it contributes to the mainstream economic literature, as it considers density as a determinant of long-run growth. Perhaps most importantly, the thesis contributes to policy debates on whether to encourage the concentration or dispersal of economic activity.

In Section 2 which follows, both theoretical and empirical issues are presented in a review of the relevant literature. Section 3 describes the data and the variables used throughout the thesis, and the procedures followed to place municipalities in the categories in Figure 1. Section 4 describes the spatial distribution of density in South Africa. Section 5 examines the relationship between density and growth and describes the results from this analysis. Section 6 uses Gibrat's Law to establish whether the spatial structure of economic activity in South Africa is convergent, divergent or static. Section 7 concludes the study and recommends directions for future research.

Section 2 The Literature Review

Economic Geography and the World Development Report

A useful starting point when examining the agglomeration of economic activity is Krugman (1991) which explains why economic or population activity tends to concentrate in certain areas over others. Krugman (1991) sketches out an agent-optimization framework that captures the fact that the spatial configuration of economic activity is the result of a complicated balance of forces that encourage the agglomeration (centripetal) and dispersal (centrifugal) of activities of consumers and firms. In this framework, opposing forces like those described in Table 2 below, push and pull consumers and firms, according to the market trends, towards a state of equilibrium.

Table 1: Forces that promote and oppose concentration

Centripetal forces (promote concentration)	Centrifugal forces (promote dispersal)
Market size effects: Sites with good access to large markets are preferred locations for the production of goods subject to economies of scale: 'backward linkages'; a large local market supports the local production of intermediate goods, lowering the costs for downstream producers: 'forward linkages'.	Immobile factors: The location of land, natural resources; and in some contexts, people may discourage concentration. From the supply side, production may have to go where the workers are. From the demand side, dispersed workers create a dispersed market, and some production would have an incentive to locate close to consumers
Thick employment markets: An industrial concentration supports a thick local labour market, especially for specialized skills, so that employees and employers find each other more easily.	Land rents: Concentrations of economic activity generate increased demand for local land, driving up local land rents, and thereby providing a disincentive for further concentration.
Knowledge spillovers: A local concentration of economic activity may create more or less pure external economies via information spillovers.	Pure external diseconomies: Concentration of activity can generate more or less pure external diseconomies, such as congestion.

Source: Krugman (1998: 8)

Krugman's framework relaxes the assumptions of perfect competition and constant returns to scale, characteristic of neoclassical economics; and formally recognizes scale economies, externalities and imperfect competition. The main thrust of the framework is that if optimizing firms can compete on price and product differentiation, then large unexhausted economies of scale will generate strong (centripetal) forces that promote the geographic concentration of firms specifically, and economic activity in general. The framework also formally introduces distance, (the cost of transporting inputs and outputs), to explain why – in instances when

transport costs are relatively low – economic activity may be spatially dispersed (World Bank, 2008; Krugman, 1998).

According to the framework, the absence of physical space between people and firms comes from the desire to create proximity, or to eliminate transportation costs for goods, people and ideas. An obvious example of this is reflected in the demand for density in cities, which are effectively conglomerations of consumers and producers, buyers and sellers, and of firms and workers (World Bank, 2008; Glaeser & Kahn, 2003). The following excerpt from the World Bank report (2008) describes this further:

“People choose to live close to one another, paying high rents and tolerating crime and congestion. Firms are drawn to dense areas concentrated with people and infrastructure, by the possibility of serving a large local market from a large plant at low transport costs. Increasing returns-to-scale production technology leads to large factories with many workers. The sizeable workforce forms a large local market. By reducing transport costs, cities with a large local market attract firms in different industries. So a self-reinforcing process of agglomeration that begins with the expanding local market further raises industry productivity.”
(World Bank, 2008: 134)

Subsequent to the framework, it is therefore inevitable that economic activity would tend to concentrate in some areas rather than in others. Across all geographical scales, whether considering localities, regions or nations, the spatial distribution of economic activity would be uneven. This gives rise to a hierarchy of density: an enduring feature of the economic landscape. At the top of the hierarchy is the primary city, which can facilitate economies of scale better than other areas; while at the bottom, are agricultural or rural areas. Between them is a continuum of settlements of varying density (World Bank, 2008).

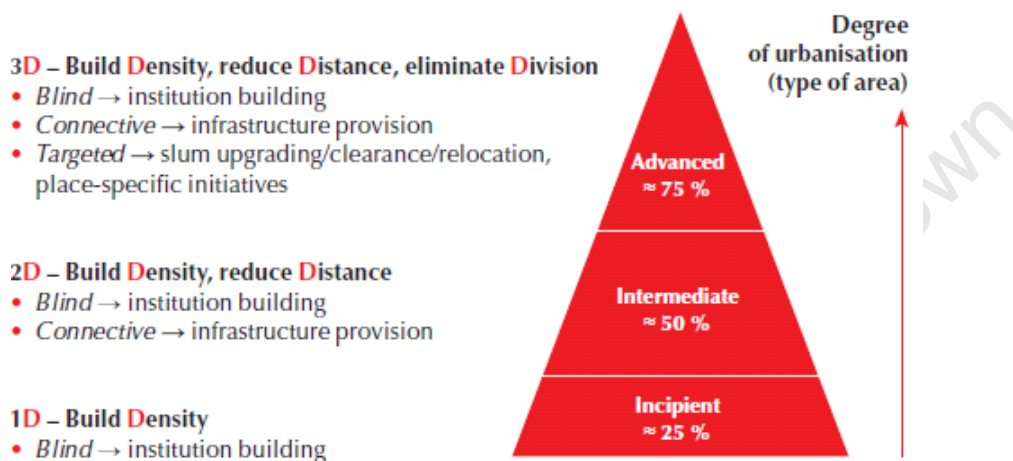
In light of the inevitable uneven distribution of economic activity, the World Bank (2008) stresses that a “bumpy” economic landscape should not be a cause for concern. Low and middle-income countries should not divert resources to try to balance out economic activity, as efforts to do so would jeopardize developmental progress. Instead, the report argues that efforts should focus on integration, through which inclusive development could still become possible.

To guide integration processes, the World Bank (2008) proposes “An I for a D”, a rule of thumb that relates how three sets of instruments: institutions, infrastructure and interventions, have to be calibrated to address the difficulties posed by the spatial dimensions or 3D’s: density, distance and division, in order to achieve development. *Institutions* refers to the amenities government should provide – regardless of place – including the financing and delivering of basic amenities, such as the administration of justice, health and education. *Infrastructure* refers to spatially connective investments, and the associated rules and regulations, such as railway lines and telecommunications. *Interventions* are spatially focused incentives, and

include regulations and investments that favour some places; examples would include export-processing zones and slum-upgrading programmes (World Bank, 2008).

Figure 2 below summarizes how these instruments should be matched at different stages of development. The basic idea is that governments should aim to build density; thereby, encouraging agglomeration economies, while reducing the time and costs which both come with, and which threaten to undermine rising concentration (World Bank, 2008; Munoz et al., 2009).

Figure 2: Dimensionality of the policy challenges for areas at different levels of urbanization



Source: Munoz et al. (2009)

Arguably, future development plans in South Africa would subscribe to the “I for a D” framework presented above. In line with the framework guidelines The National Planning Commission (NPC) has proposed the following strategies to reverse the spatial effects of apartheid: (i) Increasing urban density, while improving the liveability of cities by providing parks and other open spaces, and ensuring safety; (ii) providing more reliable and affordable public transport with better coordination across municipalities and between different modes; and (iii) moving jobs and investment towards dense townships that are on the margins of cities, while discouraging the building of new settlements far from places of work (NPC, 2011: 16).

One shortcoming of this “I for a D” perspective is that it lacks place-specific context and suggests that a concentration of economic mass will inevitably encourage growth and development (Garretsen et al., 2011). Arguing this further, Murphy (2011) suggests that the approach fails to account for social dynamics and relational factors; which play a critical role in determining whether spatial proximity encourages growth. The author puts forward that,

“With respect to density and physical proximity, the development of effective scale economies requires more than simply concentrating people and economic activities together in cities. The success of such strategies also depends on the quality of the socio-spatial relationships within urban economies and clusters, the spatial organization of an urban economy and the ability of local firms to develop

connections to external markets, value adding opportunities and sources of knowledge.” (Murphy, 2011: 185)

It therefore follows that if the strategies presented by the NPC are to enable urban or regional development, they need to be firmly rooted in an understanding of whether and how spatial proximity could influence growth in different contexts. This is especially important in South Africa given the unique spatial distribution of population and economic activity in the country as a result of spatial engineering under apartheid.

This study contributes to the dialogue on the growth effects of agglomeration by providing a South African specific case-study on this subject. The study is broadly informed by the ideas presented in the World Bank (2008) and by theories of agglomeration and international evidence, briefly presented and discussed below.

The link between agglomeration and growth: Theoretical perspectives and empirical evidence

Agglomeration economies, the positive externalities that arise from a greater concentration of economic activity, underpin the argument that density encourages growth. By locating in an area where population and economic activity are already concentrated, firms experience productivity advantages, because concentration facilitates: (i) The *sharing* of capital inputs, information, and employment; (ii) the *matching* of production requirements, such as types of land, employment and intermediate inputs; and (iii) *learning* about new techniques and products by workers and entrepreneurs, through knowledge spillovers (Roberts and Goh, 2010; World Bank, 2008).

Theoretically, agglomeration economies are divided into localization economies and urbanization economies. Localization economies are the benefits that arise when firms in the same sector are in close proximity to one another. Being in the same industry, these geographically concentrated groups of firms are generally linked by the technology they use, the skills, the products and services they require, and the markets they serve, which makes benefiting from matching, sharing and learning much easier. The benefits from localization extend to the inclusion of upstream and downstream firms and associated institutions, such as universities and trade associations (World Bank, 2008).

Theories concerned with localization economies can be traced back to Marshall (1890). Presenting a growth model for cities, Marshall (1890) suggested that the concentration of a given industry in a locality stimulates the growth of that industry, as well as the growth of the locality. If firms can internalize their externalities, as in a monopolistic market structure, innovation and growth speed up.

This model, together with one presented by Romer (1986), and Arrow (1962), holds that the accumulation of technologies and ideas creates the bulk of economic progress; and that this development would, consequently, depend critically on knowledge spillovers. The essence of the theory, dubbed the Marshall-Arrow-Romer (MAR) theory by Glaeser et al. (1992), is captured in the following excerpt from Marshall (1890):

“When an industry has thus chosen a location for itself, it is likely to stay there long: so great are the advantages, which people following the same skilled trade get from near neighbourhood to one another. The mysteries become no more mysteries; but are as it were in the air, and children learn them unconsciously. Good work is rightly appreciated, inventions and improvements in machinery, in processes and the general organization of the business have their merits promptly discussed: if one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus, it becomes the source of new ideas” (quoted in Fujita and Thisse, 2002: 7).

In line with MAR, Porter (1990) argued that localization stimulates industry, as well as city-wide growth. This happens because competitive pressure between firms forces them to innovate (or fail), thereby generating industrial growth. Porter (1990), in contrast with the MAR, regarded competition, rather than a monopolistic market structure, as being crucial for growth.

Urbanization economies arise in diverse urban areas. Industrial diversity allows firms to share indivisible facilities or public goods, a wider variety of intermediate input suppliers, and a larger pool of narrowly specialized workers (World Bank, 2008). Jacobs (1984) argued that industrial diversity is the crucial externality within cities because a diversified city stimulates the interchange of ideas across different industries. This cross-fertilization of ideas results in greater innovation and growth.

The positive externalities associated with diverse cities are sometimes referred to in the literature as Jacobs externalities. Jacobs externalities were argued to be more prevalent under a competitive market structure over a monopolistic one, as competition stimulates innovation (Jacobs, 1984).

The empirical literature generally supports a positive association between the concentration of economic activity and growth. This is, however, not universally true – with some inconsistent, and even contradictory, findings across different studies. The variation in results is attributable to differences in economic realities and to the fact that studies are very specific in terms of the methodology, data and variables that they employ. For these reasons each study should only be viewed as a specific ‘example’.

There is little debate that the benefits of agglomeration are initially realized at the micro-economic level, and then at the macroeconomic level. Positive externalities give rise to more productive firms, and increased productivity stimulates regional growth and development

(Combes et al., 2008). Empirically, the lack of highly refined (firm level) data, makes it difficult to estimate the impact of agglomeration on productivity growth. This is one of the major shortcomings in the empirical research.

To address this shortcoming Glaeser et al. (1992) and Henderson et al. (1995) propose an alternative specification. This specification – which will be used in the empirical analysis component of this thesis– involves choosing a different dependent variable; for example, estimating the impact of agglomeration on employment growth, instead of on productivity growth. In the empirical literature, the choice of dependent variable depends on the data available and the hypothesis being tested.

While employing different measures is useful for investigating the scope of agglomeration economies, it is noteworthy that the impact of agglomeration on one measure of growth does not necessarily imply a similar impact on other measures (Cingano & Schivardi, 2003; Fafchamps, 2004; Rosenthal & Strange, 2004).

Another point worth noting is that most of the empirical literature focuses on the importance of density for growth in developed countries; perhaps because these countries have more reliable data on economic activity for longer periods of time. For developing countries, the evidence base is much thinner – with a heavy Latin American and Asian focus; while evidence of agglomeration economies in Africa is “conspicuously absent” (Quigley, 2008: 12). Given the quite different physical and economic characteristics across (and within) these regions, agglomeration effects in one place do not imply similar effects in another.

Empirical studies therefore examine the effects of agglomeration in a wide range of contexts. They are generally concerned with one of the three dimensions of agglomeration economies. Studies concerned with: (i) The industrial scope of agglomeration economies distinguish between localization and urbanization economies; (ii) those examining the geographical scope of agglomeration economies consider the net effect of density at various geographical scales; and (iii) studies investigating the temporal scope of agglomeration economies examine whether the impact of agglomeration economies is static or dynamic (Rosenthal and Strange, 2004).

Across all three dimensions, agglomeration economies are said to exist when places of higher density are more productive and experience higher growth (Glaeser and Gottlieb, 2009). In the presentation of the developed and developing evidence that follows, studies will be classified according to one of the three dimensions: industrial, geographical or temporal scope.

Studies concerned with the *industrial scope* of agglomeration economies make the distinction between localization and urbanization economies, this distinction is however not always as clear in practice as it is conceptually (Rosenthal and Strange, 2004; Graham, 2007). In an extensive review of the developed country literature, Rosenthal and Strange (2004) find that

doubling city size is associated with an increase in productivity of between 3-8 per cent in developed countries. The type and magnitude of agglomeration economies reported by the authors (2004) varies across the different studies reviewed.

Henderson (1986), for example, found substantial evidence of localization, and almost no evidence of urbanization economies. Glaeser et al. (1992) find that urbanization, rather than localization, encourages growth. Whereas Nakamura (1985) found that both urbanization and localization economies would affect productivity.

The impact of localization, defined in terms of either specialization or competition, is widely covered in the empirical research. Specialization is typically measured as the share of a city's employment in a particular industry; while competition is defined as the number of firms in a given industry. Glaeser et al. (1992) and Henderson et al. (1995), seminal papers in the study of agglomeration economies, report contradictory findings with respect to localization and growth for the US.

Glaeser et al. (1992) find a negative relationship between industry specialization and employment growth over the period 1956-1987 such that increasing industrial specialization by 10 % reduces employment by 12 %¹. On the other hand, increased competition within an industry was found to be positively associated with employment growth. More firms per worker in a city-industry relative to the national average lead to the high growth of that city-industry: "Going from as many to twice as many firms per worker as the national average...raises growth of employment in the city-industry by 59 percent over 30 years" (Glaeser et al., 1992: 1144)

In contrast to the findings presented by Glaeser et al. (1992), Henderson et al. (1995) report that specialization is positively associated with growth in US mature industries between 1970-1987. They also find however that specialization does not affect growth in high-tech industries. The study was conducted using the data for 224 US metropolitan areas.

Similarly, Cingano and Schivardi (2003) report contradictory findings for Italy. The authors find that specialization has a positive effect, while competition has no effect, on employment growth. With regards to specialization they report that doubling the share of employment in a given location results in an average increase in sectoral Total Factor Productivity (TFP)² of 0.2 % per year over the period 1986-1998; while doubling the initial employment in manufacturing raises TFP by 0.4 % per year; but no relationship between competition and growth.

¹ The authors use data for the six largest industries in each of 170 counties.

² The author has used balance sheet data for a large number of Italian firms (30,000-40,000) to construct the measure of Total Factor Productivity (TFP).

For Mexico and for the UK, respectively, Cota (2001) and Graham (2007) report a consistently positive association between localization and growth. Cota (2001) attributes the positive relationship between localization and employment growth in the northern borders of Mexico to pooled labour markets in some of the cities in these areas. The author reports, in direct contrast to the findings presented by Glaeser et al. (1992), that a 10 % increase in industrial specialization increases employment growth by 12 % over the period 1988-1993.

In the UK, Graham (2007) finds positive externalities in the manufacturing industry, the construction industry, and six service industries. As shown in Table 2, doubling the economic mass of these industries is associated with an increase in productivity ranging from 7 % to 24 %. The author reports that services tend to have higher elasticities than manufacturing and suggests that this may be because services are disproportionately located in highly urbanized areas where there is greater scope for industrial interactions.

Table 2: The elasticity of agglomeration economies in the UK by industry

Industry	Elasticity
Manufacturing	0.08
Construction	0.07
Distribution, tickets and catering	0.15
Transport, storage and communications	0.22
Real estate	0.19
IT	0.08
Bank, Finance and Insurance	0.24
Business services	0.22
Service sector weighted average	0.19
Whole economy	0.12

Source: Graham (2007)

The main studies that examine the impact of urbanization on growth are those of Glaeser et al. (1992), Henderson et al. (1995) and Rosenthal and Strange (2003). All three studies consider the impact of urbanization on growth in the US and when taken together, present evidence in support of Jacob's externalities, they demonstrate that diversity encourages growth. Glaeser et al. (1992) found that diversity encourages employment growth; Henderson et al. (1995) found that diversity encourages growth among high-technology firms; while Rosenthal and Strange (2003) report that diversity fuels the birth of new firms in the US.

The results for France are similar, with Duranton and Puga (2001) reporting that diverse cities encouraged growth and the evolution of new industries. In contrast to these results, Cingano and Schivardi (2003) report that in Italy, urban diversity is not a significant determinant of TFP growth.

The papers discussed thus far suggest that, in the developed country context, the industrial scope of agglomeration economies varies across (and within) different contexts. This is also the case in developing countries.

The developing country literature draws particular attention to the industrial scope of agglomeration economies; studies examine whether localization or urbanization economies are more significant. Overman and Venables (2010) summarize this literature (see Table 3); and they suggest that localization, rather than urbanization economies, tend to be more prevalent in developing countries. Henderson (1988) suggests that this may be the case because “...a clustered or densely populated region [provides] a rich environment for competition and collaboration among firms and workers in the region, which leads to economic growth” (Henderson, 1988: 23).

Table 3: Analyses of agglomeration economies in the ‘South’

Country	Author (date)	Main type of agglomeration economies
Brazil	Henderson (1988)	Localisation economies
Korea	Henderson (2001)	Localisation economies in 3 industries. Urbanisation economies in 1 industry.
	Lee & Zang (1998)	Localisation not urbanisation economies
China	Chen (1996)	Localisation economies
India	Shukla (1996)	Urbanisation stronger than localisation economies
	Mitra (2000)	Urbanisation economies in 11 out of 17 industries
	Lall et al (2003)	Urbanisation economies in 8 industries. Localisation diseconomies
	Lall et al (2004)	No localisation or urbanisation economies
Indonesia	Henderson (1996)	Localisation economies in 3 industries. Urbanisation economies in 3 industries.

Source: Overman and Venables (2010)

Highlighting the importance of industry-specific externalities, Henderson (2001) reports that in Korea, a 1 % increase in local own-industry employment results in a 0.06 % - 0.08 % increase in plant output. In a related text, the author interprets this finding as follows:

“A coefficient of 0.06-0.08 means that a 1 percent increase in local own-industry employment results in a 0.06-0.08 per cent increase in plant output. So, a plant in a city with 1000 workers in other firms in the same industry would, without changing its own inputs, increase its output by over 70 % - by moving to another city with 10 000 workers in the same industry” (Henderson, 2002: 92).

Complementing these findings, Lee and Zang (1998) reported that localization economies were dominant for most manufacturing industries across Korea in 1983, 1988 and 1993. These

industries did not however benefit much from locating in large cities – with more occasions of negative urbanization economies than positive ones.

The relatively thin African literature, which as far as can be established is limited to Fafchamps (2004) for Morocco and Bigsten (2011) for Ethiopia, also reports that localization – particularly the agglomeration of manufacturing firms– has a strong positive impact on employment growth, output growth and productivity.

In line with MAR, Fafchamps (2004) reports that less competition within a sector is linked to higher growth in that sector³. The author also reports that an increase in diversity results in a fall in employment growth⁴, this does not support the theory of Jacob's externalities. These relationships are robust at the three levels of geographical disaggregation, commune, city and province.

For Ethiopia, Bigsten (2011) reports that clustering leads to positive externalities and reports that for every additional firm producing the same product in a town, productivity rises by about 0.5%. The authors argue that this may well be the case – because in countries with weak formal institutions, informal contract enforcement and co-operation are important for business, and would be likely to work better if the parties were located close to each other. Physical proximity could also make firms better informed about which entrepreneurs can be trusted.

While the benefits from physical proximity in Ethiopia are considered at the local scale, such benefits can impact growth across different geographical scales: international, national as well as local. This is explicitly captured by studies that consider the *geographical scope* of agglomeration economies. Studies concerned with this dimension generally measure density as the number of jobs or residents per unit of land; and they do not necessarily rely on political boundaries, such as states and counties, to define the extent of the city.

In measuring the geographical scope of agglomeration economies for the US, Ciccone and Hall (1996) found that county-level employment density has a positive impact on aggregate state-level labour productivity. The authors report that doubling county level employment densities increase state-level productivity by around 6 %. Using similar methods, Ciccone (2002) conducted a European study, and estimated the effects of employment density on productivity for the NUTS-3 regions in France, Germany, Italy, Spain and the UK. This study found that the elasticity of productivity with respect to employment density in Europe was 4.5% - only slightly lower than the 6 % found in the USA.

³ A 1 % fall in competition increases employment growth by between 0.9 % to 1.9 %, and output growth by between 0.49 % to 1.6 %.

⁴ A 1 % increase in diversity results in a fall in employment growth of between 0.37 % - 0.47 %, and a fall in output growth of between 0.024 % - 0.43 %.

Following from Ciccone and Hall (1996), Roberts and Goh (2010) have empirically assessed whether, and to what extent, density explains the spatial productivity disparities within the Chongqing municipality in China. They found that the estimated elasticity of productivity with respect to density was 3.6 %; and rejected the hypothesis of no agglomeration economies in Chongqing municipality, China.

Assessing the geographical scope of agglomeration economies somewhat differently, some studies examine the impact of agglomeration economies in an immediate area against the activity further away. Rosenthal and Strange (2003) perform this sort of analysis and report that at the US zip-code level, agglomeration effects tend to die down with distance. Soest et al. (2002) have conducted a similar analysis; and they concur that agglomeration economies in a zip code area have little effect on growth elsewhere, despite the fact that these zip codes average only 6 km² in size. Duranton and Puga (2001) presented similar findings; and they report that localization economies tend to exist within a 10km radius of firms: a relatively small spatial scale.

Together studies concerned with the geographical scope of agglomeration economies therefore suggest that while agglomeration economies can be realized across different spatial scales, the benefits of agglomeration do not automatically ‘trickle down’ and result in the growth of neighbouring areas. It therefore follows that once an industry gets launched in place, it may tend to keep growing in that place with possible lock-in effects over time.

The time or temporal dimension of agglomeration is explicitly captured by studies concerned with the *temporal scope* of agglomeration economies. These studies explore whether (and why), once an industry gets launched in a place, it tends to keep growing over time. They typically do this by regressing growth over a particular period against beginning-of-period agglomeration indicators (Rosenthal and Strange, 2004).

An example of industry ‘lock-in’ is reported in Java Indonesia, where there is a very high degree of persistence in patterns of employment concentration (Henderson and Kuncoro, 1996). Growth in traditional manufacturing is higher in cities with high concentrations of past employment⁵ in own industries. The results are such that:

“...if we compare a city with 20 000 workers in 1970 which constitute 2 percent of the workforce with a city with 10 000 machinery workers which constitute 8 percent of the workforce in 1970, the second city would have had a larger workforce in machinery in 1987, *ceteris paribus* (Henderson and Kuncoro, 1996: 1074)”

One explanation for this is that the historical concentration of own industry creates a favourable environment for attracting current producers. In addition, entrepreneurs may actively seek out localization and agglomeration to improve productivity and profits (Quigley, 2008). Extending from this, a related and important point of consideration, is that

⁵ Measured as: 1) Own industry employment/total employment; and 2) own industry employment/urban land area

agglomeration effects may decline after reaching a certain threshold (Chen ,1996; Mitra, 2000). Chen (1996) reports an example of this in Shanghai and suggests that:

“...both industries [machinery and food] have surpassed the optimal agglomeration scale, and the low efficiency firms have been squeezed out. Firm numbers in the machinery industry from 1987 to 1992 were 1522, 1641, 1696, 1661, 1623 and 1385; while firm numbers in the food industry, from 1988 to 1992, were 449, 447, 449, 442 and 347” (Chen, 1996: 429).

Similarly, Mitra (2000) reports that in India, while TFP is generally responsive to urban population or industrial spread:

“...[The] productivity augmenting effects of urbanization or urban industrial spread are not steady all through; diseconomies outweigh the economies once urban population or urban manufacturing employment are exceedingly large (Mitra, 2000: 104).”

An alternative way to test the temporal scope of agglomeration effects is to assess whether growth patterns are convergent, divergent or static over time. Gibrat’s Law which holds that (city) growth patterns are random in nature and independent of size, can be used to test this. Testing Gibrat’s Law – as will be done in this thesis– reveals the impact of agglomeration by determining whether city growth is: (i) Divergent, with larger cities growing faster than smaller cities, evidence of increasing returns to scale; (ii) convergent, where smaller cities grow faster than larger cities; or (iii) parallel or proportionate, where large and small cities experience similar growth rates (Sharma, 2003).

Country-specific evidence suggests that proportionate growth is most prevalent across cities. In the US for example, Eeckhout (2004) reports that cities have experienced parallel growth, and that even though growth rates between cities vary substantially, there is no systematic pattern with respect to size. Similarly, the results presented by Eaton and Eckstein (1997) suggest that urbanization for cities in France and Japan has followed a parallel growth pattern, rather than convergence to an optimal city size, or divergent growth by the largest cities. And for India, Sharma (2003) finds parallel growth over the period 1901-1990. Parallel growth across all three studies implies the persistence of the relative size distribution of cities. This, in turn, implies an increase in the share of economic mass in larger cities and stability in the urban hierarchy within the respective countries because:

“The ‘birth’ of cities of different sizes at the earliest point in time, could be viewed as the result of productivity shocks affecting cities differentially. Larger cities remain large relative to other cities for a long time after the cities are ‘born’” (Sharma, 2003: 318).

Together, the studies considering the temporal scope of agglomeration economies suggest that while there is a tendency for benefits to be associated with the concentration of economic activity, it is possible that these benefits result in industry lock-in effects; but also that they diminish beyond a certain threshold. Over time, these effects influence the spatial configuration of economic activity.

Having looked at the empirical evidence, the broad message is that the relationship between the concentration of economic activity and performance is not universally positive. The evidence suggests that the prevalence of agglomeration economies, varies across (and within) places; and over time. This implies that the World Bank's (2008) assertion that agglomeration encourages growth should be interrogated in different contexts rather than interpreted as a 'universal law'.

In accordance with this, the current thesis considers the relationship between agglomeration and growth in the South African case over the period 1996-2010. The data and variables used throughout the analysis are presented in the section that follows.

University of Cape Town

Section 3 Variables, data and municipality categorization

Variables and data

Density in this paper refers to: (i) The size of the resident population relative to the physical area of each geographical unit ('population density'); (ii) the level of employment relative to the same area ('employment density'); and (iii) the scale of economic output, economic activity or gross value added (GVA) relative to the same area or ('economic density').

Both an employment-based and a population-based measure of density are used because theories of learning and knowledge spillovers emphasize physical interaction as the mechanism through which information and ideas are spread. Furthermore, the exchange of information and ideas need not only be confined to places of employment (Abel, Dey, & Gabe, 2011)⁶.

Gross value added is the difference between the value of goods and services produced, and the cost of raw materials and other inputs that are used in production; this is effectively a measure of output. Using this to calculate the level of output produced, and thus income generated, for a particular unit of land is the popular conception of density used in the literature (Glaeser, 2003).

Skills share refers to an education-based measure of human capital. This is the conventional measure of human capital that has been linked to a number of measures of regional vitality (Abel, Dey & Gabe, 2011). In this paper, skills share is defined as the proportion of people with matric within a municipality⁷.

Economic growth is the dependent variable of interest in this study and refers to: (i) Economic output (GVA); (ii) total employment and (iii) total population. Population can be treated as an indicator of growth at the local level because of its influence on the consumption of goods and services, including public and private services. Population – in the form of labour – is also an input in economic activity. Consequently, expanding populations are generally associated with growing economies, especially at the local and regional scales.

Subsequent to Combes et al (2008) and the World Bank (2008), growth is calculated based on a model of continuous, exponential growth (or annual compound growth) between two points in time⁸. This rate is superior to the simple average growth rate, as the latter overstates the

⁶ Density, D , is calculated using the equation $D=X_i /A_i$ where A represents the land area and X represents the population, employment and GVA, respectively of municipality i .

⁷ It is appreciated that the education-based measure of human capital probably fails to capture the full array of knowledge and skills within an area, as put forward by Abel et al. (2011). However, data on other human capital variables are not readily available at the municipality level.

The skills share, S , is calculated using the equation $S= M_i/P_i$, where M is the number of people with a matric certificate, and P is the total population of a municipality i .

⁸ In mathematical notation, this growth rate, r , can be represented as $r = (\ln(X_{10} /X_{96})/15)*100$. Where X is population, employment and GVA respectively and 15 is the number of years in the period under consideration.

growth estimations, because it neglects the fact that the basis for growth is continuously rising (Carlin, 2008).

The data from two independent service providers: Quantec and Global Insight (GI) was considered. Unfortunately, there are no regularly updated official economic data at the municipal scale⁹. Having data available from both providers is useful, as it enables cross-checking for consistency and reliability. This helps to avoid errors that might simply be attributed to the way the data had been generated by either of the suppliers.

The summary statistics generated from both Quantec and GI, for the full sample of 237 municipalities, are presented in Table 4 and Table 5 below. The density measures presented are for 1996; and growth is calculated over the period 1996-2010. The two datasets are not entirely complementary; and one notable difference between them, can be seen when comparing the summary statistics (especially the maximum and minimum values) for the employment growth variable.

Table 4: Quantec Summary Statistics, 1996-2010

	Quantec				
	Mean	Median	S.deviation	Minimum	Maximum
Population density ¹	102	40	238	1.6	2154
Employment density ²	23	6.3	66	0.14	574
GVA density ³	2179589	357841	7664725	7598	7.51E+07
Population growth	0.85	0.74	0.99	-1.66	4.61
Employment growth	0.55	-0.67	2.19	-8.19	4.71
GVA growth	2.91	2.98	1.84	-3.4	8.38

Notes: 1 = Number of people per km²; 2 = Number of people employed per km²; 3=Output per km² in 1996

Table 5: Global Insight Summary Statistics, 1996-2010

	Global Insight				
	Mean	Median	S.deviation	Minimum	Maximum
Population density ¹	82	33.97	192	0.38	1715
Employment density ²	18	3.1	67	0.08	787
GVA density ³	2106264	297844	8262158	5170	9.41E+07
Population growth	1.07	1.07	1.47	-5.23	6.01
Employment growth	1.43	1.94	3.02	-11.87	13.19
GVA growth	2.12	2.09	1.51	-4.1	6.85

Notes: 1 = Number of people per km²; 2 = Number of people employed per km²; 3 = Output per km², in 1996

The data used in this study were compiled primarily from Global Insight. GI arrive at their sub-national estimates by:

⁹ Provinces are too large and few in number to provide robust analysis of the relationship between density and growth.

“...draw[ing] together many different sources of sub-national economic information from Statistics South Africa, government departments, development agencies, Regional Services Councils, private research houses and IHS Global Insight's own data. These data components are reworked to ensure that they are internally consistent and add up to the national totals” (GI, 2010: 4)¹⁰.

This is rather vague, and consequently not entirely satisfactory. However, there is no other option on the table. GI has more staff available to update and check their data than Quantec; and for this reason, are preferred.

The geographical units used in this study are South Africa's 231 local municipalities and 6 metropolitan municipalities. These are generally large enough to be fairly self-contained functional areas, certainly to a larger extent than in many other countries. This means that cross-boundary flows of people and resources are smaller than in countries with smaller municipal jurisdictions. Consequently, there is less leakage through commuting and trade, and a stronger connection is likely to exist between local population density, levels of economic activity and rates of economic growth.

The boundaries used to define municipalities are based on the 2005 boundaries, as reported by StatsSA. The 2005 boundaries are chosen in preference to the more up-to-date 2011 boundaries, as the latter include sparse areas and national parks within the municipal boundaries, which would lead to a misleading impression of density. Other than this, the latest boundary changes include the merger of Tshwane and Metsweding, and the classification of the new metros (Buffalo City and Mangaung). Given that the period under consideration for this analysis is 1996 to 2010, these changes do not significantly affect our results.

Municipality Categorization

Locational features such as social dynamics, levels of social capital and the institutional and industrial environment of a place can influence its development trajectory (Storper, 2008; Murphy, 2011). These features also influence why different places facilitate agglomeration economies at different propensities. The importance of taking these factors into account is highlighted by Murphy (2011), who suggests that:

“...a city or region's socio-spatial context shapes the evolution of its economy; and...‘blindness’ to these spatialities can limit the efficacy of ‘first-order’ urbanization and growth policies” (Murphy, 2011: 179).

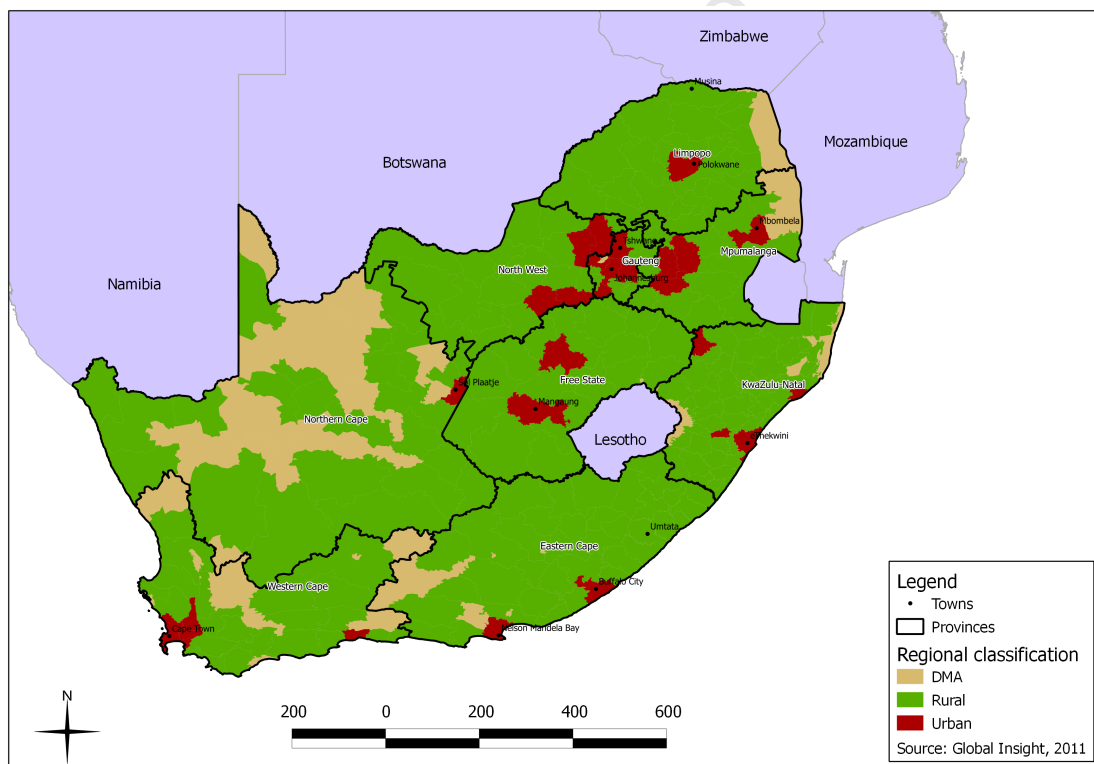
In accordance with the above argument, this study accounts for locational characteristics in the South African context by categorizing municipalities according to their historical administrative classification and dominant tradeable sectors.

¹⁰ A more detailed explanation of how GI arrives at the population, employment and GVA estimate is presented in appendix A.

Municipalities are initially categorized as either rural or urban, defined in terms of apartheid categories, according to Makgetla (2010). Rural areas defined in this way cover the former Bantustans and commercial farming areas¹¹. Urban areas cover the metropolitan municipalities and secondary cities. South Africa has nearly eight times more rural municipalities than urban ones. Despite this, about 60 percent of the country's population live in urban areas (NPC, 2011).

The distribution of rural and urban municipalities can be seen in Map 1. The areas that have been shaded brown in Maps 1-7 represent 'District Management Areas' or DMAs. These are areas within district municipalities that do not fall under any local municipality, and receive services directly from the district. Some DMAs include remote settlements, and areas of low economic potential. Others include designated pieces of land that have a high diversity and environmental value which requires protection and conservation, while others are nature reserves (HSRC, 2005).

Map 1: Urban and Rural Municipalities



Summary statistics for the full sample of 237 municipalities (national), as well as the rural and urban categories, are presented in Table 6.

¹¹ Of course classifying some of these areas as rural may not completely describe their reality.

Table 6: National, urban, and rural summary statistics, 1996-2010

	National	Urban	Rural
Number of municipalities	237	27	210
Mean population density¹	83	381	43
Mean employment density²	18	114	6
Population: employment ratio³	5	3	7
Mean GVA density⁴	R2.1m	R14.2m	R0.5m
Mean share of skills (%)⁵	7.1	13	6.3
Mean population growth (%)	1.1	1.4	1
Mean employment growth (%)	1.4	2.2	1.3
Mean GVA growth (%)	2.1	2.6	2.1

Notes: 1 = Number of people per km² 2 = Number of people employed per km² 3 = Number of people/number of jobs 4=Output per km² 5= Share of the population with a matric pass in 1996

In 1996, population density in urban municipalities was about 9 times higher than in rural municipalities and the mean employment density was about 20 times higher than that in rural municipalities. These results together with urban GVA density being about 30 times that in rural areas, support the stylized fact that urban areas are the hubs of economic activity.

The density differences are further reflected in the 1996 average population-to-employment ratio; which gives an indication of the extra pressure faced by the productive population in rural municipalities, ignoring the effects of remittances from urban households. In urban areas the population-to-employment ratio was about 3 people to 1 job. The national ratio was higher: 5 people to 1 job; and the rural ratio even higher at 7 people to 1 job.

The share of the population with a matric certificate also suggests that urban areas are relatively better off. In 1996, the share of the population in matric was higher in urban areas than the national average, and the average in rural areas. At 13 %, the share of the population with matric in urban areas was a little more than double that in rural areas and almost double the national average.

Over the period 1996-2010, urban municipalities experienced higher average growth than rural areas across all three measures of growth. Population growth was 1.4 % in urban areas compared with 1 % in rural areas; employment growth was 2.2 % in urban areas compared with 1.3 % in rural areas; and GVA growth was also faster in urban areas at 2.6 % than in rural areas, which saw the GVA grow at an average rate of 2.1 %.

It is noteworthy that the average GVA growth rate was faster than both population growth and

employment growth in both urban and rural areas. GVA growing more rapidly than employment means a decline in the labour intensity of GVA or a rise in GVA per worker (Bhorat & Oosthuizen, 2004). This may suggest that the country's economic structure has been gradually shifting towards a more capital-intensive and less labour-absorbing character .

An additional set of results is presented for the 27 urban municipalities. To arrive at these results, the urban municipality area of analysis is redefined as the built-up area. This is done by excluding sparsely populated places from the total land area of urban municipalities. Doing this for urban municipalities, in particular, may be revealing in that these areas have generous boundaries which include substantial undeveloped land. This could have the effect of significantly underestimating the 'effective' density of these municipalities.

In this study, built-up areas represent the land area covered by sub-places¹² with a population density higher than 25 people per hectare, or 2500 people per km². Areas with a density lower than this threshold are assumed to be either sparsely populated, or to have low levels of economic activity; and they, therefore, do not form part of the city's core. This threshold is lower than that in many countries, but consistent with South Africa's peculiar urban form of perversely concentrated city's populations far from their employment centre. Low-density, middle and high-income suburbs, and high-density townships are a legacy of separate development under apartheid.

The built-up area density of urban municipalities is calculated as follows:

1. Summing up the area of all sub-places within the municipality with a population density higher than 2500 people per km².
2. Summing up the 2001 Census population and employment totals of all the sub-places that lie within the defined built-up area of a municipality.
3. Deriving the population and employment densities by dividing the population and employment totals of the built-up area by that of the built-up area. To arrive at the GVA density figure, the total municipality GVA is divided by the land area of the built-up area.

Given their smaller land areas and higher levels of economic activity, the average density for the built-up areas is significantly higher across all density measures; this is shown in Table 7. The average population density of the built-up areas is 5630 people per km² compared with 381 people per km² for the total municipal land area. There are about 1337 people employed per km² for the built-up areas compared with 114 people employed per km² for the total land area.

¹² A sub-place is a portion of a municipality. In an urban area this would be a suburb and in a tribal area this would be a village (Stats SA, 2001).

The GVA density for the built-up area is 342m per km² compared with 14.2m for the total land area.

Population density is, therefore, about 15 times higher for the built-up area than for the total land area; employment density is about 12 times higher; and the GVA density is 24 times higher.

Table 7: Summary statistics for urban municipalities (built-up and total area), 1996

	Built-up area	Total area
Number of municipalities	27	27
Mean population density¹	5630	381
Mean employment density²	1337	114
Mean GVA density³	R342m ⁴	R14.2m

Notes: 1 = Number of people per km² 2 = Number of people employed per km²
 3 = Output per km² 4 = It is assumed that total municipal GVA is produced on the built-up area

Rural and urban areas are operationally different because the nature and level of interactions between economic agents varies with context; the relevant summary statistics suggest a higher level of interactions among economic agents in urban areas. The same can be argued when comparing the total land area of an (urban) municipality with the built-up area of the same municipality. Similarly, this reasoning can be applied when considering municipalities in terms of their historical administrative classification. That is comparing the former Bantustans, commercial areas, secondary cities and metros.

Municipalities in different groups can operate differently for a number of reasons – including the scale of economic activity, the levels of social capital, business associations, labour market networks and relationships to educational systems.

Accordingly, to account for these differences, and to be able to say something about the impact of historical experience on the development trajectory of places in South Africa, municipalities are categorized by their historical administrative classification. Rural municipalities are classified as either Former Bantustans or commercial farming areas; and urban municipalities, as metropolises, or secondary cities.

Former Bantustans, former homelands or former rural reserves¹³ are those municipalities which were established for Africans under the apartheid system. They are typically located on the periphery, and are distant from the economic centres in what is now Gauteng and along the coast. These areas are typically arid, with very limited agricultural and mining potential

¹³ Each of these terms is offensive for different reasons (Makgetla, 2010).

(Makgetla, 2010; Baldwin, 1975). Makgetla describes the conditions in the Bantustans in the excerpt below:

“With few exceptions, the Bantustan administrations had virtually no resource base of their own, and the central state provided only limited subsidies. The Bantustans ended up with too few and often poorly qualified educators, police and health workers. They suffered from severe underinvestment in both economic and household infrastructure, leaving them with inadequate transport, communications, power and irrigation for producers, as well as enormous backlogs in residential water, sewage and electricity ” (Makgetla, 2010: 19).

Commercial farming areas comprise smaller towns, commercial farms and most mining areas (Makgetla, 2010). It is worth emphasizing that despite the category name, these areas are not strictly speaking farming areas.

Secondary cities tend to have narrow economic bases. Given that these cities are industrially specialized, the processes of growth or decline of these places are varied. The performance of these economies can be related to shifts in production methods, the cumulative effects of poverty, or access to natural resources (The Department of Housing RSA, 1997).

Metropolitan municipalities represent the largest agglomerations. These areas serve as the economic engines for their surroundings, and arguably hold the largest potential to address the socio-economic needs of South Africa’s growing population. They boast concentrated and diversified economies, productive infrastructure on scale, well-established social networks; and they produce a variety of goods and services for distribution – both nationally and internationally (The Department of Housing RSA, 1997). These areas are also marked by inefficient and inverted density patterns, a legacy of the spatial engineering under apartheid (Gordon et al., 2007).

Map 2 and Table 8 show that the bulk of the municipalities located in the former Bantustans are contained in Kwazulu-Natal, the Eastern Cape and Limpopo. A few are also situated in Mpumalanga and the North West province; and one is located in the Northern Cape province. The Western Cape, Northern Cape and the Free State contain extensive commercial farming regions, but almost no former Bantustan areas.

Most secondary cities are located in and around Gauteng; and the six metropolitan municipalities are Cape Town, Nelson Mandela Bay, eThekweni, Johannesburg, Tshwane and Ekurhuleni. The first three are found in coastal provinces, the Western Cape, Eastern Cape and Kwazulu-Natal, and the remaining three are found in Gauteng.

Map 2: The distribution of municipalities by historical administrative classification, 1996

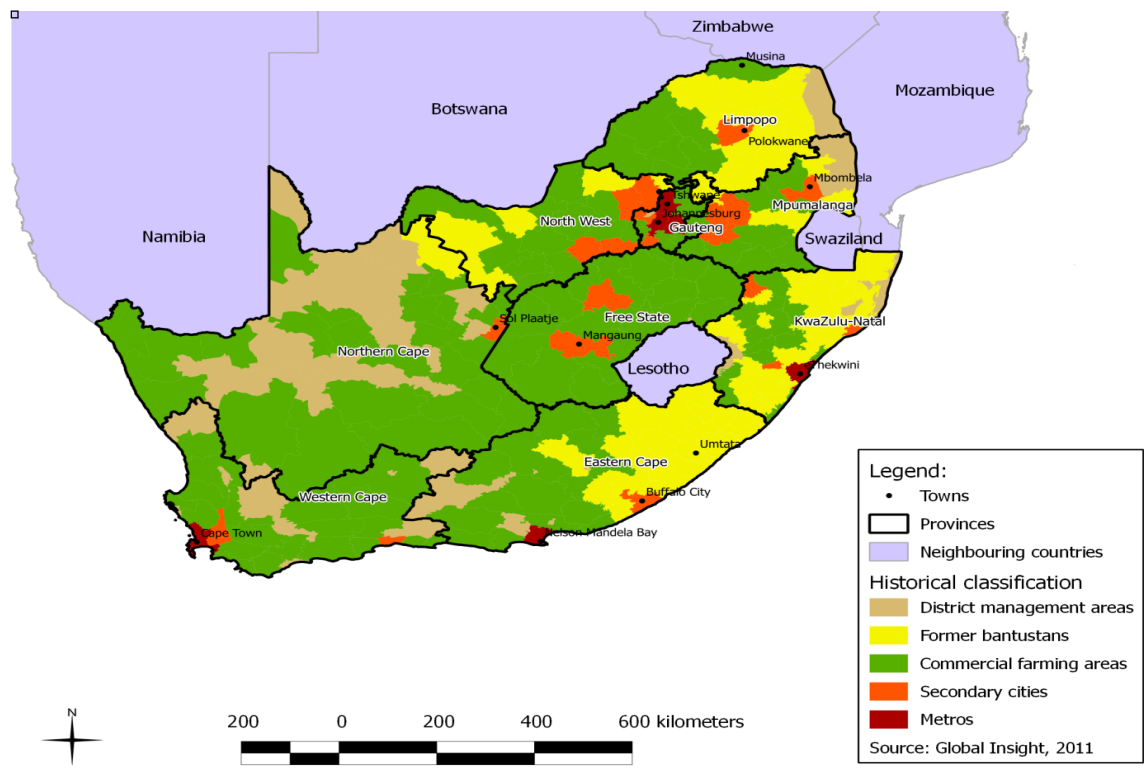


Table 8: Number of municipalities by historical classification and province, 1996

Province	Commercial			
	Former Bantustan	Farming	Secondary Cities	Metros
Gauteng	0	6	2	3
Mpumalanga	5	9	4	0
North West	5	12	4	0
Free State	0	18	2	0
Limpopo	17	7	1	0
Western Cape	0	21	3	1
Northern Cape	1	25	1	0
Eastern Cape	22	15	1	1
Kwazulu-Natal	33	14	3	1
South Africa	83	127	31	6

Table 9 presents summary statistics for the four historical classification samples. The table shows that on average metros have 1081 people and 365 jobs per km²; while secondary cities have on average 182 people and 42 jobs per km². That is to say, metros have about 6 times higher population densities and 8 times higher employment densities than secondary cities. The population-to-jobs ratio between the two groups is however very similar.

Table 9: Summary statistics for municipalities by historical classification, 1996-2010

	Metros	Secondary Cities	Commercial farming areas	Former Bantustans
Number of municipalities	6	31	127	83
Mean population density¹	1081	182	25	72
Mean employment density²	365	42	6	5
Mean population:employment³	3	4	4	15
Mean GVA density⁴	R46.1m	R5.1m	R0.5m	R0.6m
Skills share (%)⁵	15	12	8	4
Mean population growth (%)	1.3	1.3	1.4	0.4
Mean employment growth (%)	2.3	2.1	1.7	0.7
Mean GVA growth (%)	3.4	2.4	2.3	1.8

Notes: 1 = Number of people per km² 2 = Number of people employed per km² 3= Number of people/number of jobs
4=Output per km² 5= Share of the population matric, in 1996

In contrast to the urban areas, the population-to-jobs ratio in the rural areas is not similar. The former Bantustans, with 72 people per km², have about three times the population density of commercial farming areas which is not matched by a similar difference in employment. The former Bantustans have lower employment densities than commercial farming areas. This 'mismatch' is reflected in that, on average, for every 1 person employed in the former Bantustans, there are about 15 people; whereas for every one person employed in commercial farming areas, there are 'only' 4 people.

Metros are best placed in terms of GVA density which is much higher in these municipalities than in the rest of the country. Similarly, the share of the population with a matric certificate is higher in these municipalities: 15.4 % of the metro population have a matric certificate compared with 12 % of the population in secondary cities, 7.6 % of the commercial farming areas, and 4.2 % of the former Bantustans.

The average population growth rate has been similar in the metropolises, the secondary cities and the commercial farming areas: 1.4%; but much lower in the former Bantustans: about 0.4%, presumably due to emigration.

Employment grew at similar rates in the metros and secondary cities: 2.3 % and 2.1 %, respectively, but much more slowly in the former Bantustans: 0.7 %. Higher employment growth in the urban municipalities is attributable to higher levels of economic growth in these areas, relative to the former Bantustans.

Next, municipalities are categorized by their dominant tradeable sector. Sectoral considerations are important, because sectoral interests have the potential to shape the performance of general political institutions, political markets for ideas, development programmes in the region, resource-allocation processes, and ultimately regional development (Storper, 2008).

Focusing particularly on the agricultural, mining, manufacturing and community service sectors, categorization was done in such a way that the final groups were mutually exclusive. The procedure followed to categorize municipalities was as follows:

1. Calculating the proportion of employment in each broad tradeable sector for all municipalities.
2. Allocating each municipality to the category of agriculture, mining or manufacturing, according to its largest sector.
3. If none of the sectors agriculture, mining or manufacturing employed more than 10 % of the workforce, that municipality was not considered to have a dominant tradeable sector, and was categorized as community services.

Using this procedure, the number of municipalities identified in each group is:

146 agricultural municipalities, with a share of jobs in agriculture ranging from 10-65%.
25 mining municipalities, with the share of mining jobs ranging from 15-75%.
43 manufacturing municipalities, with the share of manufacturing jobs between 13-36%.
23 community-service municipalities, with these jobs ranging from 30-57%.

Map 3 shows the national distribution of municipalities by industrial composition; and the number of municipalities in each sector by province, is presented in Table 10. In all the provinces except Gauteng, the majority of the municipalities are agricultural. In Gauteng, the majority of municipalities are manufacturing. KwaZulu-Natal stands out as having a relatively high number of both manufacturing and agricultural municipalities.

Map 3: The distribution of municipalities by sector, 1996

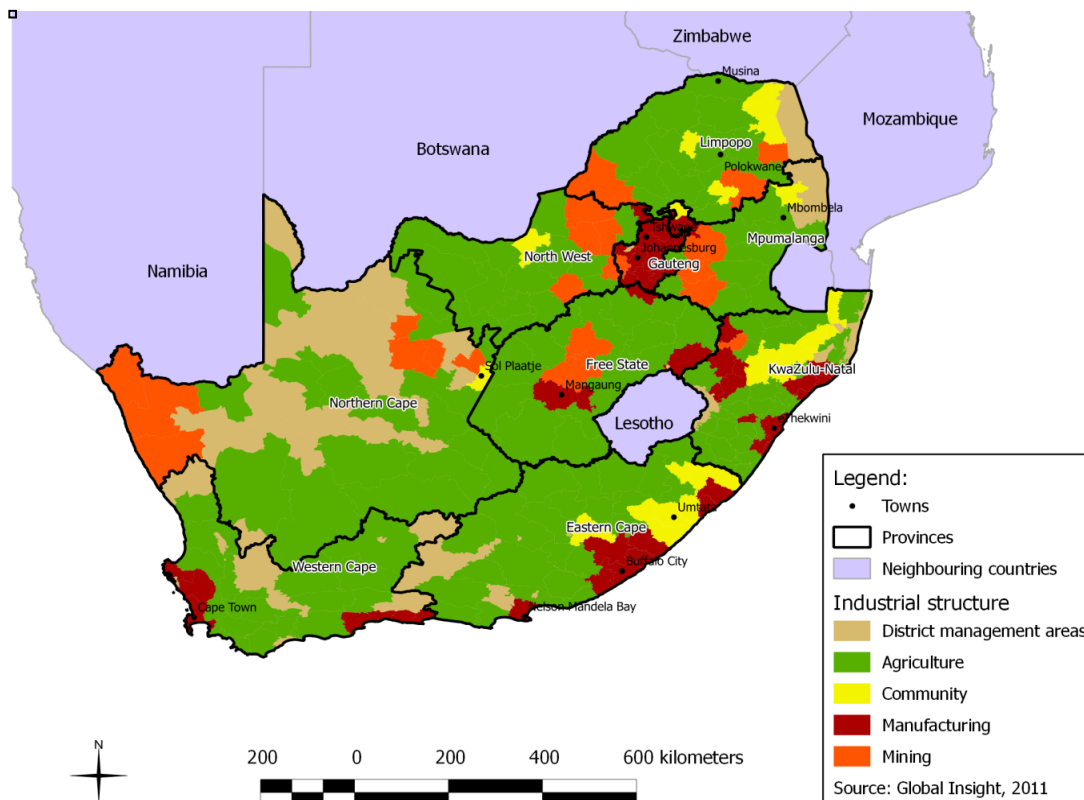


Table 10: Number of municipalities by industrial composition and province, 1996

Province	Manufacturing	Agriculture	Mining	Community services
Gauteng	9	0	2	0
Mpumalanga	1	11	4	2
North West	1	14	5	1
Free State	3	15	2	0
Limpopo	0	16	4	5
Western Cape	7	18	0	0
Northern Cape	0	19	7	1
Eastern Cape	8	23	0	8
KwaZulu-Natal	14	30	1	6
South Africa	43	146	25	23

Table 11 presents the summary statistics for each of the industrial structure samples. The table shows that manufacturing municipalities with 262 people per km² and 69 jobs per km² have higher densities than other municipalities. They also have a more skilled population; and they have experienced higher growth rates than other municipalities. Predominantly, agricultural municipalities have the lowest densities. Municipalities dominated by community services have the highest ratio of population to employment of all areas, suggesting a big shortfall in jobs in

these areas. They also have the lowest growth rates, after mining. Perhaps public sector growth in community services is compensating for areas with weak local economies.

Table 11: Summary statistics for municipalities grouped by industrial composition, 1996-2010

	Manufacturing	Agriculture	Mining	Community services
Number of municipalities	43	146	25	23
Mean population density¹	262	32	56	95
Mean employment density²	69	5	16	6
Mean population:employment³	4	6	4	15
Mean GVA density⁴	R8.6m	R0.5m	1.9m	0.6m
Mean Skills share (%)⁵	9.9	6.3	8.4	5
Mean population growth (%)	1.2	1.2	0.9	0.4
Mean employment growth (%)	1.8	1.5	0.3	1.3
Mean GVA growth (%)	2.8	2.2	1.0	1.7

Notes: 1 = Number of people per km² 2 = Number of people employed per km² 3= Number of people/number of jobs per km² 4=Output per km² 5= Share of the population with matric, in 1996

Section 4 The spatial distribution of economic activity in South Africa

Following the administrative and sectoral categorization of municipalities, this section profiles those municipalities at the top and bottom of the density and skills hierarchies in South Africa. Doing this highlights the striking differences in the national distribution of economic activity.

The density hierarchy in South Africa is similar to that described by The World Bank (2008). Primary cities (metros) are consistently at the top of the hierarchy; while agricultural areas are consistently at the bottom. The ten municipalities with the lowest and highest population densities are presented in Table 12. As is shown in the last column of the table, municipality population density ranges from being almost negligible to 1715 people per km². The top half of the table shows that the ten municipalities with the highest concentrations are either metros or secondary cities; and in 1996, these were predominantly manufacturing municipalities. Four out of the ten are located in Gauteng.

The ten municipalities with the lowest population densities are rural; and they were historically categorized as commercial farming areas. In 1996, nine of the ten were predominantly agricultural, while one was a mining area. Eight of the ten municipalities are located in the Northern Cape. Laingsburg in the Western Cape is a sparsely populated municipality in the Karoo (a semi-desert natural region in South Africa) and Molopo is in the North West province. Both municipalities border the Northern Cape.

Table 12: The ten highest and lowest-ranked municipalities by population density, 1996

Rank	Municipality	Administrative classification	Sector	Province	People/km ²
1	Johannesburg	Urban	Metro	GT	1715
2	eThekweni	Urban	Metro	KZN	1229
3	Ekurhuleni	Urban	Metro	GT	1137
4	Cape Town	Urban	Metro	WC	1063
5	Msunduzi	Urban	Secondary	KZN	854
6	Tshwane	Urban	Metro	GT	841
7	Emfuleni	Urban	Secondary	GT	672
8	N Mandela	Urban	Metro	EC	497
9	Buffalo City	Urban	Secondary	EC	272
10	uMhlathuze	Urban	Secondary	KZN	251
228	Khai-Ma	Rural	Commercial	NC	1
229	Molopo	Rural	Commercial	NW	1
230	Siyathemba	Rural	Commercial	NC	0.9
231	Ubuntu	Rural	Commercial	NC	0.9
232	Kamiesberg	Rural	Commercial	NC	0.8
233	Laingsburg	Rural	Commercial	WC	0.6
234	Kareeberg	Rural	Commercial	NC	0.6
235	Mier	Rural	Commercial	NC	0.5
236	Karoo Hoogland	Rural	Commercial	NC	0.4
237	Hantam	Rural	Commercial	NC	0.3

Table 13 presents the top and bottom ten municipalities in terms of employment, rather than population density. The spatial distribution of employment density is similar to the population density patterns.

Employment density in the country ranges from negligible to 787 people employed per km². The metros have the highest employment densities, followed by two gold mining municipalities situated in close proximity to one another in Gauteng (Randfontein and Westonaria). The ten municipalities with the lowest employment densities are generally commercial farming areas, and they are mostly located in the Northern Cape.

Table 13: The ten highest and lowest-ranked municipalities by employment density, 1996

Rank	Municipality	Administrative classification	Sector	Province	Jobs/km ²
1	Johannesburg	Urban	Metro	GT	787
2	Cape Town	Urban	Metro	WC	349
3	Ekurhuleni	Urban	Metro	GT	322
4	Tshwane	Urban	Metro	GT	312
5	eThekweni	Urban	Metro	KZN	307
6	Msunduzi	Urban	Secondary	KZN	165
7	N Mandela	Urban	Metro	EC	108
8	Emfuleni	Urban	Secondary	GT	105
9	Westonaria	Urban	Commercial	GT	70
10	Randfontein	Urban	Commercial	GT	66
228	Siyancuma	Rural	Commercial	NC	0.2
229	Kamiesberg	Rural	Commercial	NC	0.2
230	Siyathemba	Rural	Commercial	NC	0.2
231	Ubuntu	Rural	Commercial	NC	0.2
232	Laingsburg	Rural	Commercial	WC	0.2
233	Kareeberg	Rural	Commercial	NC	0.1
234	Karoo Hoogland	Rural	Commercial	NC	0.1
235	Mier	Rural	Commercial	NC	0.1
236	Molopo	Rural	Commercial	NW	0.09
237	Hantam	Rural	Commercial	NC	0.08

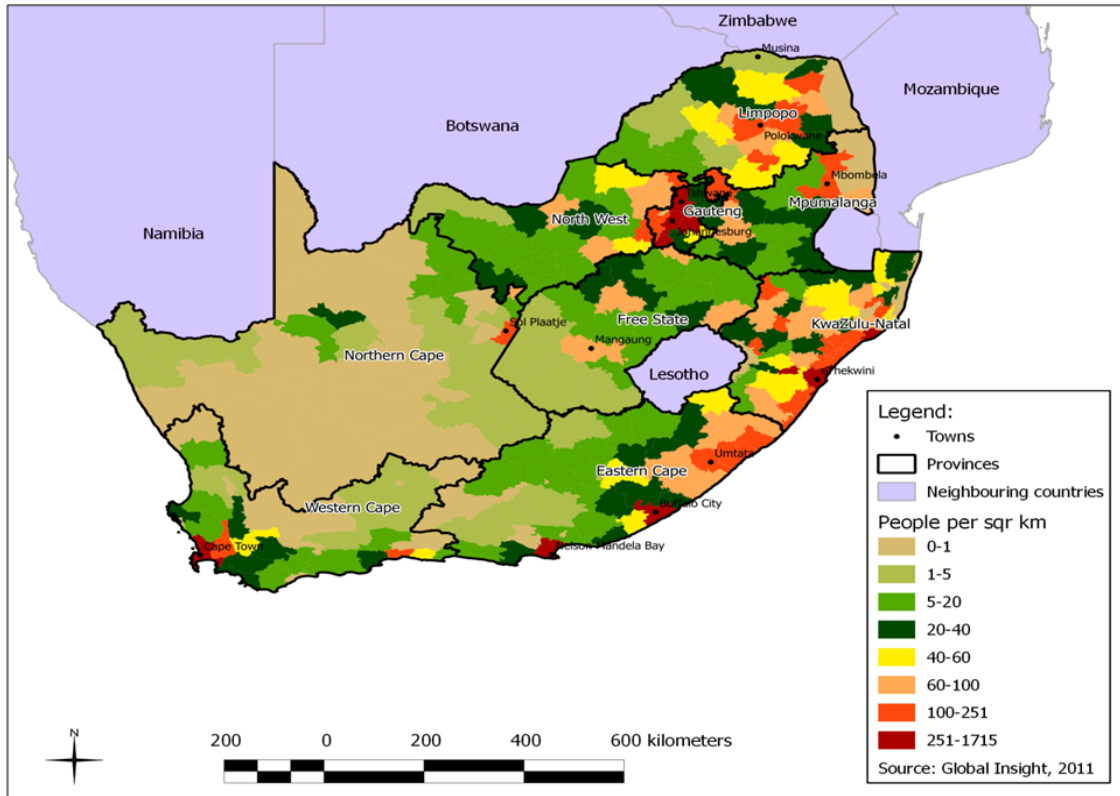
Table 14 focuses on skills and shows that the spatial distribution of skills reflects a hierarchy similar to the density hierarchy. Urban municipalities have the highest skills share; while rural areas have the lowest shares. The distributions of density and skills differ in that commercial farming areas have the lowest densities; but the former Bantustans have the lowest share of skills in the country. This reflects the low investments in African education under Apartheid (Banerjee, Galiani, Levinsohn, & Woolard, 2007).

Table 14: The ten highest and lowest-ranked municipalities by skills share, 1996

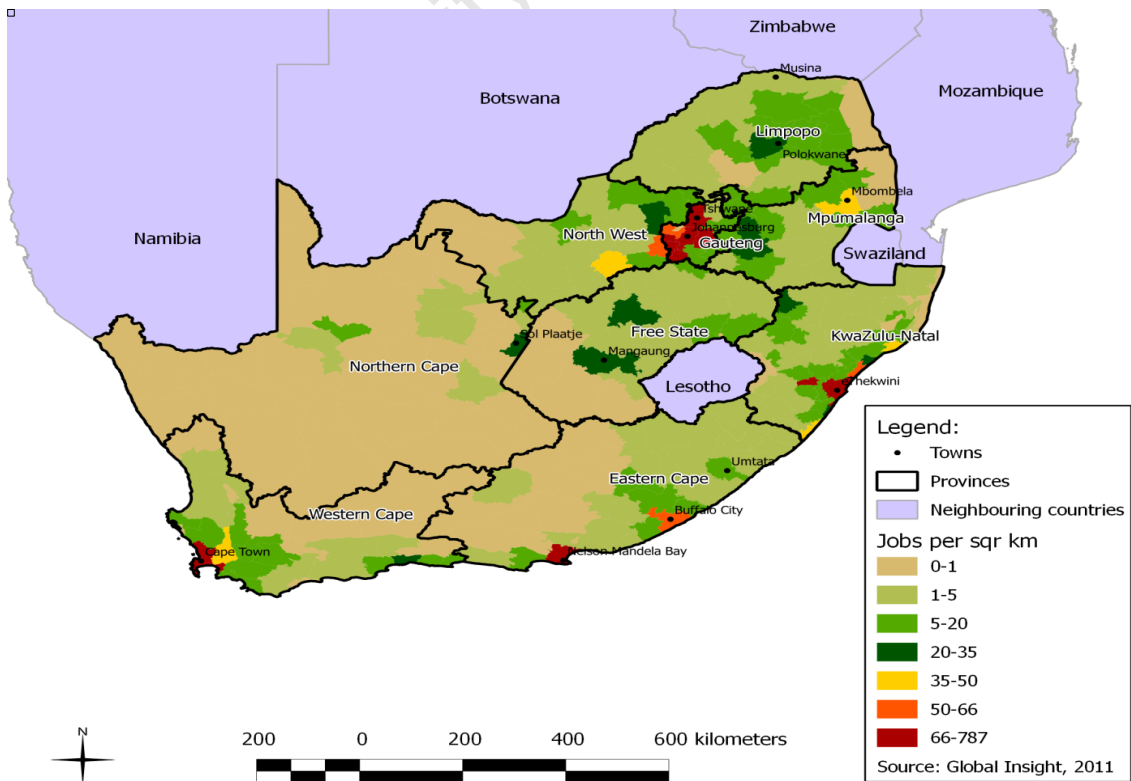
Rank	Municipality	Administrative classification		Sector	Province	Matric(%)
1	Tshwane	Urban	Metro	Community	GT	18.7
2	Midvaal	Rural	Commercial	Manufacturing	GT	17.9
3	Johannesburg	Urban	Metro	Manufacturing	GT	17.3
4	Stellenbosch	Urban	Secondary	Agriculture	WC	16.6
5	Mogale City	Urban	Secondary	Community	GT	16.5
6	Mookgopong	Rural	Commercial	Agriculture	LIM	15.9
7	Ekurhuleni	Urban	Metro	manufacturing	GT	15.4
8	Overstrand	Rural	Commercial	Agriculture	WC	15.2
9	Tlokwe	Urban	Secondary	Agriculture	NW	15.1
10	NokengtsaTaemane	Rural	Commercial	Mining	GT	14.8
228	Ratlou	Rural	Former Bantustan	Agriculture	EC	2.3
229	Matatiele	Rural	Former Bantustan	Agriculture	KZN	2.3
230	Emalahleni	Rural	Former Bantustan	Agriculture	EC	2.3
231	uMuziwabantu	Rural	Former Bantustan	Agriculture	KZN	2.3
232	Ratlou	Rural	Former Bantustan	Agriculture	NW	2.3
233	Elundini	Rural	Former Bantustan	Agriculture	EC	2.1
234	Mbhashe	Rural	Former Bantustan	Agriculture	EC	1.9
235	Port St Johns	Rural	Former Bantustan	Agriculture	EC	1.8
236	Instika Yethu	Rural	Former Bantustan	Agriculture	EC	1.7
237	Ntabankulu	Rural	former Bantustan	Agriculture	EC	1.5

Maps 4-7 show the spatial distribution of density and skills. The key on each of the maps is structured, so that the bottom ten ranked municipalities are in the lowest category; and the top ten ranked municipalities are in the highest category. Map 4 shows that the highest population densities are in Gauteng, KwaZulu-Natal, the Eastern Cape and Limpopo. The lowest population densities are found in the Northern Cape. Comparing Map 4 and Map 5, the spatial mismatch between population and employment density in KwaZulu-Natal, the Eastern Cape and Limpopo is striking. There is an obvious shortfall of jobs in these provinces. Employment density in Gauteng is high, as could be expected. Map 6 shows that the distribution of GVA density is slightly different again, possibly because mining and tourism areas feature more prominently than they do on the employment density map. Map 7 shows the spatial distribution of skills in the countries; and confirms that the metropolitan areas are relatively better off.

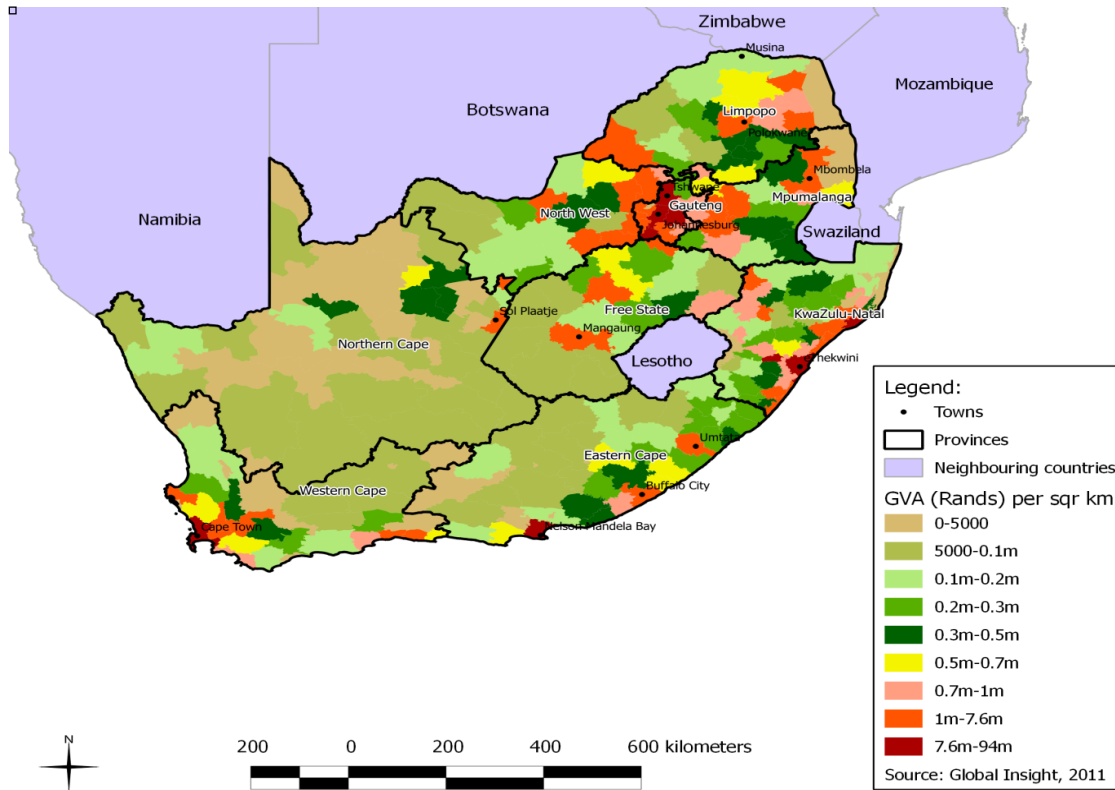
Map 4: Population density by local municipality, 1996



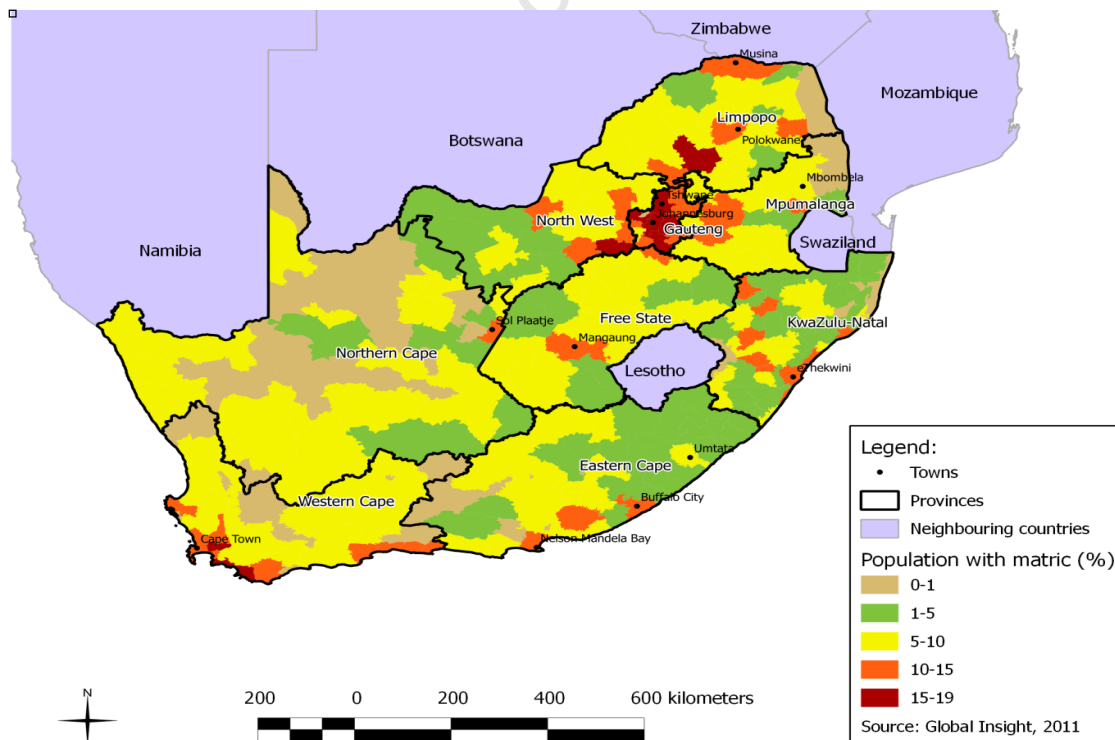
Map 5: Employment density by local municipality, 1996



Map 6: GVA density by local municipality, 1996



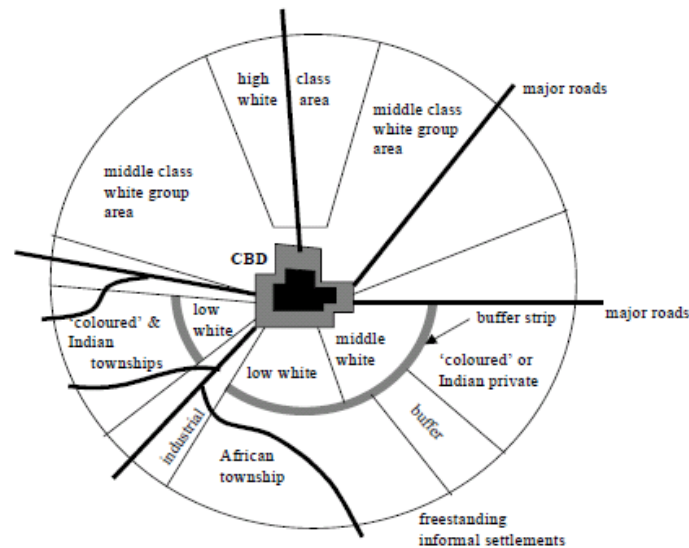
Map 7: Share of the population with matric by local municipality, 1996



The previous tables show that metros are consistently at the top of the density and skills hierarchy. These cities form the largest agglomerations and boast highly concentrated and diversified economies. They are however, also marked by inefficient and inverted density patterns, with the highest population densities far from major employment centres. This city structure is a legacy of spatial engineering from the apartheid era (Gordon et al., 2007).

Within the metros, townships, which form large settlement areas on the periphery are largely characterised by dormitory suburbs, with fairly rudimentary rental housing and infrastructure, overloaded sewage systems, schools and other public facilities. In contrast, former ‘white’ suburbs have smaller populations to serve, and much higher concentrations of economic activity, and wealth to tax. They also have a well-developed transport infrastructure, good educational facilities, high standards of public service, good housing and substantial employment, commercial and recreational facilities (Turok, 2001). This is a legacy of spatial development under apartheid, which saw cities structured along race and class lines, as in Figure 3 below.

Figure 3: The Apartheid city



Source: (Gordon et al., 2007)

The above spatial divisions tend to be reinforced by institutional practices and market forces (Turok, 2001). Concentrations of business relationships in industry clusters, and the value chains that link these, continue to drive the economy in the metros. The poor are almost entirely excluded from these interactions. Furthermore, formal urban areas are highly regulated, and they provide few opportunities for the informal sector and small businesses, in which a large proportion of the poor are predisposed (City of Cape Town, 2011).

Consequently, South Africa's metropolitan municipalities remain characterized by social exclusion along both race and class lines. Despite large sums of government capital investment in infrastructure and facilities, private investors have continued to avoid 'previously disadvantaged' areas in these cities. Meanwhile, the cities are shifting towards services with the service sector clustered in already established commercial centres (City of Cape Town, 2011).

The National Planning Commission (2011) cites increasing urban density as a critical factor for reversing these spatial effects of apartheid. In light of this, a consideration of whether and to what extent density is associated with growth is both crucial and relevant. For these reasons, the next section assesses the relationship between density and growth.

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Section 5 Does density drive development?

Having described the density hierarchies in South Africa, this section assesses whether there is a causal relationship between density and growth. While a number of international studies have assessed this relationship, as far as can be established, no research of this kind has been conducted in South Africa to date. Testing this association is of critical importance to public decision-makers, who might want to design policies that aim to concentrate or disperse activity (Combes et al., 2008), the former being the case in South Africa.

To assess whether higher density results in faster growth, a simple non-structural econometric model is used. The theoretical foundations of the model are based on the impact of density on the growth of productivity; but because of a lack of relevant (firm-level) data, an alternative specification is used. This specification, set out by Glaeser et al. (1992) and Henderson et al. (1995), involves choosing a different dependent variable, for example by replacing productivity growth with employment growth. Regressions will therefore take the following form:

$$Growth_r = \alpha + \beta \ln dens_r + \varepsilon_{rs}$$

Where,

$$Growth_r = (\ln x_{r,t} - \ln x_{t-k}) * \frac{100}{k+1}$$

And,

$$dens_r = \frac{x_{r,t-k}}{A_r}$$

x_r represents the total population, employment and GVA for municipality r , respectively. In calculating the growth rate, x_t represents x in 2010 and x_{t-k} represents x in 1996. Calculating the change between the log-transformed x variables over the period 1996-2010, multiplying this by 100, and dividing the product by $k+1$, gives the average annual growth rate in percentage form. Density is calculated by dividing the 1996 total of variable x for municipality r by that municipality's land area. In the regression, density is log-transformed, allowing us to interpret β as an elasticity: a (relative) percentage change in growth from a (relative) percentage change in density.

Two sets analysis are conducted: Firstly, a series of OLS bivariate regressions are run. Bivariate regressions examine the relationship between density and growth. These are very useful indicators of underlying relationships; and they are one of the easiest ways to see whether a relationship even exists (Wittenberg, 2010). Following these regressions, control variables are

introduced to the model and multivariate regression analysis is conducted. Regression analysis implies (but does not prove) causality between density and growth¹⁴.

The relationship between density and growth is assessed on the full sample of 237 municipalities, and bivariate regressions are also run separately on the urban and rural samples, and then on each of the historical classification and industrial structure samples. In total, regressions are run on twelve samples¹⁵. Grouping municipalities by common characteristics makes it possible to compare the impact of agglomeration on certain groups relative to others; and it also permits within-sample municipality comparisons. Analysing each group separately also reduces within-sample heterogeneity.

One shortcoming of this analysis is that it we are not able to infer that the impact of agglomeration on the alternative measures of growth used implies a similar impact on productivity (Cingano & Schivardi, 2003). By not directly considering the impact of agglomeration on productivity growth, the resulting specification strays slightly from its theoretical foundations. Nonetheless, employing different measures of growth is useful for identifying robust correlations, and for investigating the scope of agglomeration economies (Combes et al., 2008). Also, density and growth may be endogenously determined. This could happen because places with relatively higher growth rates, may attract more people, and as a result become denser.

A third shortcoming of this model is that it only identifies the net effect of density; we cannot say anything about whether the negative impact of some variables is offset by the positive impact of others. Even so, knowing this net effect is still of critical importance to public decision-makers, who might want to design policies that aim to concentrate or disperse activities, the former being the case in South Africa.

¹⁴ All regressions in this thesis are based on unweighted observations, in line with Glaeser et al. (1992) and Henderson et al. (1995). An avenue for further research could be to test the associations using weighted data.

¹⁵ Urban, urban built-up area, rural, former Bantustan, commercial farming area, secondary city or metro, agriculture, mining, manufacturing or community services municipalities.

Bivariate regression results

To examine the relationship between density and growth, bivariate regression analysis was initially conducted. The statistically significant regressions corresponding to this analysis will be presented here; all the regressions run can however be found in Appendices C-F. Statistical significance would allow us to infer that a relationship between density and growth does not occur just by chance, and rather that some fundamental causal relationship actually exists between the variables.

Correlations, on the other hand, imply no causality or dependence but refer simply to the type and degree of the association between two variables. For example, density and growth may be correlated because another variable affects them both. A full set of correlations can be found in Appendices C-F¹⁶.

Graphical correlations (scatterplots) are presented alongside some of the bivariate regressions. Only a small sample of correlations is shown, to avoid overload; as with twelve samples, three measures of density, and three measures of growth the permutations multiply rapidly.

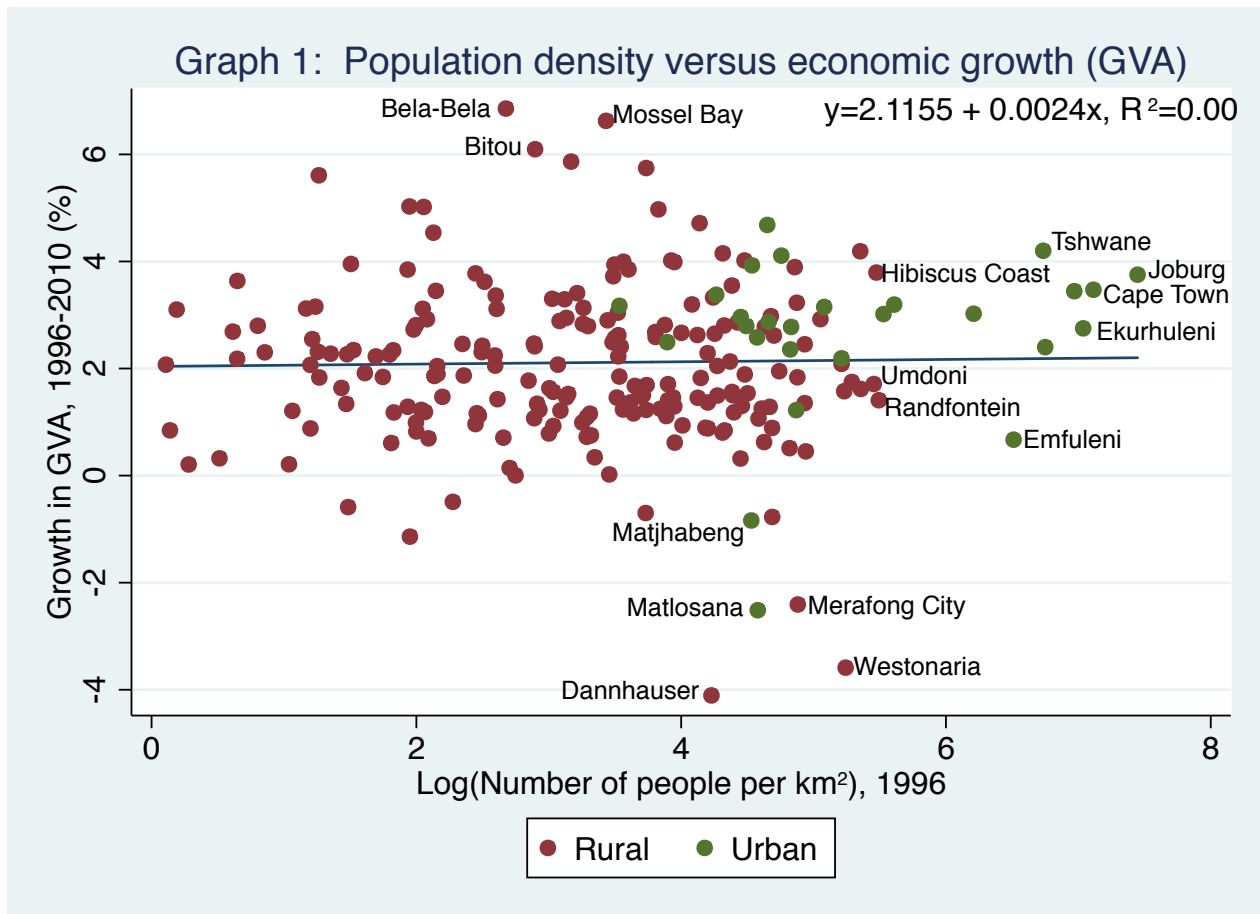
The basic message when assessing the relationship between different measures of density and growth is that, holding all else constant, density does not consistently explain variations in growth, at the scale of municipality in South Africa. This suggests that, contrary to the World Bank's assertion, spatial proximity is not a sufficient condition for growth.

When the sample consists of all 237 municipalities, and also for the urban and rural samples separately, no statistically significant relationship between any measure of density and any measure of growth is found. One way to explain this is that the costs in dense areas (i.e. higher wages, rents and congestion) counteract benefits, such as inter-industry transfers and productive services. Another explanation is that other factors, not explicitly considered by the World Bank (2008), may play a more important role in enabling spatial proximity to affect regional development. These factors include social dynamics and relational factors such as socio spatial relationships and the institutional environment (Murphy, 2010).

Graphs 1-4 present the relationship between a selection of density and growth measures when the full sample of 237 municipalities is used. From the regressions corresponding with these graphs, it cannot be inferred that municipalities with the highest densities have necessarily grown faster than municipalities with low densities. A full set of regressions and correlations for this sample and the urban and rural samples can be found in Appendix D.

¹⁶ Spearman rank correlations are presented in Appendices C-F. These correlations suggest that density and growth are positively correlated in the national, rural, commercial farming area, agriculture, mining, community services and former Bantustan samples. Evidence of negative correlation is presented in the secondary city and former Bantustan samples. The aim of this section is to investigate causality which cannot be inferred from correlation analysis.

Graph 1 shows the correlation between population density in 1996 and economic growth over the period 1996-2010 for all the 237 municipalities. The graph distinguishes between rural municipalities (red dots) and urban municipalities (green dots).



While the regression corresponding to Graph 1 suggests no relationship between population density and growth, looking at the graph, it is somewhat surprising that there are about 11 rural areas that have grown faster than all the urban areas. These are led by Bela-Bela (Limpopo), Mossel Bay (Western Cape) and Bitou (Western Cape).

The relatively high growth in these areas may be because all three have strong performing tourism sectors along well-connected transport routes. Bela-bela is located off the N1 road between Tshwane and Polokwane, and is widely known for the strong mineral springs (warmbaths) around which the town is built. Both Mossel Bay and Bitou (formerly known as Plettenburg Bay), are located on the south-eastern coast (or Garden route) of South Africa, and are accessed by the N2 coastal highway. Mossel Bay is the harbour town of the Garden Route; and it is located half-way between the coastal metropolitan municipalities of Cape Town and Nelson Mandela Bay.

Urban municipalities generally have a higher population density than rural municipalities. There are, however, some rural municipalities of relatively high density, such as, Randfontein (Gauteng), Hibiscus Coast (Kwazulu Natal) and Umdoni (KwaZulu-Natal). The high levels of population density in these municipalities may be because all three are accessed by major national or provincial roads. This makes them more easily accessible – possibly making them favourable places for population and economic activity. Randfontein, for example, is a gold mining town about 40 km West of Johannesburg; and it is accessed by the N12 and R41, national and provincial roads, respectively.

Similarly well accessed, both the Hibiscus Coast and Umdoni are situated in the Ugu district along the N2 highway, the district's primary transport corridor. The district municipality is a part-rural, part-urban centre and houses some major industrial complexes. Ugu district is situated about 150km south of eThekweni metropolitan municipality; and Hibiscus Coast is the most concentrated economic hub in the district.

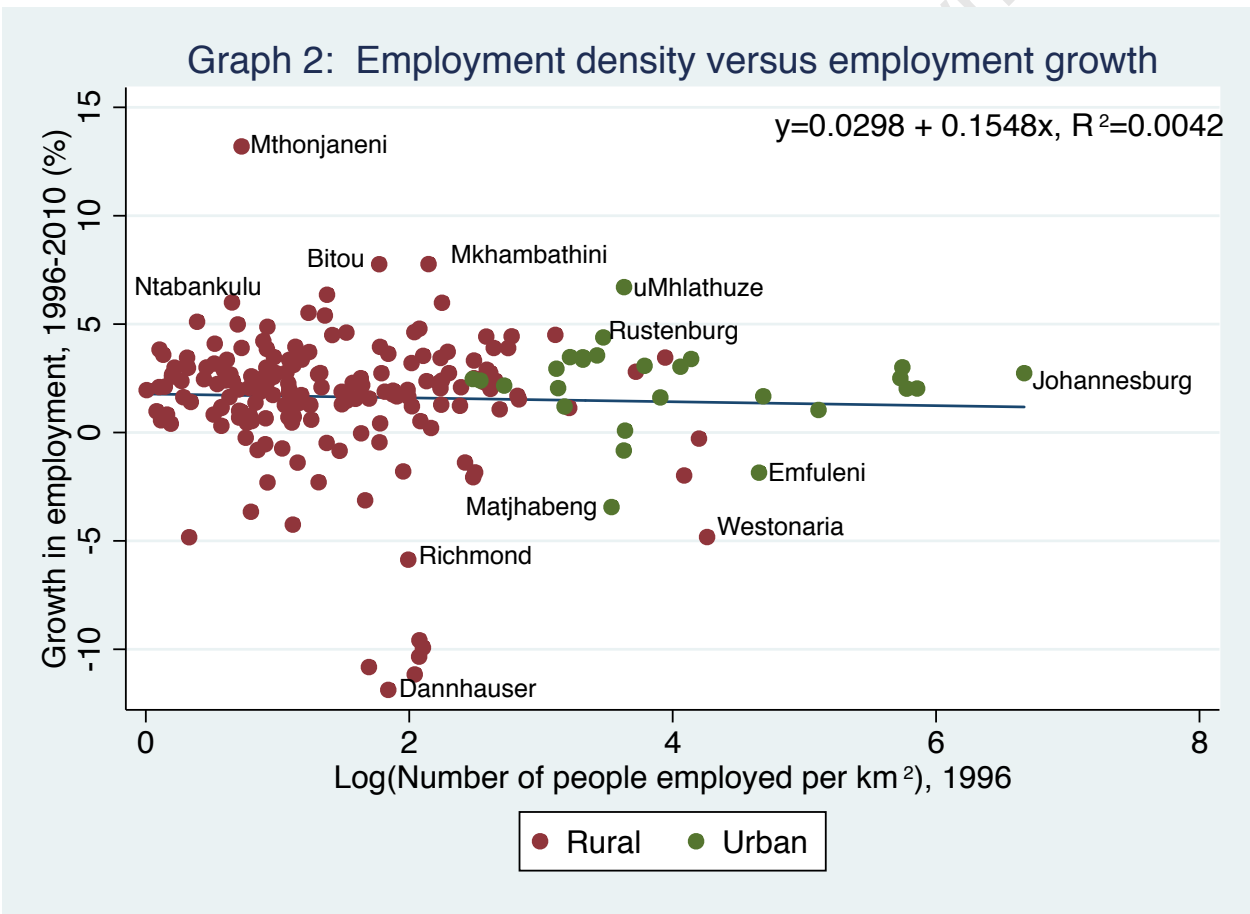
The rural municipalities of Merafong City (North West), Westonaria (Gauteng) and Dannhauser (KwaZulu-Natal) are some of the municipalities experiencing declining GVAs. Merafong City and Westonaria are located on the West Rand, where gold mining is the principal activity; while Dannhauser (located half-way between eThekweni and Johannesburg) is surrounded by some of the largest coal mines in KwaZulu-Natal. The decline in GVA for these municipalities may, therefore, be linked to a shrinking mining sector.

The urban municipalities of Matjhabeng (Free State) and Matlosana (North West) are also experiencing declining GVAs- possibly linked to the shrinking mining sector; both of these are administrative districts, and are situated in mining areas.

Theories of learning and knowledge spillovers emphasize physical interaction as the mechanism through which ideas are spread. This spread of ideas generates industry- as well as city- growth (Marshall, 1890; Jacobs, 1984; Porter, 1990). The extent to which these knowledge spillovers take place and their impact on growth may be better reflected when considering employment density rather than population density. To that end, Graph 2 presents the association between employment density in 1996 and growth in employment over the period 1996-2010.

The impact of employment density on growth is similar to the impact of population density on growth- no statistically significant relationship is found between employment density and employment growth. Similarly to the previous graph, Graph 2 shows that urban areas have a higher employment density than rural areas; and a handful of rural areas are among the fastest and slowest growing municipalities.

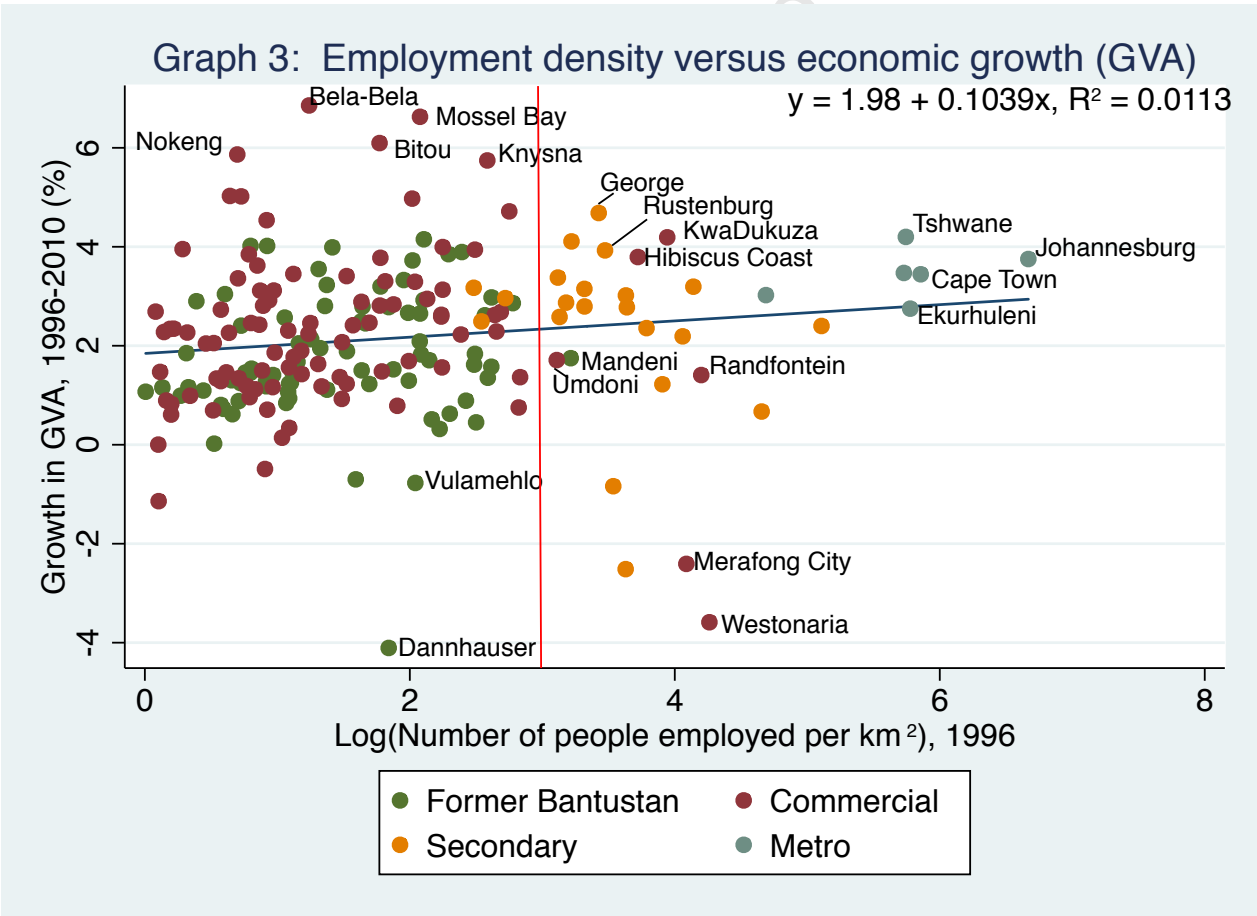
Interestingly, the municipalities of Mthonjaneni and Ntabankulu, which have experienced a relatively high employment growth rate over the period 1996 to 2010, are both among the poorest 5 % of municipalities in South Africa. Ntabankulu is the poorest municipality, with 85 % of its residents living below the poverty line (Schwabe, 2004). The relatively high rate of employment growth in these places is, therefore, likely to be linked to a low employment base in 1996.



In the Graph 3 that follows the association between employment density and GVA growth is shown, this time characterizing municipalities by their historical administrative classification. Similarly to the first two graphs presented, a relationship between density and growth cannot be inferred from the regression corresponding to this graph.

The graph distinguishes between former Bantustans (red dots), commercial farming areas (green dots), secondary cities (orange dots) and metros (blue dots). This distinction highlights the relatively low employment density experienced in the rural municipalities. Beyond a very pronounced threshold, illustrated by the red line in the figure, there lies only 1 former Bantustan and 6 commercial farming areas.

The actual value represented by the red line is about 22 people employed per km² of land. Beyond this threshold, the maximum employment density is 787 people employed per km² (Johannesburg). The employment density in Johannesburg is 10 times the maximum employment density for rural areas, which is 70 people employed per km² in Westonaria (Gauteng).

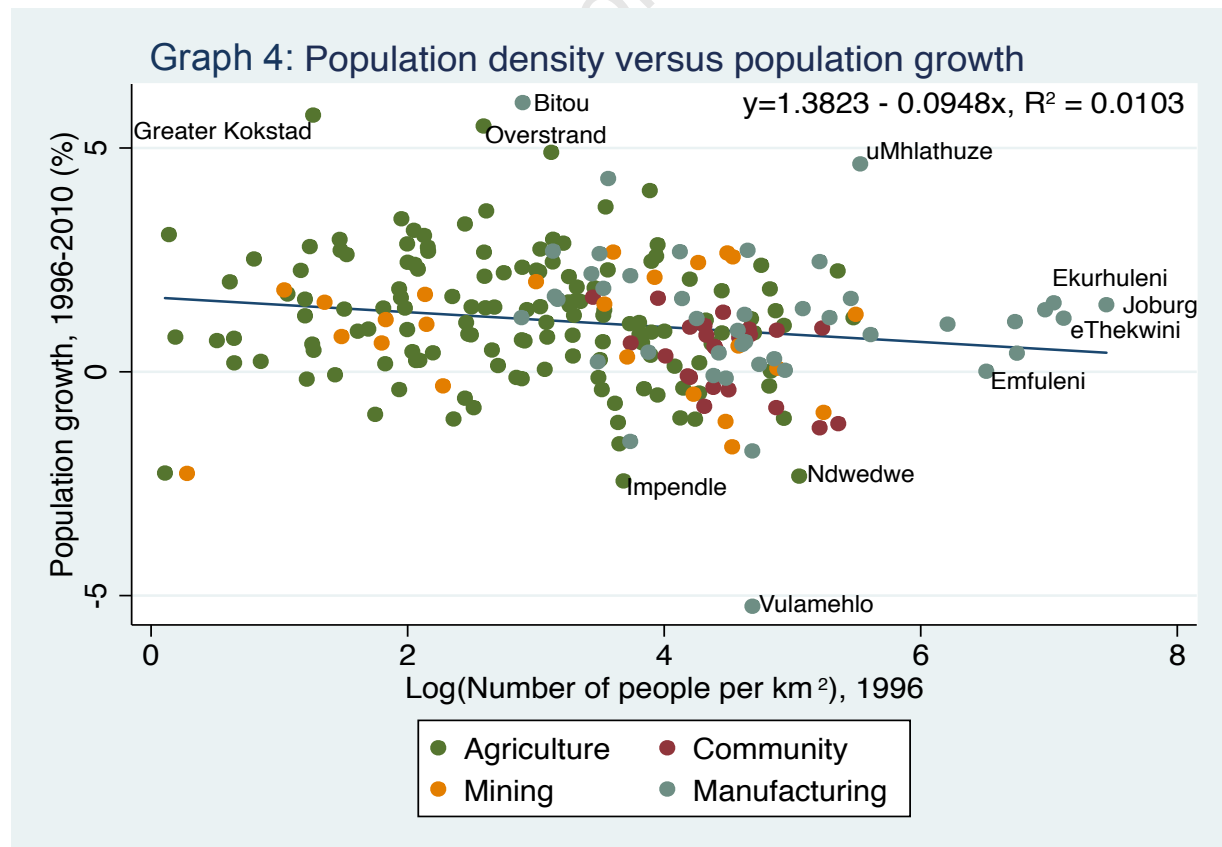


Graph 4 that follows shows the association between population density in 1996 and population growth over the period 1996-2010 and this time accounts for the industrial structure of municipalities: agricultural (green dots), mining (red dots), community services (orange dots) and manufacturing municipalities (blue dots). Holding all else equal, the regression that corresponds with the graph suggests no statistically significant relationship between density and growth.

The graph shows that the municipalities experiencing the highest rate of population growth are Greater Kokstad (KwaZulu-Natal), Bitou (Western Cape) and Overstrand (Western Cape). These municipalities are either predominantly agricultural or manufacturing, suggesting that something other than industrial structure may be influencing the growth of these places.

One explanation may be that growth in these areas is attributable to them all being well-connected tourism hubs. Greater Kokstad, for example, is located on the main transport arterial road linking KwaZulu-Natal and the Eastern Cape, and is the point at which the rail transport link stops. Overstrand is situated on the “Cape Whale Coast”, and includes the booming town of Hermanus.

The municipalities of Vulamehlo, Impendle and Ndwedwe are all experiencing lagged population growth. All three areas are characterized as having very limited economic activity, which may be a driver for the emigration in these areas.



The previous graphs show the association between density and growth for the full sample of 237 municipalities. When this sample is considered, no significant relationship between density and growth is found.

One reason for this may be that the sample used is made up of municipalities with quite different economic and physical characteristics which dilutes the relationship between density and growth. In Graph 3 for example the red line highlights a clear divide between urban and rural municipalities. While in Graph 4, a similar line could be drawn to separate the manufacturing (and also urban) municipalities grouped to the right of the graph.

Taking this into account, it may therefore be revealing to test the association separately on the urban sample, the rural sample and on each of the historical classification and industrial structure samples; this would reduce within sample heterogeneity. Consequently, the relationship between density and growth is tested on a total of 12 samples¹⁷.

Through assessing the association in this way, significant relationships between density and growth are found in the metro, commercial farming area and community-service samples.

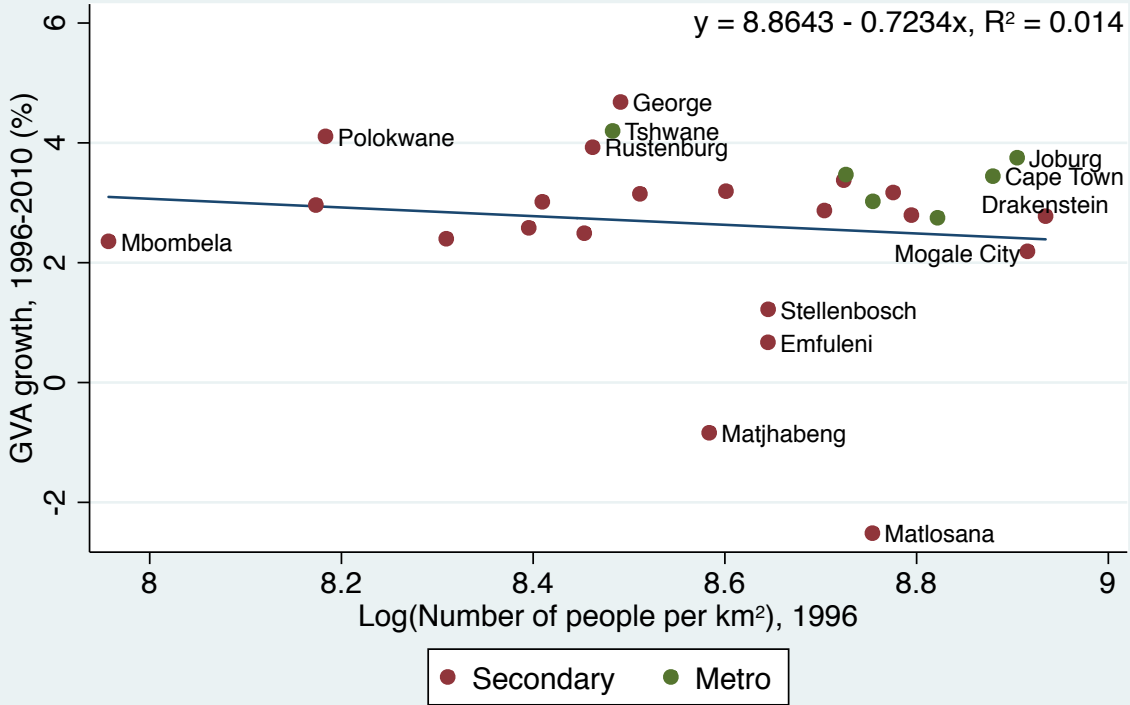
For each of the urban and rural samples, no statistically significant relationship between density and growth was found. For the urban sample of municipalities this was the case for two separate samples: In the first sample, density was calculated as the level of activity on the total land area of each urban municipality; and in the second sample, density was calculated as the level of economic activity in the built-up area of the urban municipality. The second method is based on excluding sparsely populated areas that would lower density estimates in urban areas.

'Statistical insignificance' aside, it is interesting that for urban areas, the relationship between built-up area population density and municipality GVA growth (Graph 5) is negative; while that between built-up area employment density and GVA growth (Graph 6) is positive. This suggests that employment density may be a more important determinant of GVA growth than population density; implying that perhaps development strategies should promote the agglomeration of jobs rather than population to encourage regional growth.

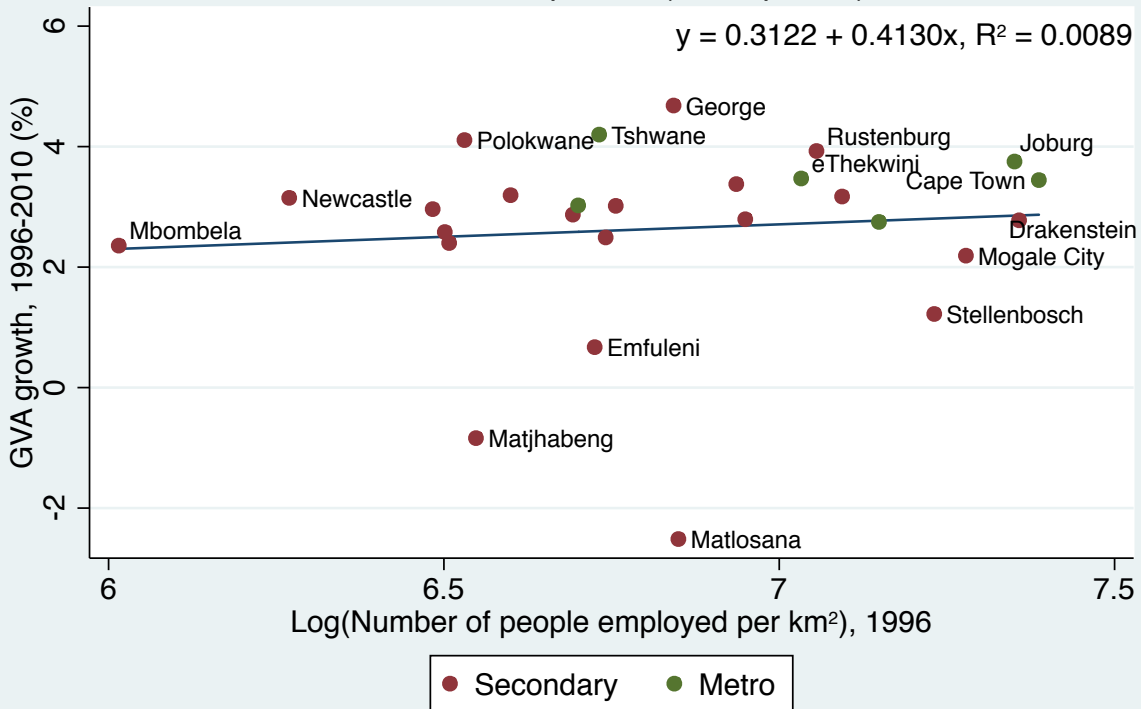
The former industrial city of George (Western Cape) has the highest GVA growth rate among urban municipalities. George is located on the south-eastern coast (or Garden route) of South Africa, 420 km from Cape Town and 320 km from Nelson Mandela Bay. The high growth of this municipality may be attributable to high levels of economic activity given that the municipality is promoted as a "tourism mecca" and is the (administrative) capital of the Southern Cape.

¹⁷ National (237), urban, urban built-up area, rural, former Bantustan, commercial farming area, secondary city, metro, agriculture, mining, manufacturing and community services

Graph 5: Population density versus economic growth (GVA)
Urban municipalities (built-up area)



Graph 6: Employment density versus economic growth (GVA)
Urban municipalities (built-up area)



Next, regressions were run on each of the four historical classification samples: former Bantustan, commercial farming area, secondary city and metro. This made it possible to establish whether within each sample more-dense municipalities are growing faster than less-dense ones. It is important to look at each sample separately, as each category has quite distinct economic and physical characteristics, a peculiarity in South Africa's economic geography, as a result of the spatial engineering implemented under apartheid.

The results for each historical classification sample are presented in Appendix E. Statistically significant results were obtained in the metro and commercial farming area samples.

For the six metropolitan municipalities, the association between population growth over the period 1996-2010 and population density in 1996 is positive and statistically significant at the 10 % level¹⁸. The statistically significant relationship is presented in equation 1 below. The positive association may be as a result of higher natural growth rates in metropolitan municipalities (given their relatively young populations). Another explanation is that people may migrate to densely populated metros – with the perception that these places offer greater employment opportunities and a better quality of life, in terms of access to education and healthcare.

Interpreting the coefficient of density as an elasticity suggests that, holding all else constant, a 1 % increase in population density in 1996 across metros saw an increase in population growth of about 0.4 %. This implies that considering the two metros A and B, if in 1996 metro A had a population density 10% higher than metro B, all else being equal, metro A would experience a population growth rate about 4 % higher than metro B over the period 1996-2010. Standard errors are in parentheses¹⁹.

$\text{Population growth} = -1.2269 + 0.3653 * (\text{Log}(\text{Population density})), N=6, R^2=0.5726 \quad (1)$ <p style="text-align: center;">(1.0937) (0.1578)</p>

For the 127 commercial farming areas, employment growth over the period 1996-2010 is positively related to population density, employment density and GVA density in 1996. All of these relationships are statistically significant at a 1 % level and are presented in equations 2, 3 and 4 that follow.

Holding all else constant, increasing any one of the three measures of density in 1996 by 1 % increased employment growth over the period 1996-2010 by about 0.4 %. This suggests that for commercial farming areas, holding all else equal, if in 1996 population, employment or GVA density, respectively, were 10 % higher in municipality A than in municipality B, then it is likely

¹⁸ The metro results are presented with the acknowledgement of the limited sample size.

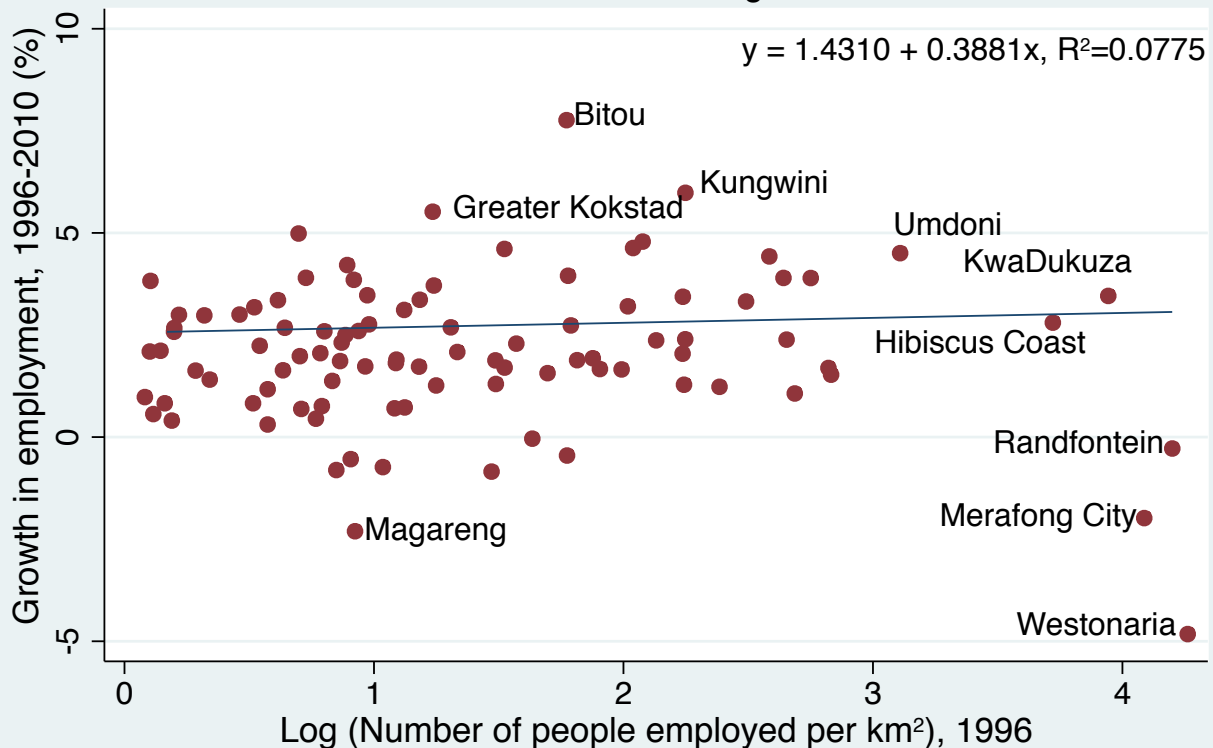
¹⁹ Dividing the coefficient by the standard error, gives 0.3653/0.1578=2.31. Since this is greater than 2 we can infer that density has a significant impact on growth.

that municipality A would experience an employment growth rate roughly 4 % higher than that of municipality B over the period 1996-2010.

$\text{Employment growth} = 0.9019 + 0.36 * (\text{Log}(\text{Population density})), N=83, R^2=0.0645$ $(0.3325) \quad (0.1227)$	(2)
$\text{Employment growth} = 1.4310 + 0.3881 * (\text{Log}(\text{Employment density})), N=83, R^2=0.0775$ $(0.1921) \quad (0.1198)$	(3)
$\text{Employment growth} = -2.7084 + 0.3676 * (\text{Log}(\text{GVA density})), N=83, R^2=0.0769$ $(1.3652) \quad (0.1118)$	(4)

Graph 7 shows the relationship between employment density in 1996 and employment growth over the period 1996-2010 for the commercial farming municipalities. The regression that corresponds with this graph is statistically significant and suggests that commercial farming areas with higher employment densities grew faster than their lower density counterparts over the period 1996-2010. Several areas have experienced employment decline, including Randfontein, Merafong City and Westonaria. All three are located in Western Gauteng, or on the West Rand where gold mining is the main activity. Job losses in these areas may therefore be attributable to a contraction in the mining industry.

Graph 7: Employment density versus employment growth
Commercial farming areas



When the association between density and growth was tested on each of the four industrial structure samples- to account for the quite different economic characteristics municipalities- statistically significant relationships were found in the community-services sample only.

This is an interesting result, as no significant relationship was found in manufacturing where one would be most likely to expect it; given that existing empirical research, for example Fafchamps (2004) for Morocco and Bigsten (2011) for Ethiopia, suggests that agglomeration effects are most apparent in areas with sizeable industrial sectors. The bivariate regressions run on each of the four samples are presented in Appendix G.

Among the 23 community-services municipalities, there were some contradictory relationships. The relationship between population density and population growth is negative; while the relationship between GVA growth and employment density, and that between GVA growth and GVA density, were positive. All three relationships are statistically significant at the 10 % level and are presented in equations 5, 6 and 7 that follow.

$$\text{Population growth} = 4.3198 - 0.8824 (\text{Log}(\text{Population density})), N=23, R^2=0.2292 \quad (5)$$

$$(1.5785) (0.3531)$$

$$\text{GVA growth} = 1.1451 + 0.4130 (\text{Log}(\text{Employment density})), N=23, R^2=0.1378 \quad (6)$$

$$(0.2254) (0.3706)$$

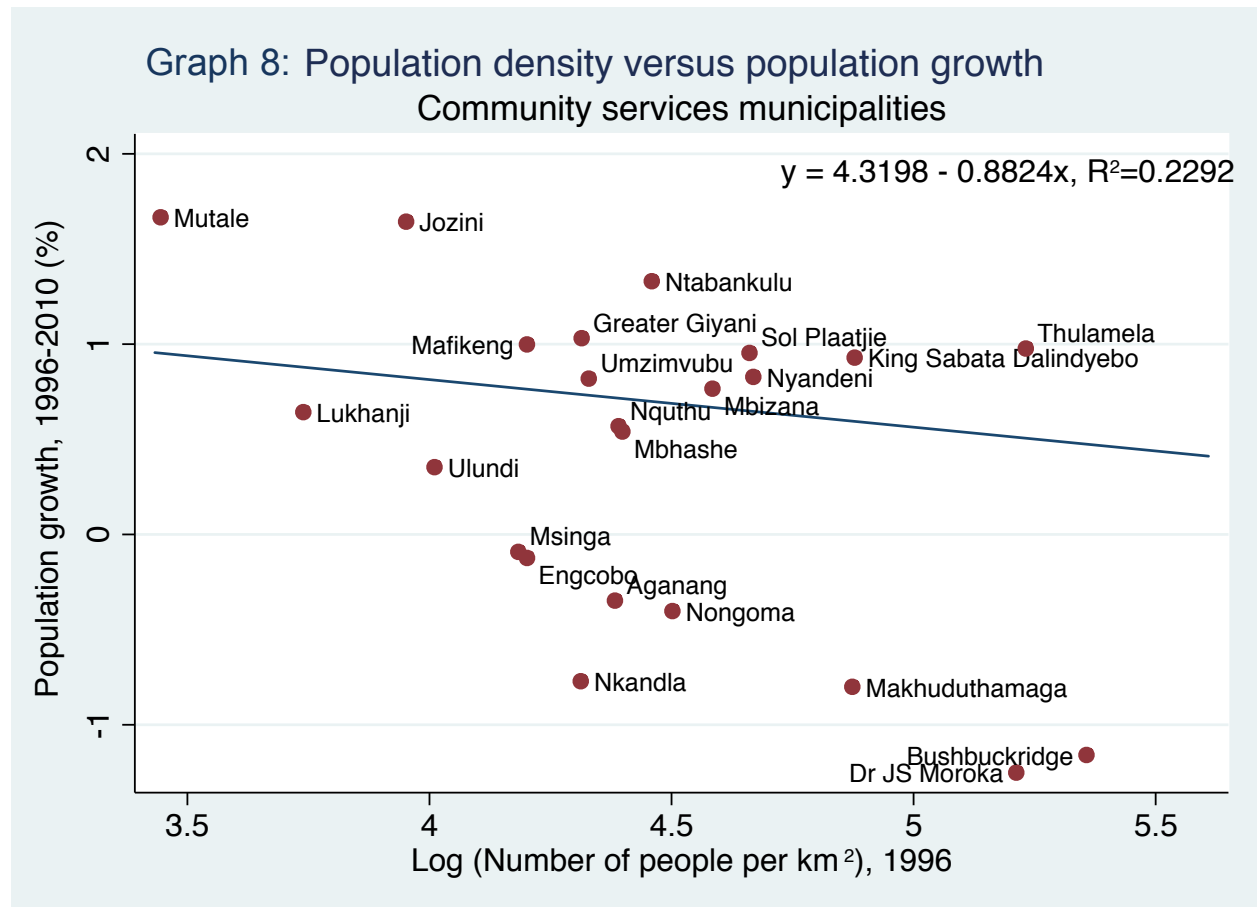
$$\text{GVA growth} = -3.3036 + 0.3917 (\text{Log}(\text{GVA density})), N=23, R^2=0.1774 \quad (7)$$

$$(2.3708) (1.840)$$

The relationship between population density and population growth is negative and statistically significant at the 5 % level. Holding all else constant, as the 1996 population density increased by 1 % among community-services municipalities, population growth fell by about 0.88 %.

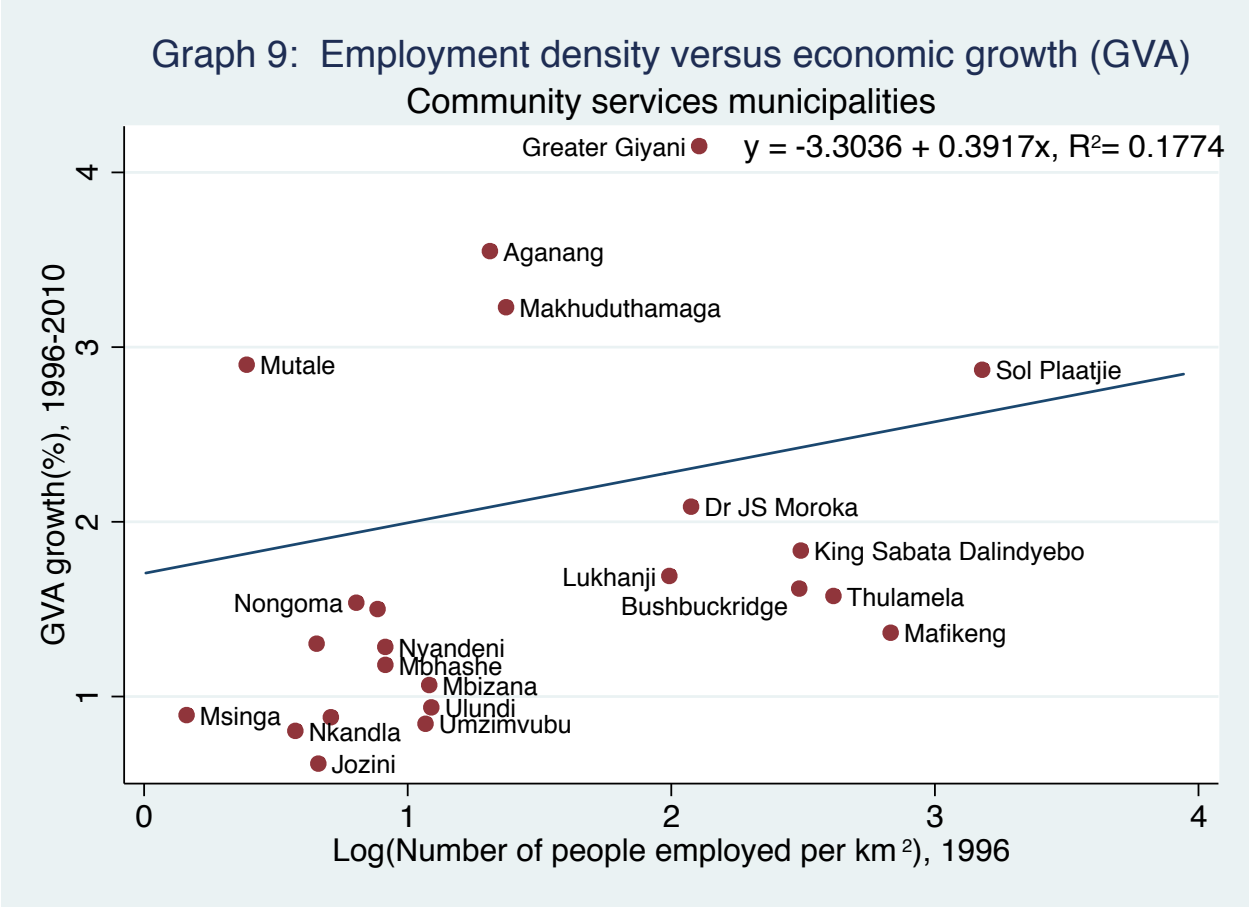
This result suggests that within this group of municipalities, if in 1996 population density was 10 % higher in municipality A than in municipality B, then it is likely that municipality A would experience a population growth rate roughly 9 % lower than that of municipality B over the period 1996-2010. The relationship between population density and population growth for community-services municipalities is shown in Graph 8.

The slower population growth experienced by more densely populated community services municipalities may be because of weak economies and a limited economic scope in these areas. This is a reasonable inference, considering that 22 out of the 23 community-services municipalities are rural; 18 are former Bantustans, and 4 are commercial farming areas. Over the period 1996-2010, large numbers of people (especially the youth) may have migrated out of these municipalities to areas with more vibrant economic environments.



The relationship between employment density in 1996 and GVA growth over the period 1996-2010 is positive and statistically significant at the 10 % level. All else being equal, a 1 % increase in employment density across municipalities in 1996 would see a 0.4% increase in GVA growth over the period 1996-2010. This relationship is presented in Graph 9.

The impact of GVA density on GVA growth was also positive, and of a similar magnitude. All else being equal, a 10 % increase in the density of economic output in 1996 increased growth over the period 1996 to 2010 by 3.9 %. This result is statistically significant at the 5 % level.



The community-service municipality results suggest that if for two municipalities A and B, the employment or GVA density was 10 % higher in municipality A than in municipality B in 1996, ceteris paribus, municipality A would experience a GVA growth rate about 4 % higher than that of municipality B.

One explanation for the positive relationship between density and GVA growth in community-services municipalities may be that places with higher economic densities offered larger consumer markets and better-established social networks and institutions; and were therefore, more attractive to new investors in the post-apartheid era.

In sum, the bivariate results presented suggest that the spatial proximity of economic activity is not a sufficient condition for growth. When the full sample of 237 municipalities considered, no significant relationship between density and growth is found. However, when considering each of the historical administrative and industrial structure samples separately, some statistically significant relationships between density and growth were found. In particular, higher density was associated with faster growth in the metro, commercial farming area and community services samples.

The primary drawback in using bivariate regression analysis is that it is difficult to draw conclusions about how density affects growth because factors that simultaneously affect growth are not included in the regression. To improve this, multivariate analysis was conducted and other variables that are useful for explaining growth are explicitly introduced to the model.

Multivariate regression results

Multivariate regression analysis was conducted on the full sample of 237 municipalities. This was done by introducing control variables to the regressions between density and growth. The control variables used are: a skills variable and dummy variables for the historical administrative classification and industrial structure groups. This is in line with the literature, which suggests controlling for workers skills, a region's industrial mix, as well as variables that capture regional characteristics, such as public amenities or local public goods (Combes et al., 2008). The multivariate regressions run are presented in Appendix G.

Consistent with the bivariate regression results, the multivariate regressions run on the full sample of 237 municipalities suggest that the concentration of economic activity is not a sufficient condition for growth.

While no significant positive relationships were found between any of the three measures of density and any three measures of growth, somewhat surprisingly, upon introducing control variables, significant negative significant relationships were found between density and GVA growth.

The results suggest that, *ceteris paribus*, a 1% increase in the population density in 1996 is associated with a fall in GVA growth between 1996-2010 of 0.23 %. This relationship is statistically significant at the 1 % level. Similarly, holding all else constant, a 1 % increase in GVA density in 1996 is associated with a fall in GVA growth between 1996-2010 of 0.21 %. This relationship is statistically significant at the 5 % level.

These relationships imply that if in 1996, the population or GVA density was 10 % higher in municipality A than in municipality B, *ceteris paribus*, in either case municipality B, with the

lower density, would experience a GVA growth rate about 20 % higher than that of municipality A. This may be the case because the costs in dense areas, such as higher wages, rents and congestion outweigh any benefits, such as intra- and inter-industry transfers and productive services.

Of the control variables in the multivariate regression, the coefficient on skills share is consistently positive and statistically significant. All else constant, a 1 % increase in the proportion of the population with matric is associated with an increase in population, employment and GVA growth, respectively, of between 0.2-0.3 %. This is in line with bivariate regressions of skills on growth presented in Appendices C-F. For the statistically significant (GVA growth) regressions mentioned above, the commercial farming area dummy and the mining dummy were the only statistically significant historical classification and industrial structure dummies, respectively. The coefficient on the commercial farming area dummy suggests that, holding all else constant, the median GVA growth rate in commercial farming areas is between 40% - 49% lower than that in the former Bantustans.

The coefficient on the mining dummy suggests that the median GVA growth rate in mining municipalities is between 68%-76% lower than that in community-services municipalities. This may be attributed to a declining mining sector.

From the bivariate and multivariate analysis conducted, a robust causal relationship between density and growth cannot be inferred. This suggests that, contrary to the World Bank's (2008) assertion, density does not necessarily encourage growth.

Based on this result it is difficult to determine whether the spatial structure of economic activity in South Africa is static or evolving. Consequently, in the section that follows size is considered as an alternative measure of agglomeration. The section examines whether population, employment and GVA growth patterns in the country are convergent, divergent or proportionate.

Section 6 Are growth patterns in South Africa convergent, divergent or static?

In the previous section it was concluded that density is not a sufficient condition for growth at the scale of municipality in South Africa. Based on this information alone, it is difficult to infer whether the spatial distribution of population and economic activity in South Africa is locked-in or dynamic. The nature of growth patterns in the country can however be established by assessing the link between initial size -in terms of population, employment and GVA- and the growth rates of these variables.

When considering the relationship between size and growth, a systematic pattern in which smaller municipalities are growing faster than larger municipalities implies converging levels of population, employment or GVA. On the other hand, larger municipalities growing faster than smaller ones is evidence of increasing returns to scale in these areas, and of a widening gap between the two groups. A third possibility is that municipalities experience a proportionate growth rate – where the growth rate experienced by both large and small firms is random or independent of size.

Assessing the relationship between size and growth is similar to testing Gibrat's Law. This law states that *"the growth rate of an entity (firm, mutual fund, city) of size S, has a distribution function, with a mean and variance that are independent of S.* It is sometimes used in the literature to mean that the distribution of growth rates of firms of size S is independent of S, not just the first and second moments" (Gabaix and Ioannides, 2004: 7). The theory establishes that though growth rates between different cities vary substantially, there is no systematic pattern with respect to size, i.e. the underlying stochastic process is the same for all cities. This is labelled the proportionate growth process.

Following from Sharma (2003), the logarithmic specification of Gibrat's Law is tested:

$$\ln S_{it} = \beta_0 + \gamma \ln S_{it-1} + \varepsilon_{it}$$

Where S_{it} is the size of municipality i at time t , S_{it-1} is the size in the previous period, and ε_{it} is a random variable distributed independently of S_{it-1} . In order to make the interpretation of the results easier, the equation is estimated as follows:

$$\Delta \ln S_i = \beta_0 + \beta_1 \ln S_{it-1} + \varepsilon_{it}$$

Where,

$$\Delta \ln S_i = \ln S_{it} - \ln S_{it-1}$$

And,

$$\beta_1 = (\gamma - 1)$$

The validity of Gibrat's Law depends on the significance of β_1 : If $\beta_1=0$ then Gibrat's Law is supported and the probability of a given proportionate change in population, employment or GVA during a specified period is the same for all municipalities, regardless of their initial size. If $\beta_1<0$, then smaller municipalities grow at a higher rate than their counterparts, and if $\beta_1>0$, larger municipalities enjoy relatively higher rates of growth.

Gibrat's Law is tested for the periods 1996-2000, 2000-2005 and 2005-2010, and the results are presented in Appendix H. The statistically significant results, which imply that $\beta_1\neq 0$, are presented below.

The results suggest that between 1996-2000, the population growth rate in smaller municipalities was higher than in larger ones, i.e. $\beta_1<0$. In the subsequent periods, 2000-2005 and 2005-2010, estimated population growth patterns support Gibrat's Law. Population growth rates are proportionate across municipalities and independent of size.

$\Delta \text{Population}_{1996-2000} = 0.2459 - 0.0155(\text{Population}), N=237, R^2=0.0285$ <p style="text-align: center; margin: 0;">(0.0638) (0.0055)</p>	(8)
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Employment in large and small municipalities grew at a proportionate rate between 1996-2000, i.e. $\beta_1=0$. However, over the subsequent periods, 2000-2005 and 2005-2010, municipalities with higher levels of initial employment totals have experienced relatively higher employment growth rates, i.e. $\beta_1>0$.

$\Delta \text{Employment}_{2000-2005} = -0.2531 + 0.0308(\text{Employment}), N=237, R^2=0.0342$ <p style="text-align: center; margin: 0;">(0.1031) (0.0106)</p>	(9)
$\Delta \text{Employment}_{2005-2010} = -0.2595 + 0.0332(\text{Employment}), N=237, R^2=0.0660$ <p style="text-align: center; margin: 0;">(0.7897) (0.0081)</p>	(10)

Over the period 1996-2000, and again between 2000-2005, GVA growth was higher in municipalities with higher initial levels of GVA, i.e. $\beta_1>0$. Between 2005-2010, GVA growth was proportionate across all municipalities ($\beta_1=0$).

$\Delta \text{GVA}_{1996-2000} = -0.1305 + 0.0124(\text{GVA}), N=237, R^2=0.0196$ <p style="text-align: center; margin: 0;">(0.0802) (0.0057)</p>	(11)
$\Delta \text{GVA}_{2000-2005} = 13.9839 + 2.0297(\text{GVA}), N=237, R^2=0.0315$ <p style="text-align: center; margin: 0;">(0.0926) (0.7341)</p>	(12)

Generally, the growth rates in larger municipalities have either been proportionate or higher than the growth rates in their smaller counterparts. Municipalities grow proportionately when the pattern of growth across municipalities is independent of size or municipalities grow at

similar rates. Higher than proportionate growth for larger municipalities implies increasing returns to scale in these areas.

Both cases imply divergent growth and an increased share of population, employment and GVA in larger municipalities relative to smaller municipalities. In either case, the gap between the largest and smallest municipalities expands. Using an example to illustrate this for the proportional growth case, two municipalities are considered, municipality A with a total population of 50 000 and municipality B with a total population of 5 000. If both municipalities were to experience a 10 % increase in population, municipality A would see an absolute change of 5 000 people, whereas municipality B would see an absolute change of 500 people. The difference between the two municipalities was initially 45000 people and after a proportionate increase of 10 % the difference would be 49500²⁰; resulting in a widened gap between the largest and smallest municipalities. In the case where larger municipalities experienced higher than proportionate growth, the gap would be even wider.

An increasing share of population, employment and GVA in the largest municipalities implies an increasing concentration of economic mass at the top of South Africa's urban hierarchy. This distribution of population and economic activity would only change if smaller municipalities were to experience faster growth rates than larger ones, which is not the case in the country.

These existing patterns of growth could have a positive impact on development, both regionally and nationally. However, for the bottom of the hierarchy, divergent growth implies that smaller municipalities could become dormant areas characterized by limited economic activity over time. Rather than reversing the effects of apartheid in terms of human, capital, and spatial development, this could imply broad continuity with the past. Furthermore, within the largest municipalities, the costs of increased concentration -congestion, insufficient educational and housing facilities, backlogs in infrastructure provision or crime- could adversely impact developmental efforts over time. A thorough consideration of these (and other) potential scenarios is crucial given the strategies proposed to increase urban density in South Africa.

²⁰ Before the proportionate change in population the difference between the two municipalities is 50000-5000=45000. After a 10 % increase in population for both groups the difference is 55000-5500=49500

Section 7 Conclusion

There is a growing awareness that the spatial distribution of economic activity is important for economic development. Geography matters for economic development in various ways, and the proximity between economic actors (or 'density') is one of these. According to the World Bank (2008) more densely populated places grow faster, simply because they can enjoy agglomeration economies that firms get from locating close to one another (World Bank, 2008).

The empirical literature generally supports a positive association between the concentration of economic activity and growth. However, this is not universally true, with some inconsistent, and even contradictory findings across different studies. The variation in results is attributable to differences in economic realities and to the fact that studies are very specific in terms of the methodology, data and variables that they employ. For these reasons each study can only be viewed as a specific 'example'.

It follows from this, that to be able to assess the direct relevance of the proposition that agglomeration encourages growth, place-specific analysis has to be conducted. To that end, this thesis considers the relationship between agglomeration and growth in the South African case. To do this, the paper: (i) presents an analysis of the spatial patterns of economic activity in the country; (ii) examines whether density in 1996 and growth over the period 1996-2010 are causally related, using a series of simple bivariate and multivariate OLS regressions; and then (iii) tests Gibrat's law, to determine whether the spatial distribution of economic activity is converging, diverging or static.

The description of the spatial distribution of population and economic activity in South Africa shows evidence of a density hierarchy similar to that described by The World Bank (2008). Primary cities (metros) are consistently at the top of the hierarchy; while agricultural areas are consistently at the bottom. And between them is a continuum of varying density.

When assessing whether the high density of the municipalities at the top of the hierarchy results in faster growth for those municipalities, the results are contrary to expectations. No statistically significant positive relationship is found between density and growth when the sample consists of all 237 municipalities. Holding all else constant, higher concentrations of people, jobs or output per km² in municipalities in 1996 did not result in faster growth over the period 1996-2010. These results are robust across both bivariate and multivariate regression analysis.

To probe the relationship further, the full sample of 237 municipalities was disaggregated and municipalities characterized by their historical administrative classification and industrial structure. This was done on the grounds that the full sample of municipalities consists of places with quite different economic and physical characteristics, which may dilute the relationship between density and growth. Subsequently testing the association separately on a total of 12

samples -the urban sample, the rural sample and on each of the historical classification and industrial structure samples- revealed positive relationships between density and growth in the metro, commercial farming area and community services municipalities.

In contrast to these positive relationships, and somewhat surprisingly, the multivariate regression results suggest that GVA growth, and both population density and GVA density are negatively related. Holding all else constant, municipalities with higher population or GVA densities in 1996 experienced a slower GVA growth rate over the period 1996-2010. This may be the case because the costs in dense areas in 1996, such as higher wages, rents and congestion outweighed any benefits, such as intra- and inter-industry transfers and productive services.

By comparison, the association between skills and growth is consistently positive and statistically significant, which may imply that human capital is a more important determinant of economic growth.

Together, the bivariate and multivariate results suggest that, *ceteris paribus*, there is no robust causal relationship between the density of population, or economic activity within an area, and the rate of economic growth, at the scale of municipalities in South Africa.

Based on these density results, it is difficult to draw inferences about whether growth patterns in the country, are divergent, convergent or static. This information can however be established, by using size as an alternative measure of scale, and testing Gibrat's law.

The results from testing Gibrat's Law suggest that growth patterns in South Africa are divergent. Larger municipalities are associated with increasing shares of population, employment and GVA relative to smaller municipalities. This could suggest economic development in these larger municipalities. On the contrary, it could also imply that spatial patterns of human and economic development are in broad continuity with those under apartheid. This is noteworthy given that the NPC proposes increasing urban density as a strategy to reverse the spatial effects of apartheid.

An important message from this analysis is that spatial proximity is not a sufficient condition for growth. While agglomeration may matter, it is not sufficient to create positive externalities. This is not adequately put forward by the World Bank (2008) which asserts that places must promote higher densities to encourage growth. A lesson from this analysis is that, development strategies aimed at concentrating economic activity should thoroughly account for place-specific factors such as available networks, governing institutions and social dynamics. These factors can all impact the quality and significance of density for growth.

There are several possible reasons why the relationship between density and growth may not hold here, assuming it applies elsewhere. Firstly, there is significant potential for reverse

causality between density and growth. It may well be the case that municipalities that have higher densities grow faster but also that municipalities that grow faster encourage higher density. If this is the case, the parameters presented in this paper are likely to be biased and inconsistent. Secondly, the legacy of the colonial and apartheid spatial policies may have disrupted this relationship by creating artificially high population densities in the former Bantustans. Thirdly, the impact of racial segregation within cities and towns may have resulted in more spatially fragmented and dysfunctional urban areas than would otherwise have been the case. This would undermine the economic performance in such areas. Fourthly, the equitable sharing of fiscal or other government transfers to compensate poorer districts may have distorted the impact of density. Also, agglomeration economies in the 'Global South' may be different to those in developed economies where urban areas are to a large extent only characterized by the most innovative firms and the most highly skilled workers. This is not necessarily the case for developing countries. Finally, there may be problems with the dataset, bearing in mind that these are modelled data, rather than actual data. In particular, the requirement that the local statistics add up to the national totals may have introduced a systematic distortion. Against this, the discovery of a significant relationship between skills and growth provides some reassurance that the dataset should not be discounted.

The scope for future research on agglomeration economies in South Africa is broad. Building directly on this paper, researchers could interrogate the findings presented here by controlling for reverse causality. This could be done by finding an appropriate instrument for density and proceeding with a two-stage least squares approach. Also, the multivariate analysis could be extended by weighting observations and by including a greater range of control variables that reflect the socio-spatial context and the industrial environment of municipalities. Conducting empirical applications on structural models is another extension of this work, which would allow for a more rigorous validation of the relationship between density and growth. It may also be revealing to explicitly consider industry employment as a proportion of total municipality employment – across a broad range of industries, to assess whether either regional or industrial growth is driven by concentration in particular sectors.

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Appendix A: Global Insight data description

Population

GI determines national population projections by five primary factors:

- Size of population in the base year, P_t
- Number of deaths occurring between the base and projected years, D_t
- Number of births occurring between the base and projected years, B_t
- Immigrants arriving in the country between the base and projected years, I_t
- Emigrants leaving the country during the base and projected years, E_t

These variables contribute to the projected population, P_{t+1} , within the following demographic balancing identity:

$$P_{t+1} = P_t + B_t - D_t + I_t - E_t$$

Census data and factor-based backward extrapolation is then used to arrive at a 1970 base population figure. This is used to estimate the national base population figure and the base population estimates for each province. Municipal populations are then estimated by adjusting provincial factors and assumptions based on underlying provincial evidence.

Employment

GI uses a Labour Model built on two pillars. One estimates formal and informal employment (i.e. the demand side), while the other estimates unemployment and economically activity (i.e. the supply side). They do this because the data from employers are believed to be more reliable than data from home-based surveys. Unemployment is measured at the place of residence, while employment is measured at the place of work. The estimates for each area are balanced and checked against the Quarterly Labour Force Survey and the General Household Survey. GI also obtains regional employment data from relevant industry associations and interpolates these data for the missing figures – on the basis of the relevant sector's output growth in each region. Employment numbers are then estimated, so that the following labour market identities balance: $EAP = U + E$ (1)

Where:

- EAP = Total Economically Active Population
- U = Number of people unemployed
- E = Number of people employed

Furthermore: $E = E^I + E^F$ (2)

Where:

- E = Number of people employed
- E^I = Number of people employed in the informal sector
- E^F = Number of people employed in the formal sector

Gross value added (GVA)

GI obtains initial estimates of GVA growth rates from five sources: mining, construction, electricity, retail trade and regional service council levies. These growth rates are applied to preliminary estimates of GVA benchmarked on national-level Reserve Bank estimates of value added by sectors to arrive at preliminary estimates of GVA for each year from 1997 to 2005. These estimates are then benchmarked and adjusted to national-level estimates of sectoral

GVA (unpublished detailed series obtained from StatsSA, as well as Reserve Bank published series) to arrive at final regional estimates.

Appendix B: The categorisation of municipalities by industrial structure

Municipalities with more than 10% of their jobs in mining are initially classified. The overriding principle is that municipalities are classified, according to their dominant tradeable sector.

In 1996, there were 34 municipalities in South Africa with a mining share of employment of over 10 %; this will be referred to as group 1. To establish whether these should be classified as mining or as another sector, the share of employment in the mining sector is compared to the share of employment in the agricultural and manufacturing sector for these municipalities. If mining has the maximum share of employment relative to the other sectors, municipalities are classified as mining, and are then “excluded” from the pool of municipalities that still need to be classified.

- 1) Of the 34 municipalities in group 1, 8 have both
 - Agricultural share of employment **less** than 10 % and
 - Manufacturing share of employment **less** than 10 %.

That is, for 8 municipalities within group 1, the share of mining employment is higher than the share of both agricultural employment and manufacturing employment. These are classified as mining.

Municipality	Sector	Agriculture	Mining	Manufacturing	Community
Westonaria	Mining	1%	75%	3%	4%
Merafong City	Mining	2%	68%	4%	6%
Matjhabeng	Mining	3%	61%	3%	9%
City of Matlosana (Klerksdorp)	Mining	4%	55%	4%	10%
Kgetlengrivier	Mining	6%	47%	6%	10%
Rustenburg	Mining	7%	46%	6%	10%
Moses Kotane	Mining	7%	23%	8%	22%
Fetakgomo	Mining	1%	17%	2%	43%
Classified	8	0	8	0	0

- 2) 26 municipalities from group 1 are still to be classified. Of these 26 municipalities, 5 have:
 - Manufacturing share of employment **greater** than 10 %, and an
 - Agricultural share of employment **less** than 10 %.

These municipalities would, therefore, be either be classified as manufacturing or mining, depending on which of the two sectors has the maximum share of employment in the municipality. Of these 5 municipalities, 4 municipalities were classified as mining, and 1 as manufacturing.

Municipality	Sector	Agriculture	Mining	Manufacturing	Community
Randfontein	Mining	5%	43%	12%	10%
Govan Mbeki (Highveld)	Mining	5%	36%	20%	9%
Dannhauser	Mining	6%	35%	16%	13%
Emalahleni(Mpumalanga)	Mining	4%	23%	19%	11%
NokengtsaTaemane	Manufacturing	8%	14%	17%	20%
Classified	5	0	4	1	0

- 3) 21 municipalities in group 1 are still to be classified. Of these 21, 16 municipalities have
 - Agricultural share **greater** than 10 %, and
 - Manufacturing share of employment **less** than 10 %.

These municipalities would therefore be classified as either mining or agriculture, depending on which of the two sectors has the maximum share of employment in the municipality. 10 municipalities are classified as mining, and 6 as agriculture.

Municipality	Sector	Agriculture	Mining	Manufacturing	Community
Thabazimbi	Mining	13%	63%	3%	4%
Masilonyana	Mining	27%	40%	2%	9%
Kgatelopele (Dan-Lime)	Mining	12%	36%	6%	16%
Tsantsabane	Mining	12%	36%	6%	16%
Gamagara	Mining	15%	32%	5%	15%
Richtersveld	Mining	13%	30%	4%	18%
Kamiesberg	Mining	13%	30%	4%	18%
NamaKhoi	Mining	13%	30%	4%	18%
Ba-Phalaborwa	Mining	19%	21%	4%	17%
Ga-Segonyana	Agriculture	22%	18%	3%	21%
Emadlangeni (Utrecht)	Agriculture	38%	16%	4%	18%
Greater Tubatse	Mining	12%	15%	6%	27%
Khai-Ma	Agriculture	50%	13%	2%	12%
Letsemeng	Agriculture	41%	13%	3%	11%
Delmas	Agriculture	28%	11%	9%	10%
Abaqulusi	Agriculture	22%	10%	8%	19%
Classified	16	6	10	0	0

- 4) The remaining 5 municipalities in group 1 have both
- Agricultural share of employment **greater** than 10 %, and
 - Manufacturing share of employment **greater** than 10 %.

Given that these 5 municipalities, therefore, have shares of employment in all 3 sectors: mining, agriculture and manufacturing greater than 10 %, all 3 sectors are compared, and municipalities are classified as the sector with the highest share of employment. 2 municipalities are classified as agriculture, and 3 as mining.

Municipality	Sector	Agriculture	Mining	Manufacturing	Community
Lekwa (Standerton)	Mining	23%	27%	10%	10%
Dikgatlong	Mining	15%	25%	14%	13%
Steve Tshwete (Middelburg)	Mining	11%	23%	15%	12%
Madibeng	Agriculture	19%	10%	15%	17%
Umjindi	Agriculture	45%	10%	13%	8%
Classified	5	2	3	0	0

All 34 municipalities in group 1 have been classified, which implies that all 203 municipalities that are still to be classified have an employment share in mining of less than 10 %.

5) Group 2 consists of all unclassified municipalities with agricultural share of employment greater than 10 %. 157 municipalities fall into this group. Of the 157 municipalities, 100 municipalities have:

- Agricultural share of employment **greater** than 10 %, and
- Manufacturing share of employment **less** than 10 %²¹. These municipalities are classified as agriculture.

Municipality	Sector	Agriculture	Mining	Manufacturing	Community
Witzenberg	Agriculture	65%	0%	8%	9%
Siyancuma	Agriculture	59%	1%	6%	13%
Sunday's River Valley	Agriculture	58%	0%	4%	12%
Tokologo	Agriculture	57%	6%	2%	8%
Theewaterskloof	Agriculture	56%	0%	7%	11%
Cederberg	Agriculture	55%	0%	6%	10%
Ventersdorp	Agriculture	54%	2%	5%	10%
Kannaland	Agriculture	54%	0%	9%	13%
Kou-Kamma	Agriculture	52%	0%	7%	9%
Renosterberg	Agriculture	52%	0%	1%	16%
Karoo Hoogland (Frasuwil)	Agriculture	52%	0%	2%	12%
Nxuba	Agriculture	52%	0%	1%	22%
Baviaans	Agriculture	51%	0%	3%	19%
Prince Albert	Agriculture	51%	0%	3%	15%
Setsoto	Agriculture	50%	0%	5%	11%
Tswelopele	Agriculture	49%	0%	4%	11%
Maquassi Hills	Agriculture	48%	4%	4%	11%
Tsolwana	Agriculture	48%	0%	4%	23%
Siyathemba	Agriculture	48%	0%	5%	16%
Mamusa (Schweizer-Reneke)	Agriculture	47%	4%	4%	10%
Impendle	Agriculture	47%	0%	6%	17%
Matzikama	Agriculture	46%	4%	6%	10%
Richmond	Agriculture	46%	0%	10%	13%
Nala	Agriculture	46%	1%	6%	12%
Blue Crane Route	Agriculture	46%	0%	6%	19%
!Kai! Garib	Agriculture	45%	2%	4%	15%
Tswaing	Agriculture	43%	7%	4%	13%
Naledi	Agriculture	43%	1%	5%	12%
Naledi (Free State)	Agriculture	43%	0%	3%	16%
Modimolle	Agriculture	43%	1%	7%	14%
!Kheis	Agriculture	43%	2%	4%	16%
Kagisano	Agriculture	42%	0%	4%	24%
Molopo	Agriculture	41%	0%	3%	28%
Ikwezi	Agriculture	41%	0%	3%	17%
Mantsopa	Agriculture	41%	0%	5%	15%
Ubuntu	Agriculture	40%	0%	3%	18%
Musina	Agriculture	40%	4%	5%	13%
Ndlambe	Agriculture	39%	1%	7%	13%
Kouga	Agriculture	38%	0%	10%	12%
Nketoana	Agriculture	38%	0%	4%	13%

²¹ Following from 6) these municipalities also have mining share less than 10 %

Municipality	Sector	Agriculture	Mining	Manufacturing	Community
Mohokare	Agriculture	38%	0%	3%	17%
Mafube	Agriculture	38%	0%	5%	15%
Gariep (Eastern Cape)	Agriculture	38%	0%	8%	19%
Phokwane	Agriculture	38%	1%	5%	15%
Dipaleseng	Agriculture	38%	4%	7%	12%
Kareeberg	Agriculture	37%	0%	4%	20%
KharaHais	Agriculture	37%	3%	5%	17%
Mier	Agriculture	37%	3%	5%	17%
Hantam	Agriculture	37%	0%	6%	17%
Hessequa (Langeberg)	Agriculture	37%	0%	7%	14%
Greater Letaba	Agriculture	36%	0%	7%	16%
eDumbe	Agriculture	36%	5%	9%	13%
Mookgopong	Agriculture	35%	1%	8%	13%
Kopanong	Agriculture	35%	0%	3%	20%
Elias Motsoaledi	Agriculture	34%	3%	5%	20%
Cape Agulhas	Agriculture	33%	0%	9%	15%
Dihlabeng	Agriculture	33%	0%	6%	15%
Greater Kokstad	Agriculture	33%	0%	6%	14%
PixleyKaSeme	Agriculture	32%	2%	5%	13%
Magareng	Agriculture	32%	2%	6%	19%
Umsobomvu	Agriculture	32%	0%	2%	21%
Albert Luthuli	Agriculture	31%	7%	5%	23%
Thembelihle	Agriculture	31%	0%	5%	22%
Greater Tzaneen	Agriculture	31%	1%	8%	18%
Phumelela	Agriculture	31%	0%	8%	13%
Msukaligwa	Agriculture	31%	8%	7%	14%
Greater Marble Hall	Agriculture	31%	1%	5%	23%
Ngwathe	Agriculture	30%	0%	9%	16%
Makhado	Agriculture	29%	1%	7%	20%
InxubaYethemba	Agriculture	28%	2%	5%	24%
RamotshereMoiloa (Zeerust)	Agriculture	28%	1%	5%	28%
Bela-Bela	Agriculture	27%	0%	7%	13%
Maruleng	Agriculture	26%	0%	6%	20%
Lekwa-Teemane	Agriculture	26%	2%	9%	16%
Senqu	Agriculture	26%	0%	3%	32%
Moqhaka	Agriculture	25%	4%	9%	19%
Sakhisizwe	Agriculture	24%	0%	4%	30%
Beaufort West	Agriculture	23%	0%	5%	22%
Makana	Agriculture	23%	0%	7%	33%
Lephalale	Agriculture	23%	9%	4%	11%
Elundini	Agriculture	22%	0%	5%	30%
Emalahleni	Agriculture	21%	0%	5%	38%
Maletswai	Agriculture	20%	0%	8%	25%
Moshaweng	Agriculture	20%	5%	3%	41%
Camdeboo	Agriculture	19%	0%	8%	23%
Molemole	Agriculture	18%	1%	8%	20%
The Big Five False Bay	Agriculture	18%	0%	7%	33%
Emthanjeni	Agriculture	17%	0%	5%	25%
Umzimkhulu (Umzimkulu)	Agriculture	17%	1%	9%	38%
Nkonkobe	Agriculture	16%	0%	4%	47%

Municipality	Sector	Agriculture	Mining	Manufacturing	Community
Ratlou (Setla-Kgobi)	Agriculture	16%	0%	6%	32%
Mogalakwena	Agriculture	15%	1%	2%	11%
Blouberg	Agriculture	15%	1%	5%	37%
Matatiele	Agriculture	14%	0%	4%	31%
Polokwane	Agriculture	14%	0%	8%	21%
Mhlontlo	Agriculture	12%	0%	6%	43%
IntsikaYethu	Agriculture	12%	0%	3%	42%
Lepelle-Nkumpi	Agriculture	12%	1%	3%	19%
Greater Taung	Agriculture	11%	2%	6%	39%
Umhlabuyalingana	Agriculture	10%	1%	5%	39%
Classified	100	100	0	0	0

6) The remaining 57 municipalities in group 2 have

- Agricultural share of employment **greater than 10 %**,
- Manufacturing share of employment **greater than 10%**.

These municipalities are classified as that sector, agriculture or manufacturing, with the highest share of employment. Stellenbosch, with a 20 % share of agriculture and mining, is categorized as agriculture.

Municipality	Sector	Agriculture	Mining	Manufacturing	Community
Bergrivier	Agriculture	54%	0%	11%	10%
Breede River/Winlands	Agriculture	51%	0%	13%	11%
Swellendam	Agriculture	47%	0%	10%	11%
uMshwathi	Agriculture	44%	1%	22%	11%
MooiMpfana	Agriculture	44%	0%	17%	12%
Laingsburg	Agriculture	44%	1%	10%	13%
KwaSani	Agriculture	43%	0%	11%	9%
Umvoti	Agriculture	42%	0%	12%	14%
Breede Valley	Agriculture	42%	0%	13%	16%
Mthonjaneni	Agriculture	38%	0%	15%	19%
KwaDukuza	Agriculture	38%	0%	22%	9%
Mkhondo	Agriculture	36%	5%	14%	12%
Ubuhlebezwe	Agriculture	35%	0%	10%	19%
Inkwanca	Agriculture	35%	0%	13%	21%
Ingwe	Agriculture	33%	0%	10%	21%
Nkomazi	Agriculture	31%	6%	11%	18%
Ndwedwe	Agriculture	30%	0%	16%	22%
Hlabisa	Agriculture	29%	0%	11%	24%
ThabaChweu	Agriculture	29%	6%	11%	13%
Maphumulo	Agriculture	29%	0%	13%	30%
Drakenstein	Agriculture	29%	0%	24%	15%
Mtubatuba	Agriculture	27%	1%	12%	23%
Swartland	Manufacturing	27%	0%	31%	11%
Oudtshoorn	Agriculture	26%	0%	11%	23%
Ditsobotla (Lichtenburg)	Agriculture	25%	4%	12%	18%
Mandeni (Endondakusuka)	Manufacturing	24%	0%	30%	16%
Emakhazeni (Highlands)	Agriculture	24%	9%	12%	12%
Okhahlamba	Agriculture	24%	0%	11%	24%
Mkhambathini	Agriculture	23%	0%	20%	18%
Overstrand	Agriculture	22%	0%	11%	14%

Municipality	Sector	Agriculture	Mining	Manufacturing	Community
Umzumbe (Khiphinkunzi)	Agriculture	21%	0%	17%	18%
uMuziwabantu	Agriculture	21%	0%	16%	21%
Ezingoleni (Izingolweni)	Agriculture	20%	1%	15%	20%
Stellenbosch	Agriculture	20%	0%	20%	22%
Umdoni	Manufacturing	20%	0%	22%	18%
uMngeni	Agriculture	19%	0%	17%	18%
Mbombela	Agriculture	19%	1%	13%	16%
Vulamehlo	Manufacturing	18%	0%	21%	21%
uPhongolo	Agriculture	18%	5%	12%	21%
Hibiscus Coast	Agriculture	18%	1%	12%	16%
Saldanha Bay	Manufacturing	17%	1%	27%	16%
uMlalazi	Manufacturing	17%	1%	35%	19%
Ntambanana	Manufacturing	16%	4%	18%	16%
Tlokwe (Potchefstroom)	Agriculture	15%	3%	11%	25%
Great Kei	Manufacturing	14%	0%	21%	18%
Endumeni	Agriculture	14%	4%	11%	24%
uMhlathuze	Manufacturing	14%	4%	20%	18%
George	Manufacturing	13%	0%	17%	18%
Lesedi	Manufacturing	12%	1%	21%	19%
Umtshezi	Manufacturing	12%	0%	25%	19%
Indaka	Manufacturing	11%	2%	19%	22%
Mossel Bay	Manufacturing	11%	3%	21%	17%
Amahlati	Manufacturing	11%	0%	22%	34%
Kungwini	Manufacturing	11%	2%	15%	15%
Knysna	Manufacturing	11%	0%	16%	14%
Bitou (Plettenberg Bay)	Manufacturing	11%	0%	16%	14%
Port St Johns	Manufacturing	10%	0%	13%	40%
Classified	57	39	0	18	0

7) Group 3 is made up of the unclassified municipalities with manufacturing share greater than 10 %. Of these 23 municipalities have:

- Manufacturing share of employment **greater** than 10 %, and
- Agricultural share of employment **less** than 10 %. These 23 are classified as manufacturing.

Municipality	Sector	Agriculture	Mining	Manufacturing	Community
Newcastle	Manufacturing	3%	1%	36%	20%
Emfuleni	Manufacturing	3%	0%	35%	15%
Emnambithi-Ladysmith	Manufacturing	4%	0%	35%	18%
Moretele	Manufacturing	1%	0%	32%	22%
N Mandela	Manufacturing	2%	0%	31%	21%
Metsimaholo	Manufacturing	6%	1%	30%	14%
eThekwini	Manufacturing	2%	0%	29%	18%
Imbabazane	Manufacturing	9%	0%	28%	19%
Ekurhuleni	Manufacturing	1%	3%	27%	14%
Buffalo City	Manufacturing	4%	0%	27%	27%
City of Cape Town	Manufacturing	2%	0%	26%	20%
Ngqushwa	Manufacturing	5%	0%	24%	40%
Midvaal	Manufacturing	4%	0%	21%	16%
Thembisile	Manufacturing	5%	2%	21%	28%

Municipality	Sector	Agriculture	Mining	Manufacturing	Community
Msunduzi	Manufacturing	3%	0%	21%	24%
Mogale City	Manufacturing	8%	4%	20%	18%
Mbonambi	Manufacturing	10%	5%	19%	15%
City of Johannesburg	Manufacturing	1%	1%	19%	17%
Maluti a Phofung	Manufacturing	9%	0%	18%	27%
Mnquma	Manufacturing	4%	0%	15%	40%
City of Tshwane	Manufacturing	1%	0%	15%	25%
Ngquza Hill	Manufacturing	9%	0%	14%	38%
Mangaung	Manufacturing	5%	0%	13%	28%
Classified	23	0	0	23	0

7) The 23 remaining unclassified municipalities have:

- Agriculture, mining and manufacturing share **less** than 10%, and
- Community **greater** than 10 %. These municipalities are classified as community

Municipality	Sector	Agriculture	Mining	Manufacturing	Community
Bushbuckridge	Community	9%	0%	9%	39%
Sol Plaatjie	Community	5%	3%	9%	30%
Dr JS Moroka	Community	7%	0%	9%	40%
Thulamela	Community	6%	1%	9%	38%
Lukhanji	Community	7%	0%	8%	33%
Aganang	Community	3%	0%	8%	39%
Mafikeng	Community	7%	0%	7%	36%
King SabataDalindyebo	Community	3%	0%	6%	39%
Nyandeni	Community	7%	0%	6%	43%
Jozini	Community	9%	1%	6%	40%
Engcobo	Community	5%	0%	5%	41%
Nkandla	Community	8%	0%	5%	57%
Ulundi	Community	4%	6%	4%	49%
Greater Giyani	Community	9%	1%	4%	39%
Mutale	Community	8%	4%	4%	47%
Nquthu	Community	9%	1%	4%	48%
Mbizana	Community	4%	1%	3%	39%
Msinga	Community	6%	1%	3%	47%
Makhuduthamaga	Community	5%	7%	3%	46%
Ntabankulu	Community	6%	1%	3%	46%
Nongoma	Community	6%	3%	3%	46%
Umzimvubu	Community	7%	0%	3%	42%
Mbhashe	Community	6%	1%	2%	46%
Classified	23	0	0	0	23

Graphs B1 to B4 show the distribution of municipalities by sector.