Does density drive development?

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SUMMARY

There is growing interest among governments and researchers around the world in the contribution of cities to economic development. Several influential international organisations have argued that the spatial concentration of economic activity is necessary for faster economic growth. This paper examines whether the density of population and economic activity influences the rate of local economic growth in South Africa. Municipalities are the basic units of analysis and the time frame is 1996-2010. Contrary to expectations, no statistically significant relationship is found between density and growth across the full range of 237 local municipalities. However, searching hard for a relationship among particular kinds of municipality, some evidence does emerge. The influence of human skills on local growth is also examined and is found to be more robust than density. Several reasons are given for why the relationship between density and growth is generally weak or non-existent.

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SECTION 1

INTRODUCTION

There is increasing awareness that the spatial distribution of population and industry is important for economic development. Geography matters in all sorts of ways, including the degree of proximity between economic agents ('density'). A growing body of evidence suggests that larger and higher density settlements experience higher levels of productivity and growth. The World Bank's 2009 World Development Report raised the profile of economic geography on the policy agenda of many countries and international organisations. It argued strongly that the steady concentration of economic activity through urbanisation is both inevitable and desirable for national economic growth. Governments should not try to counteract spatial inequalities by restricting urbanisation or encouraging development in marginal and dispersed locations.

> No country has grown to middle income without industrialising and urbanising. None has grown to high income without vibrant cities. The rush to cities in developing countries seems chaotic, but it is necessary … urbanisation, done right, can help development *more* in Africa than elsewhere (World Bank, 2008: 24, 285).

The main objective of the present paper is to assess whether the proposition that density drives development is applicable to South Africa. Although many international studies have explored this question, to our knowledge similar research has not been conducted in South Africa. We seek to fill the gap by analysing whether density has any influence over the rate of economic development across the country. This is important for a country seeking to tackle poverty and inequality by maximising employment growth and generating additional tax revenues from economic growth to fund the extension of essential services throughout the population.

The concept of external scale economies and the related concept of increasing returns to scale underpin the argument that density supports development. Density raises productivity and growth because firms benefit from 'positive externalities' in large concentrations of economic activity. These include (i) *sharing* infrastructure and information; (ii) *matching* production requirements such as skills and premises, and (iii) *learning* about new techniques, products and services through 'knowledge spillovers'. Isolated firms may gain internal scale economies by increasing their scale of production, but they cannot exploit the benefits of external scale economies.

External scale economies arising from concentrated activity are generally defined as 'agglomeration economies'. The greater the concentration of firms, workers, suppliers and consumers in one place, the greater the scope for these interactions to generate advantages for each agent. Different places facilitate agglomeration economies to different degrees and in different ways. This creates a hierarchy of density,

reflecting the uneven distribution of activity at different scales. At the top of the hierarchy is the primary city, with the greatest economies of scale. At the bottom are small towns and rural areas, with a continuum of settlements of varying size and density in between.

Other factors besides size and density can also affect the relative trajectories of different cities and towns. The historical industrial composition of a city may favour the persistence of industry concentration. Places get 'locked-into' particular economic structures and continue to attract disproportionate investment in those sectors because of the head-start they enjoy through distinct skill-sets and supporting institutions with accumulated knowledge and expertise. Alternatively, cities and towns may be disadvantaged by some inherited feature, such as an isolated physical location or the depletion of mineral resources on which the city's initial growth depended.

This paper assesses the relevance of these ideas in the case of South Africa. This is an interesting and important case, bearing in mind the history of extreme policies of spatial control of population movements and business location. The paper examines (i) whether and to what extent settlement density has affected the rate of growth of different places post-Apartheid, and (ii) the nature of the settlement hierarchy across the country. Local municipalities constitute the basic spatial units of analysis.

To estimate the strength of the association between density and growth, we run a series of regressions and present these alongside their corresponding scatterplots. Density in 1996 is the independent variable, and growth over the period 1996 to 2010 is the dependent variable. Regression analysis allows us to estimate the sensitivity (or 'elasticity') of growth in relation to density.

Three measures of density are used: (i) the size of the resident population relative to the physical area of the municipality ('population density'), (ii) the level of employment relative to the same area ('employment density') and (iii) the scale of economic output or economic activity (gross value added - GVA) relative to the same area or ('economic density'). For the sake of comparison, we also assess the relative importance of skills (or 'human capital') on growth on the grounds that this is another potentially significant driver of development, independent of density. We measure skills as the proportion of people in each municipality with matric.

Three measures of growth are used: (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 into economic activity. Consequently, expanding populations are generally associated with growing economies, especially at the local and regional scales.

The analysis also explores variations among different types of municipality (urban versus rural, metros versus secondary cities, former Bantustans versus commercial farming areas, and predominantly manufacturing versus mining and agricultural economies). The strength of the association between density and growth might be expected to vary between these categories because of their distinctive economic and physical characteristics. For example, unusually high population densities and poor performing economies might be expected in the former Bantustans compared with commercial farming areas because of their historical experience of forced relocations and restrictions on mobility. Figure 1 (*see p6*) shows the number of municipalities in each category.

By analysing municipalities in these different categories, we are further able to infer (i) whether physical characteristics, historical experience or industrial structure influence the relationship between density and growth, and (ii) whether the association between skills and growth varies with the industrial composition of the local economy.

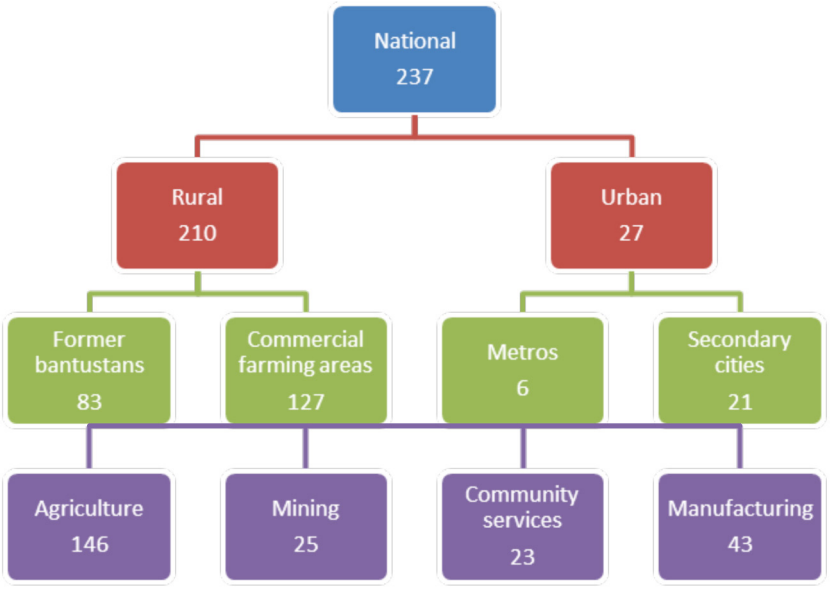


FIGURE 1: The number of municipalities by municipality type

The paper proceeds as follows. Section 2 reviews the relevant literature and evidence. Section 3 describes the methods and data sources used. Section 4 describes the distribution of density across the country. In Section 5 and 6 we present the original results of the analysis. Section 7 draws the findings together and offers tentative explanations.

SECTION 2

LITERATURE REVIEW

2.1. Economic Geography and the World Development Report

The World Development Report (World Bank, 2008) argues that economic progress depends on spatial transformation involving: (i) **higher densities** as cities grow; (ii) **shorter distances** as workers and businesses migrate closer to density and reduce the costs of transporting inputs and outputs, and (iii) **fewer divisions** as nations lower their economic borders and enter world markets to take advantage of scale and trade in specialised products (the 3Ds). Density is the most important dimension at the local level. Densely populated places enjoy larger agglomeration economies as firms locate close to each other. These advantages are offset by other forces that promote dispersal of firms, especially firms that are more sensitive to higher production costs and congestion in cities (Krugman, 1998; World Bank, 2008). Table 1 summarises the forces for concentration and dispersal.

TABLE 1: Forces for and against concentration

Centripetal forces (promote concentration)	Centrifugal forces (promote dispersal)
Market size effects: Sites with good access to large markets are preferred for the production of goods subject to economies of scale ('backward linkages'). A large local market supports the production of intermediate goods, lowering costs for downstream producers ('forward linkages').	**Immobile factors:** The location of land, natural resources and sometimes people may impede the concentration of production. Producers may have to go to where the workers are. Also dispersed workers create a dispersed market of consumers, encouraging some producers to locate close by.
Thick employment markets: An industrial concentration supports a thick local labour market, especially for specialised skills, so workers find it easier to find employers and vice versa.	**Land rents:** Concentrations of economic activity increase the demand for local land, driving up local land rents and thereby discouraging further concentration.
Knowledge spillovers: Local concentrations of economic activity create external economies via information spillovers.	**Pure external diseconomies:** Concentrations of activity can generate external diseconomies such as congestion and over-heating.

Source: Krugman (1998: 8)

Agglomeration economies can be subdivided into localisation and urbanisation economies. Localisation economies arise from the interactions between firms within particular industries, including shared inputs and information, experimentation and mutual learning about similar technologies, and access to common skill-sets. The 'clustering' of upstream and downstream firms and associated institutions such as universities and trade associations can foster creativity, innovation, competitiveness and accelerated growth.

Urbanisation economies arise from business interactions in different industries. Industrial diversity allows firms to share indivisible facilities or public goods (such as transport infrastructure, logistics systems or broadband networks), a wider variety of suppliers of equipment, components and services, and a larger pool of specialised workers, professionals and managers. These positive externalities lower costs, promote flexibility and facilitate growth. There may also be some cross-fertilisation of ideas between industries, such that industry-specific knowledge spills over into other industries to become city-wide innovation. This increases the adaptability of local economies, promotes diversification, and avoids lock-in to outmoded activities and stagnant markets (Overman and Venables, 2005; Roberts and Goh, 2010; Glaeser, 2011).

Agglomeration economies can be amplified by density. The desire for proximity between firms comes from the need to reduce transportation costs and other obstacles to the exchange of goods, services, people and ideas. 'Network effects' are another advantage - the more firms in the network, the more information, knowledge and intelligence available to learn from. Dense cities are conglomerations of consumers and producers, buyers and sellers, firms and workers (Glaeser and Kahn, 2003).

> 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 sizable 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).

The World Development Report argues that the spatial concentration of activity is necessary for faster economic growth. Therefore, low and middle income countries should not divert major resources to try and narrow spatial inequalities as this will jeopardise economic progress. The report argues that inclusive development is still possible. The key is integration. Three sets of instruments are proposed to address the 3Ds of density, distance and division. **Institutions** are universal services governments should provide regardless of place, including basic amenities such as the administration of justice, health and education. **Infrastructure** refers to spatially connective investments, such as railways, roads and telecommunications. **Interventions** are spatially focused incentives and investments that favour particular places, such as export processing zones and slum upgrading programmes. These instruments vary in importance at different points in the national trajectory of development. Figure 2 summarises how these instruments should be matched at different stages. Above all, governments should promote agglomeration economies by building density, while reducing the time and costs that threaten to undermine rising concentration through congestion and other inefficiencies associated with large cities (Munoz et al, 2009).

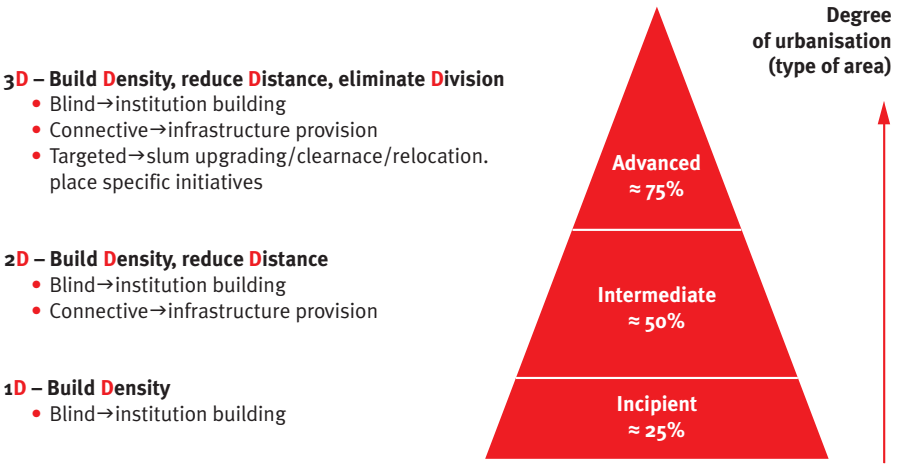


FIGURE 2. Policy priorities at different levels of urbanisation

Source: (Munoz et al., 2009)

2.2 Overview of the literature

It is difficult to measure the effects of agglomeration because of their complexity and feedback effects, and because they may be outweighed by other factors. Consequently, there is no consensus about the best way of doing so. Different studies employ different analytical frameworks, economic variables, estimation methods, types of data and spatial units. Such studies can be classified according to three dimensions of agglomeration economies: (i) their industrial scope, (ii) geographical scope, and (iii) temporal scope (Rosenthal and Strange, 2004). Across all three dimensions, agglomeration economies are said to exist when places of higher density are more productive and prosperous (Glaeser and Gottlieb, 2009).

2.2.1. Industrial scope

Studies concerned with the industrial scope of agglomeration economies generally make the distinction between localisation and urbanisation economies, although this distinction is not always as clear in practice as it is conceptually. Localisation tends to mean industrial specialisation, which can be measured by the share of a city's employment in a particular industry. Competition is also important in localisation economies, measured by the number of firms in that industry. Urbanisation economies should be reflected in industrial diversity, rather than specialisation. The theoretical foundations can be traced back to Jacobs (1984), who argued that diversity is a source of externalities as industries can borrow ideas from each other.

2.2.2. Geographical Scope

The standard approach to capturing geography is to use administrative boundaries such as municipalities to define the extent of the city. However, this ignores the distribution of economic activity across the municipality – whether it is concentrated or spread out can presumably make a difference. It also tends to assume that all firms in a city benefit from all other firms in the city, regardless of the distance between them. Finally it ignores the effects of firms immediately beyond the boundary, which is a weakness if municipal boundaries are tightly drawn. Several studies use smaller geographical units to capture the graduated effects of agglomeration (Ciccone and Hall, 1996) or assess the cross-boundary impacts (Rosenthal and Strange, 2003; Soest et al, 2002).

2.2.3. Temporal scope

The issue here is whether the analysis is able to detect whether agglomeration economies are static (once-off) or dynamic (cumulative), i.e. their temporal scope. For example, Henderson (1997) suggests that learning from neighbours takes time to develop. Dynamic studies take into account the potential for agglomeration advantages to accumulate and affect the growth of a city over subsequent periods (Rosenthal and Strange, 2004). They regress growth against agglomeration indicators at the beginning of the period.

2.2.4. Growth variables

Different measures of growth have been used in empirical studies, including increases in productivity, income, employment, population and output. The choice depends on the specific proposition being examined and the available data. It may be sensible to use a range of measures to investigate the scope of agglomeration economies and avoid false conclusions. Of course, careful interpretation of the findings is important since different variables are not interchangeable (Cingano and Schivardi, 2003; Fafchamps, 2004; Rosenthal and Strange, 2004). Some studies have used employment growth as a proxy for productivity because of the lack of suitable firm-level data on productivity. They assume that productivity increases result in proportionate employment increases through shifts in labour demand. However, such inferences are dangerous because others forces may be at work.

This approach implicitly assumes that changes in *labour supply* are independent of local conditions. This is a rather strong assumption: for example, congestion externalities such as higher rents and pollution, are likely to influence mobility choices, potentially breaking the causality chain going from agglomeration economies to productivity and employment (Cingano and Schivardi, 2003:3).

The existence of migration between localities complicates the measurement of agglomeration effects. For example, migration from poor to richer regions may eliminate differences in average incomes caused by productivity differentials. Higher incomes in large cities may also be absorbed by higher property rents and commodity prices (Glaeser, 2007). If they exist, higher incomes in large cities may reflect differences in occupation (e.g. more managerial and professional jobs) rather than productivity per se. Glaeser (1993) suggests that growth in employment and population may be better indicators than average incomes.

The next sections present the evidence from developed and developing countries. Studies are classified according to one of the three dimensions: industrial, geographic or temporal scope.

2.3. DEVELOPED COUNTRY EVIDENCE

2.3.1. Industrial scope

Rosenthal and Strange's (2004) review of the evidence suggests that doubling city size increases productivity by somewhere between 3-8 per cent. The strength of urbanisation and localisation economies varies across the studies considered. Henderson (1986) finds substantial evidence of localisation and almost no evidence of urbanisation. Yet Glaeser et al (1992) finds that urbanisation economies are much more important for growth. Nakumura (1985) finds that both processes affect productivity. Below we consider evidence of localisation and urbanisation economies separately.

2.3.1.1. Localisation economies

Glaeser et al (1992) consider the impact of industrial specialisation on employment growth for the six largest industries in each of 170 US counties over the period 1956-1987. They find that increased specialisation results in lower employment growth. Increasing the concentration of a given industry within a city by 10% reduces employment growth by 12%.

Henderson (1995) also considers the link between specialisation and employment growth, using data for 8 industries: 3 high tech and 5 mature industries. Growth is examined for the period 1970-1987. The findings are not robust: specialisation does not seem to affect employment growth for high tech industries, while it has a positive effect on job growth in mature industries.

Cingano and Schivardi (2003) construct a measure of sectoral total factor productivity (TFP) using data from the balance sheets of over 30,000 Italian firms. They find that specialisation has sizeable effects on TFP over the period 1986-1998. Doubling the share of sectoral employment in a given location raises sectoral TFP by 0.2% a year, and increases the growth rate by 10%. Doubling the initial level of employment in manufacturing raises TFP by 0.4% a year.

Glaeser et al (1992) find that increased competition (more firms) is positively associated with employment growth, unlike specialisation. More firms per worker in a city-industry relative to the national average leads to 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).

2.3.1.2. Urbanisation economies

The main studies that measure urbanisation economies are Glaeser et al (1992), Henderson et al (1995) and Rosenthal and Strange (2003). They all find that diversity fosters growth. Glaeser et al (1992) find that it specifically supports employment growth; Henderson et al (1995) find that it promotes employment growth among high-technology firms; and Rosenthal and Strange (2003) report a positive relationship with the births of new firms. Duranton and Puga (2001) find that diverse cities in France encourage new industries to emerge, which then move to specialised cities after they mature.

Graham (2007) uses company-level data to estimate the returns to agglomeration in the UK. He finds positive externalities for manufacturing, construction and six service industries. The estimated elasticities range from 0.07 to 0.23, suggesting that doubling city size is associated with an increase in productivity of between 7%-23%. Services seem to benefit more from agglomeration than manufacturing, particularly transport, management consultancy, financial services and public services.

2.3.2. Geographical scope

Ciccone and Hall (1996) examine the geographical scope of agglomeration economies in the USA. They do this by considering how county-level employment affects productivity at the wider state-level. They find that doubling county employment density increases state productivity by around 6%. Ciccone (2002) uses similar methods to estimate the effects of employment density on productivity for regions in France, Germany, Italy, Spain and the UK. He finds the elasticity of productivity with respect to growth in Europe to be 4.5% – slightly lower than the US result.

Rosenthal and Strange (2003) find that agglomeration economies diminish quite quickly with distance from the core city. Soest et al (2002) concur that the benefits of agglomeration attenuate rapidly with distance, even within cities.

Duranton and Overman (2002) consider both the industrial and geographical scope of agglomeration economies and estimate the impact of density on productivity for 4 separate radii from the firm: 1km, 5km, 10km and 15km. They find positive localisation and urbanisation externalities for both manufacturing and service industries. The weighted average localisation elasticity for manufacturing is 0.03 and 0.01 for services. Furthermore, localisation economies tend to exist over short distances (within 10km of firms).

A study in the UK by Rice et al (2006) extended this work by measuring the rate at which the advantages of proximity diminish with travel time from the core city. They found that the benefits are greatest within 40 minutes driving time of the city core, tapering off quite sharply thereafter and having little or no effect beyond about 80 minutes. The effects of agglomeration are four times stronger 30 minutes driving-time away than 60 minutes away, and 17 times stronger than 90 minutes away.

2.4 DEVELOPING COUNTRY EVIDENCE

Most econometric studies of agglomeration have been in developed countries. There have been few studies of agglomeration economies in developing countries, especially in Africa (Quigley, 2008). Table 2 summarises this literature.

One message is that localisation economies are more prevalent in developing countries than urbanisation economies. For example, Henderson (1988) finds that the concentration of firms in Brazil is positively related to city growth. This is because "a clustered or densely populated region [provides] a rich environment for competition and collaboration among firms and workers in the region, which lead to economic growth" (Henderson, 1988: 23).

TABLE 2: Analyses of agglomeration economies in developing countries

Country	Author (date)	Main conclusions
Brazil	Henderson (1988)	Localisation economies apparent
Korea	Henderson (2001)	Localisation economies in 3 industries. Urbanisation economies in 1 industry.
	Lee and 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)

Henderson et al (2001) estimate the relationship between agglomeration, output growth and employment growth using industry data for South Korean cities. They find that localisation economies are positively related to both output and employment growth. A 1% increase in local own industry employment results in a 0.06% - 0.08% increase in plant output. This is interpreted as follows:

> 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 10000 workers in the same industry (Henderson, 2002: 92).

Lee and Zang (1998) estimate the effects of localisation and urbanisation economies on the productivity of 19 Korean manufacturing industries. Using cross-sectional census data for Korean cities the authors report that localisation economies have been dominant for most manufacturing industries across Korea. Urbanisation economies were generally unimportant because of the negative effects of locating in large cities.

Cota (2001) looks at the effects of agglomeration on manufacturing employment in Mexico and finds a positive relationship between specialisation and job growth. A 10% increase in industry specialisation boosts employment growth by 12%. This is the opposite of Glaeser's (1992) finding. Pooled labour markets in some of the northern Mexican cities could help to explain this positive effect.

Chen (1996) assesses the impact of agglomeration on productivity in the machinery and food industries for 30 Chinese regions. He finds that agglomeration positively impacts productivity. However, the positive impact diminishes with the growth of the city and then declines:

> In Shanghai 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; and firm numbers in the food industry, from 1988 to 1992, were 449, 447, 449, 442 and 347 (Chen, 1996: 429).

In research on India, Mitra (2000) also finds that the benefits of agglomeration diminish after a certain city size threshold is reached. While TFP is generally responsive to urban population or industrial spread,

> productivity augmenting effects of urbanisation 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).

Roberts and Goh (2010) assess whether density explains the spatial productivity disparities within Chongqing in China. The estimated elasticity of productivity with respect to density is 3.6%.

Considering the temporal scope of agglomeration, Henderson and Kuncoro (1996) find that historic concentrations of particular employment sectors in Indonesia are linked with subsequent growth of the same sectors. Examining five major capital goods industries (machinery, electrical machinery, primary metals, transportation equipment and instruments), they find that patterns persist over time. Growth in traditional manufacturing jobs is higher in cities with high past concentrations of these industries, presumably because a conducive environment is created to attract further investment.

Fafchamps (2004) assesses the impact of agglomeration on employment and output growth for manufacturing in Morocco, using firm-level census data. He concludes that agglomeration has a strong effect on both measures of growth. However, the underlying mechanism is neither competition nor industrial diversity, in contrast with the findings of Glaeser et al (1992).

Bigsten et al (2011) consider the impact of agglomeration in Ethiopia and find a positive, statistically significant relationship with productivity. They use census panel data for Ethiopian manufacturing firms and find that for every additional firm producing the same product in a town, productivity rises by about 0.5%. This supports the argument that localisation or clustering generates positive externalities. They suggest that trust, cooperation and the informal enforcement of contracts between businesses is particularly important in countries with weak formal institutions. These social processes are much easier if firms are located close together.

To sum up, the broad message from previous research is that agglomeration tends to improve economic performance. This is not universally true, and there are important differences in the nature and magnitude of this effect depending on the local context and way in which density and growth are measured. There are also some inconsistent and even contradictory findings between different studies.

2.5 EVIDENCE IN THE WORLD DEVELOPMENT REPORT

The 2009 World Development Report is largely a review, synthesis and repackaging of previous research. It presents little original evidence to support a strong relationship between economic concentration and growth. This is somewhat surprising considering the assertive tenor of the policy recommendations. There are also few qualifications and conditions associated with these recommendations. Key authors of the report subsequently explained that:

> The WDR is parsimonious in its approach and limited in its scope. For a global report to be instructive and informative, with findings and messages that are applicable to large and small countries at different levels of development, it has to be stripped to its essence (Deichmann et al., 2011: 172).

One of the dangers in this approach is that it can oversimplify and exaggerate the contribution of cities to economic development. Other important factors and forces that either create the conditions for agglomeration economies to take effect, or that may override the influence of agglomeration, are neglected. The connection between urbanisation and development ends up being portrayed as a kind of universal law. This is inconsistent with the empirical evidence available.

SECTION 3

ESTIMATION APPROACH

3.1. METHODS

Our empirical analysis relates measures of density to measures of growth at the local municipality level. This is done using bivariate linear regression. Bivariate comparisons are useful indicators of underlying relationships and one of the easiest ways to see whether a relationship exists (Wittenberg, 2010). This type of correlation cannot prove that density in 1996 caused growth over the period 1996-2010, but it can at the least suggest that density and growth are strong complements. The regression model effectively treats all other factors affecting growth as unobserved.

Using ordinary least squares (OLS) regression analysis, we estimate equations 1 and 2 as follows

$$\text{Growth} = a + b1\ \text{Log (Density)} + e \quad (1)$$

$$\text{Growth} = a + b2\ (\text{Skills}) + u \quad (2)$$

Equation 1 is a log-linear regression model. Both density and growth can be said to be in logarithmic form. The logarithmic transformation of density is used in this equation and by definition, the exponential growth model used to calculate population, employment and growth is in the logarithmic form[1]. One attractive feature of this model, which has made it popular in applied work, is that the slope coefficient b1 can be interpreted as an elasticity (Gujarati, 2003). In this case, b1 represents the elasticity of growth with respect to density, that is, a percentage change in growth for a given (small) percentage change in density. Another attractive feature of the model is that using the logarithms of the values rather than the actual values reduces the wide range (particularly on the X axis) to a more manageable size.

In equation 2 only one variable (growth) appears in the logarithmic form. The equation can therefore be said to represent a semi-log model. The slope coefficient measures the relative change in growth for an absolute change in the proportion of the population with skills. Since the skills variable in the equation represents a percentage (the proportion of the municipal population with matric), b2 can be interpreted as a percentage change in growth given a percentage increase in the proportion of the population with skills. b2 is known as a semi elasticity (Gujarati, 2003).

The variables *e* and *u*, called the error terms in the relationship, represent the 'unobserved' factors. The intercept parameter *a* is not central to the analysis.

1 Exponential Growth= $\ln(x_n/x_1)/n$, where n is the number of years in the period

If density contributes to growth, this should show up as a statistically significant relationship between at least one set of density-growth regressions. Statistical significance allows us to infer that a relationship between density and growth did not occur just by chance; rather that some fundamental relationship exists between the variables. Significance is typically measured by the t-statistic (or p-value). We do not report the t-statistic explicitly, but it can easily be calculated by dividing a coefficient by its respective standard error. In all the regressions we report, the standard error is presented in parenthesis below the coefficient. If the t-stat is more than 2 (the coefficient is at least twice as large as the standard error), we would generally conclude that density has a significant impact on growth.

A series of scatter plots corresponding to the regression results is presented. These show the direction and magnitude of the association between density in 1996 and economic growth over the subsequent 15 year period.

3.2. DATA

Data was obtained from two independent service providers, Global Insight and Quantec. In the absence of official time-series data for localities in South Africa, these are the two main sources available. Having data from two sources enables some cross-checking for consistency and reliability. After this process and discussions with both providers we decided to rely on the Global Insight (GI) database, using the latest version of the IHS Regional Explorer (ReX) available at the time (March 2011). GI was chosen partly because they have more staff available to update and check their data than Quantec. GI arrives at their sub-national estimates by:

> 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).

A more detailed explanation of how GI achieves its estimates is presented in appendix A. It is fair to say that the procedure remains unsatisfactorily vague in some respects.

The geographical units used are the 231 local municipalities and 6 metropolitan municipalities. South African municipalities are relatively large compared with most countries, so they are more self-contained as functional areas. 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 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 Stats SA. The 2005 boundaries are chosen over the more up-to-date 2011 boundaries as the latter include several sparse areas and national parks within the municipality boundary which would give a misleading impression of density. The latest boundary changes also include the recent merger of Tshwane and Metsweding and the reclassification of two new metros (Buffalo City and Mangaung). Since the period under consideration for the analysis is 1996 to 2010, it seems sensible to use the original boundaries.

Population, employment, gross value added (GVA) and education data is obtained for each of the 237 municipalities and then manipulated to create the variables of interest for this study, namely measures of density, skills share and growth.

3.3. MEASURES

3.3.1. Dependent variables

Economic growth. The growth rate used in the analysis is based on continuous, exponential growth (or annual compound growth) between two points in time. This is superior to the simple average growth rate as the latter overstates the growth estimations because it neglects the fact that the base for growth is continually rising (Carlin, 2008). The three measures of growth are population, employment and GVA.

3.3.2. Independent variables

Density. Economic density is shorthand for the scale of output produced, and thus the income generated, for a particular area. Gross value added is the key measure of economic output, based on the difference between the value of goods and services produced and the cost of materials and other inputs. Gross value added per km^2 of land is used as one of the measures of density.

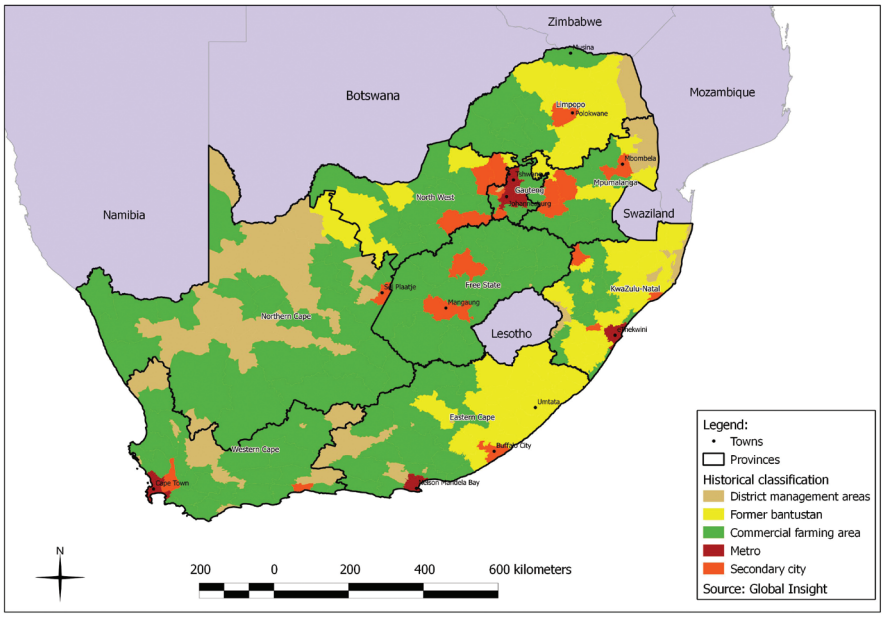
Knowledge spillovers, learning and labour market matching emphasize physical interaction as the way in which information and ideas are spread. Our second and third measures of density therefore capture the proximity between people/workers. One is an employment-based measure of density and the other is a population-based measure (Abel et al, 2011).

Skills share. The conventional measure of human capital is based on education. It has been linked to several measures of regional vitality (Abel et al, 2011). We use the share of people with matric to represent human capital within a municipality. It does not capture the full rage of human capabilities and competences.

3.3.3. Categorisation

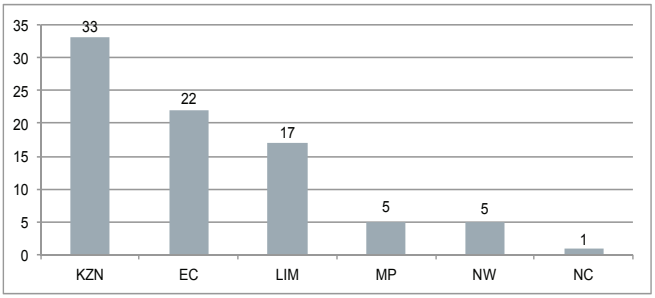
To convey an initial impression of the diverse composition of the 237 municipalities we disaggregate them for descriptive purposes. Later we assess whether there is a stronger relationship between density and growth in some groups than in others, in case the connection is diluted or washed-out by aggregating the municipalities all together. Municipalities are put into rural and urban groups based on their historical administrative classification and are also grouped according to their principal industry.

MAP 1. The Distribution of municipalities by historical administrative classification, 1996



Rural and urban groups

This paper defines rural and urban municipalities in terms of apartheid categories and in line with Makgetla's (2010) approach. Rural areas cover the former Bantustans and commercial farming areas. Urban areas cover the metros and secondary cities. The distribution of municipalities by historical administrative classification is shown in Map 1 (*see p16*).

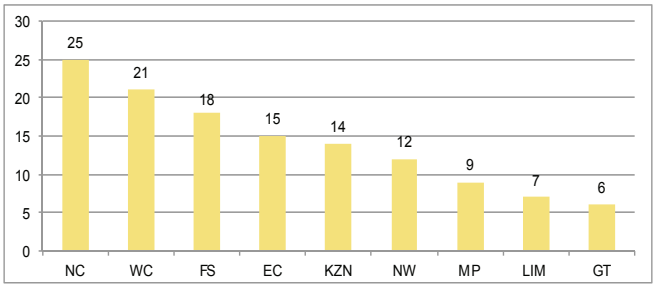


GRAPH 1: Number of municipalities in the former Bantustans per province

Rural Municipalities

Former Bantustans. Under apartheid Africans who made up 80% of the population of South Africa were restricted to land ownership in 'rural reserves', 'homelands' or 'former Bantustans' (Baldwin, 1975). They were typically located on the periphery of and distant from the main economic centres. These areas were typically arid with very limited agricultural and mining potential.

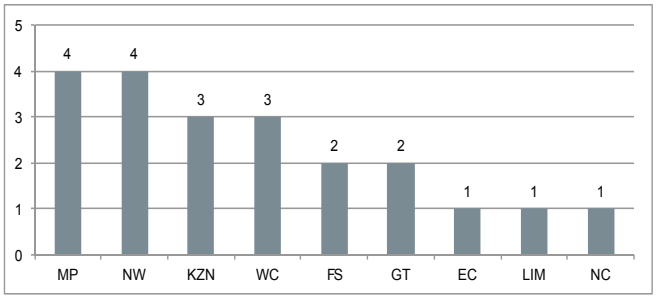
> With few exceptions, the Bantustan administrations had virtually no resource base of their own, and the central state provided only limited subsidies. The Bantustans ended up with too few and often poorly qualified educators, police and health workers. They suffered from severe underinvestment in both 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).



GRAPH 2: Number of municipalities in commercial farming areas per province

The bulk of the municipalities located in the former Bantustans are contained in the Eastern Cape, Limpopo and Kwazulu Natal. A few are also situated in Mpumalanga, the North West and the Northern Cape provinces.

Commercial farming areas. These areas are made up of smaller towns, commercial farms and most mining areas (Makgetla, 2010). The Western Cape, Northern Cape and the Free State contain extensive commercial farming regions but almost no former Bantustan areas. Graph 2 shows the number Commercial farming areas by province.



GRAPH 3. Number of secondary city municipalities per province

Urban municipalities

Secondary cities. These areas tend to have narrow economic bases and specialised industries. Hence they face diverse processes of growth and decline, depending on the performance of their basic industries. The distribution of the municipalities of secondary cities by province can be seen in Graph 3.

Metropolitan municipalities. The 6 metros of Cape Town, Nelson Mandela Bay, eThekwini, Johannesburg, Tshwane and Ekurhuleni are the largest agglomerations and serve as the economic engines for their

surrounding areas. They have most potential to address the socio-economic needs of the population. They have diversified economies, large-scale productive infrastructure, and produce a variety of goods and services for national and international markets.

Built-up area. An additional set of results is presented for the 27 urban municipalities. This is based on redefining the area of analysis as the built-up area. Sparsely populated areas within each municipality are deliberately excluded. This procedure is particularly important for the metros because they have generous boundaries including substantial undeveloped areas. We define built-up area as the land area covered by those sub-places with a population density above 25 people per hectare or 2500 people per km^2. This is lower than in many countries but consistent with South Africa's distinctive urban form comprising concentrated populations on the urban outskirts. Low density middle and high income suburbs and high density townships are a legacy of separate development under apartheid.

We assume areas with a population density lower than 25 people per ha or 2500 people per km^2 are either sparsely populated or have low levels of economic activity. These areas do not form part of the city's core and are therefore excluded from the built-up area.

Built-up area density is calculated as follows

1. Summing the area of all sub places within the municipality with a population density higher than 2500 people per km^2.
2. Summing 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 the built up area.

Table 3 shows the total number of municipalities in each province and their average population. Gauteng has by far the fewest municipalities and the biggest in terms of average population. At the other end of the spectrum, Northern Cape has many municipalities with small populations, because of its physical extent and sparcity. The provinces with most former Bantustans (Limpopo, Kwazulu Natal and the Eastern Cape) have relatively large average populations.

TABLE 3: Number of municipalities and average population per province

Province	Number of municipalities	Ave. population of each municipality
Gauteng	11	748000
Limpopo	25	186500
Mpumalanga	18	174600
Kwazulu Natal	51	173200
Western Cape	25	161700
Eastern Cape	39	158500
North West	21	143800
Free State	20	133000
Northern Cape	27	35700
South Africa	**237**	**176100**

Industrial composition

Municipalities are also categorised by their dominant tradable sector to assess whether, for example, agglomeration economies are stronger in manufacturing than in agricultural areas. The procedure followed ensured that the final groups were mutually exclusive:

1. Calculate the proportion of employment in each broad tradable sector for all municipalities in 1996.
2. Allocate each municipality to the category agriculture, mining or manufacturing according to its largest sector.
3. If none of these sectors employed more than 10% of the workforce, that municipality was not considered to have a dominant tradable sector and was categorised as community (i.e. public) services (which includes health, education and social services)

Using this procedure, we identify:

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%.

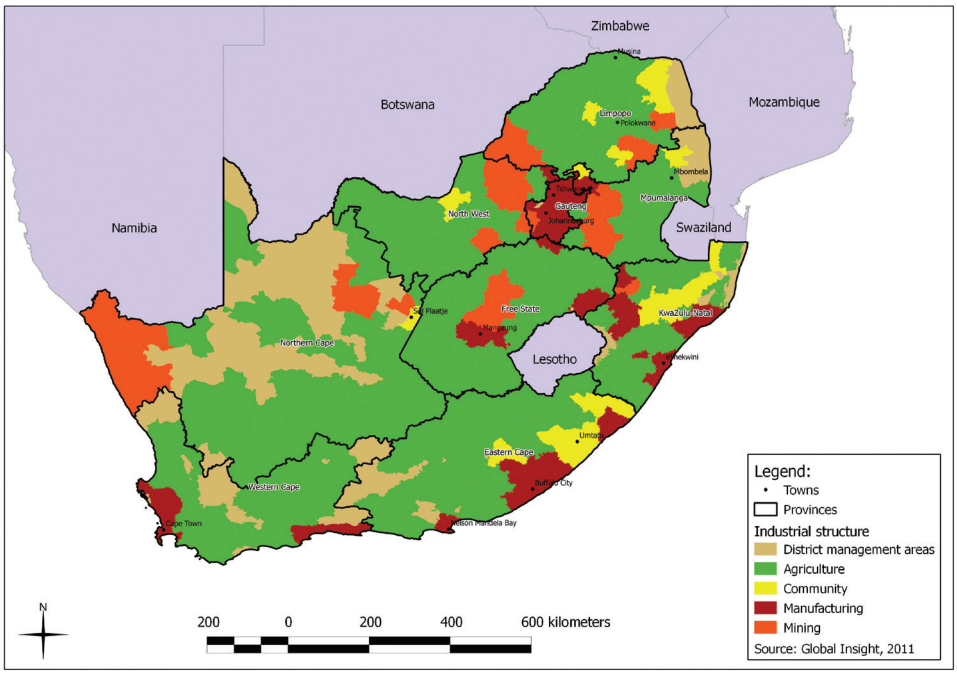
23 community services municipalities, with these jobs ranging from 30-57%.

The breakdown of municipalities in each province by local economic structure is shown in Table 4. Their national distribution is shown in Map 2. The majority of municipalities are agricultural in all provinces except Gauteng, where most are manufacturing.

TABLE 4: Number of municipalities in each province by industrial composition

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**

MAP 2: The Distribution of Municipalities by Industrial Composition



SECTION 4

EMPIRICAL ANALYSIS: Descriptive

4.1. THE DISTRIBUTION OF DENSITY IN SOUTH AFRICA

There is a hierarchy of density across municipalities. Primary cities are at the top and rural farming areas are at the bottom. Table 5 shows the 10 municipalities with the lowest and highest population densities. The top 10 are metros or secondary cities, and are predominantly manufacturing. Four are in Gauteng. The bottom 10 are rural and historically categorised as commercial farming. Nine are predominantly agricultural and one is mining. Eight are in the Northern Cape. Laingsburg is in the semi-desert area of the Karoo and Molopo is in North West province. Both municipalities border on the Northern Cape.

TABLE 5: The ten highest and lowest ranked municipalities by population density

Rank	Municipality	Administrative classification		Sector	Province	People/km²
1	Johannesburg	Urban	Metro	Manufacturing	GT	1715
2	eThekwini	Urban	Metro	Manufacturing	KZN	1229
3	Ekurhuleni	Urban	Metro	Manufacturing	GT	1137
4	Cape Town	Urban	Metro	Manufacturing	WC	1063
5	Msunduzi	Urban	Secondary	Community	KZN	854
6	Tshwane	Urban	Metro	Community	GT	841
7	Emfuleni	Urban	Secondary	Manufacturing	GT	672
8	N Mandela Bay	Urban	Metro	Manufacturing	EC	497
9	Buffalo City	Urban	Secondary	Manufacturing	EC	272
10	uMhlathuze	Urban	Secondary	Manufacturing	KZN	251
228	Khai-Ma	Rural	Commercial	Agriculture	NC	1
229	Molopo	Rural	Commercial	Agriculture	NW	1
230	Siyathemba	Rural	Commercial	Agriculture	NC	0.9
231	Ubuntu	Rural	Commercial	Agriculture	NC	0.9
232	Kamiesberg	Rural	Commercial	mining	NC	0.8
233	Laingsburg	Rural	Commercial	Agriculture	WC	0.6
234	Kareeberg	Rural	Commercial	Agriculture	NC	0.6
235	Mier	Rural	Commercial	Agriculture	NC	0.5
236	Karoo Hoogland	Rural	Commercial	Agriculture	NC	0.4
237	Hantam	Rural	Commercial	Agriculture	NC	0.3

Map 3 shows the national distribution of population density. The key on each map is structured such that the bottom 10 ranked municipalities are in the lowest category and the highest 10 ranked municipalities are in the highest category. The most extensive areas of high density are in Kwazulu Natal, Eastern Cape, Gauteng and Limpopo.

MAP 3. Population density by local municipality, 1996

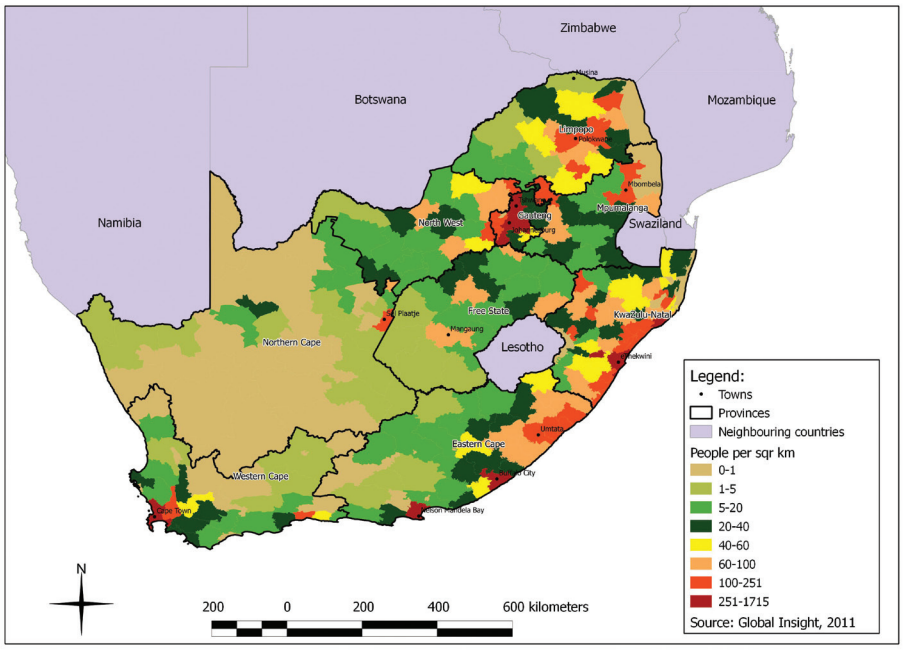
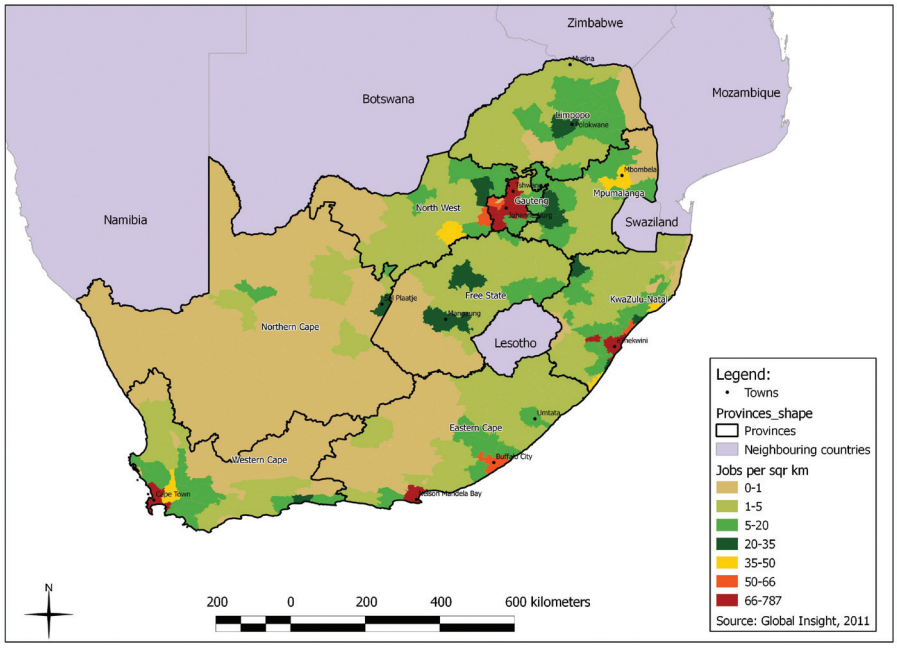


Table 6 shows the pattern for employment density rather than population. The result is very similar. The metros have the highest job densities followed by two gold mining municipalities close to Gauteng (Randfontein and Westonaria). Municipalities with the lowest job densities are generally commercial farming areas in the Northern Cape

TABLE 6: The ten highest and lowest ranked municipalities by employment density

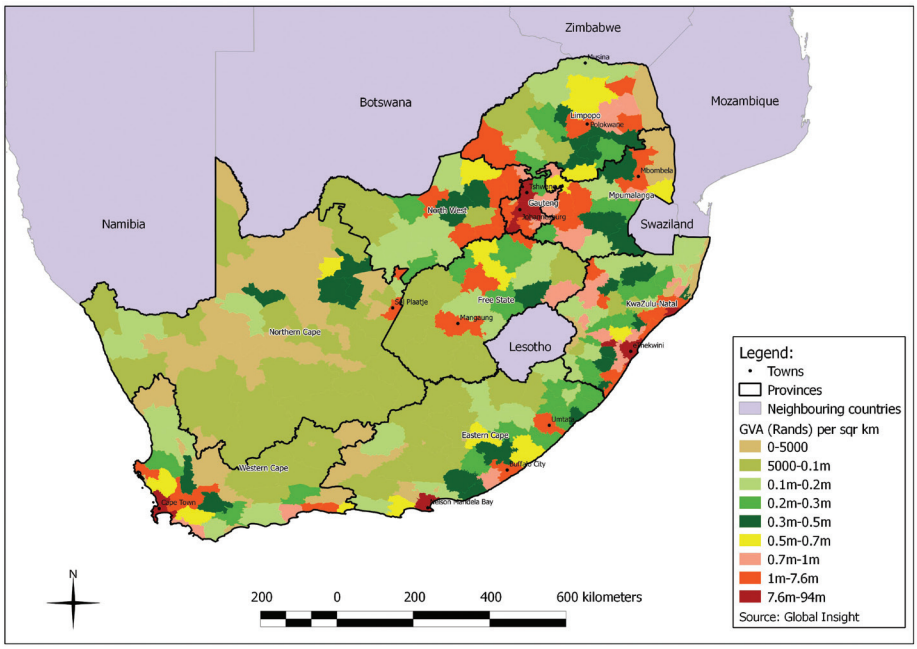
Rank	Municipality	Administrative classification		Sector	Province	Jobs/km²
1	Johannesburg	Urban	Metro	Manufacturing	GT	787
2	Cape Town	Urban	Metro	Manufacturing	WC	349
3	Ekurhuleni	Urban	Metro	Manufacturing	GT	322
4	Tshwane	Urban	Metro	Community	GT	312
5	eThekwini	Urban	Metro	Manufacturing	KZN	307
6	Msunduzi	Urban	Secondary	Community	KZN	165
7	N Mandela Bay	Urban	Metro	Manufacturing	EC	108
8	Emfuleni	Urban	secondary	Manufacturing	GT	105
9	Westonaria	Urban	Commercial	Mining	GT	70
10	Randfontein	Urban	Commercial	Mining	GT	66
228	Siyancuma	Rural	Commercial	Agriculture	NC	0.2
229	Kamiesberg	Rural	Commercial	Mining	NC	0.2
230	Siyathemba	Rural	Commercial	Agriculture	NC	0.2
231	Ubuntu	Rural	Commercial	Agriculture	NC	0.2
232	Laingsburg	Rural	Commercial	Agriculture	WC	0.2
233	Kareeberg	Rural	Commercial	Agriculture	NC	0.1
234	Karoo Hoogland	Rural	Commercial	Agriculture	NC	0.1
235	Mier	Rural	Commercial	Agriculture	NC	0.1
236	Molopo	Rural	Commercial	Agriculture	NW	0.09
237	Hantam	Rural	Commercial	Agriculture	NC	0.08

Map 4 shows the national distribution of employment density. The areas of high job density are limited to the metros and a few secondary cities. Elsewhere, job densities tend to be low. The contrast between the areas of high *population* density in Kwazulu Natal, Eastern Cape and Limpopo and their low *employment* densities is very striking. There is clearly a serious jobs shortfall in these places.



MAP 4. Employment density by local municipality, 1996

The map of GVA density (Map 5) is slightly different again, partly because mining and tourism areas feature more prominently than they do on the employment density map.



MAP 5. GVA density by local municipality, 1996

Table 7 shows the distribution of people with matric. The 10 municipalities with the lowest level of skills are all in the former Bantustans, reflecting the low investments in African education under Apartheid (Banjeree et al, 2007). The 10 municipalities with the highest skills are a mixture of cities, towns and rural areas. The pattern is quite different to the density hierarchy.

TABLE 7: The ten highest and lowest ranked municipalities by skills share

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

Map 6 shows the national distribution of skills. It confirms the stronger position of the cities.

MAP 6. Share of the population with matric by local municipality, 1996

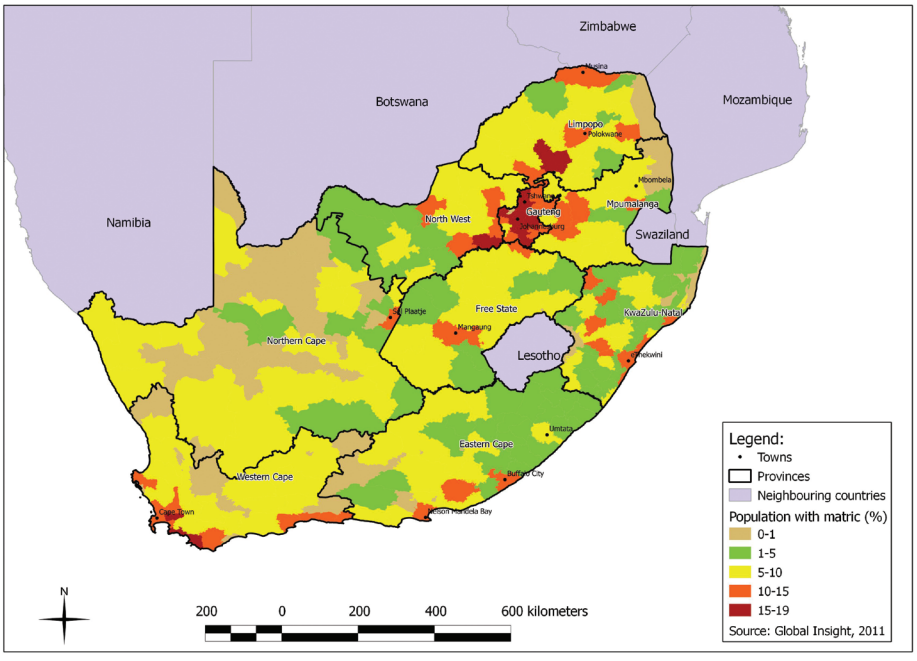


Table 8 compares the higher and lower ends of the population density distribution for the former Bantustans and commercial farming areas. There are a few high density commercial farming areas that include towns and tourism destinations. Otherwise their densities are generally lower than the former Bantustans. This is also clear at the lower end of the density distribution.

TABLE 8: The ten highest and lowest ranked rural municipalities by population density

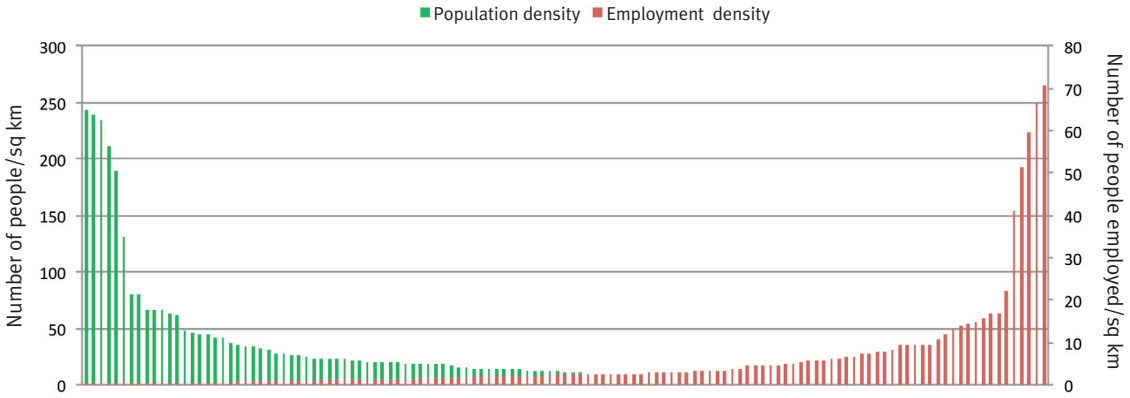
Rank	Former Bantustans	People/km²	Commercial farming areas	People/km²
1	Bushbuckridge	212	Randfontein	243
2	Mandeni	198	Hibiscus Coast	238
3	Thulamela	187	Umdoni	233
4	Dr JS Moroka	183	KwaDukuza	211
5	Ndwedwe	156	Westonaria	189
6	Imbabazane	140	Merafong City	131
7	Umzumbe	138	Nquthu	80
8	Maphumulo	138	Maluti a Phofung	80
9	King Sabata Dalindyebo	131	Mafikeng	66
10	Makhuduthamaga	130	Phokwane	66
228	Maruleng	27	Khai-Ma	1.1
229	Elundini	26	Molopo	1.1
230	Sakhisizwe	26	Siyathemba	0.9
231	The Big Five False Bay	25	Ubuntu	0.9
232	Great Kei	23	Kamiesberg	0.8
233	Ratlou (Setla-Kgobi)	21	Laingsburg	0.6
234	Senqu	17	Kareeberg	0.6
235	Moshaweng	10	Mier	0.5
236	Kagisano	7	Karoo Hoogland	0.4
237	Tsolwana	5	Hantam	0.3

Table 9 (*see p26*) compares the higher and lower ends of the employment density distribution for the former Bantustans and commercial farming areas. The former are much worse off in terms of the ratio of employment to population. For example, Bushbuckridge has the highest population density among the former Bantustans but only 12 jobs per km², i.e. 1 job for about 18 people. Randfontein is the commercial farming municipality with the highest population density and has 66 jobs per km², i.e. about 1 job for every 4 people.

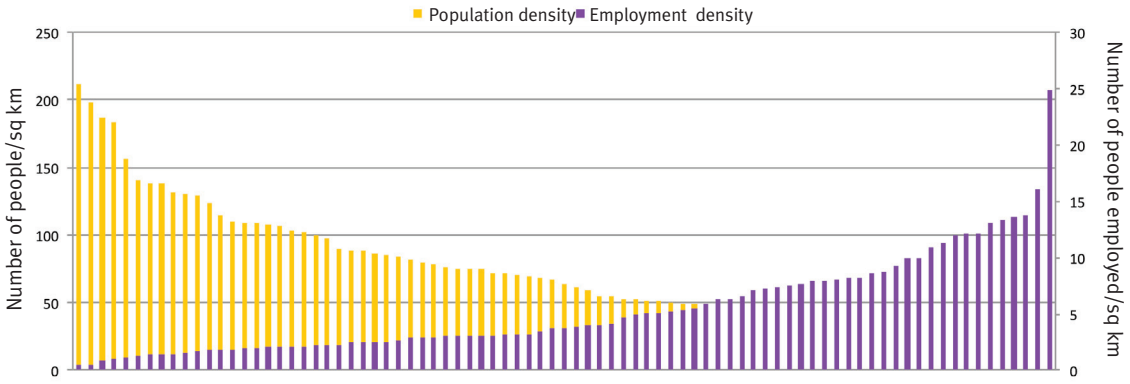
Graphs 4 and 5 (*see p26*) show the spread or distribution of the population and employment densities for the former Bantustans and the commercial farming areas. There are a few places with high population and employment densities among the commercial farming areas, but a more even distribution among the former Bantustans. Bearing in mind the different scales of the two figures (especially for employment density), the other important point emerging is that the ratio of population to employment in the former Bantustans is generally much higher than in the commercial farming areas.

TABLE 9: The ten highest and lowest ranked rural municipalities by employment density

Rank	Former Bantustans	Jobs/km²	Commercial farming areas	Jobs/km²
1	Mandeni	24	Westonaria	71
2	Mbonambi	16	Randfontein	66
3	Greater Tzaneen	13	Merafong City	59
4	Thulamela	13	KwaDukuza	51
5	Umzumbe	13	Hibiscus Coast	41
6	Greater Letaba	13	Umdoni	22
7	Imbabazane	12	Mafikeng	16
8	King Sabata Dalindyebo	12	Umjindi	16
9	Bushbuckridge	12	Metsimaholo	15
10	uMlalazi	11	Breede Valley	14
228	Elundini	1.6	Siyancuma	0.2
229	Emalahleni	1.5	Kamiesberg	0.2
230	Kagisano	1.4	Siyathemba	0.2
231	Moshaweng	1.4	Ubuntu	0.2
232	Mutale	1.3	Laingsburg	0.2
233	Okhahlamba	1.1	Kareeberg	0.1
234	Senqu	1	Karoo Hoogland	0.1
235	The Big Five False Bay	0.8	Mier	0.1
236	Tsolwana	0.5	Molopo	0.09
237	Umhlabuyalingana	0.5	Hantam	0.08



GRAPH 4: Population versus employment density. Commercial farming areas 1996



GRAPH 5: Population and employment density. Former Bantustans 1996

SECTION 5

EMPIRICAL ANALYSIS: Summary statistics

Before embarking on a systematic analysis of the relationship between density and growth, it is instructive to explore summary statistics for the different types of municipality.

5.1. NATIONAL, URBAN AND RURAL MUNICIPALITIES

Table 10 presents summary statistics for rural and urban municipalities in 1996. The mean population density in urban municipalities was about nine times higher than in rural areas. The mean *employment* density in urban areas was about 20 times higher than in rural areas. And the mean *GVA* density in urban areas was nearly 30 times the rural figure. This implies that urban areas were considerably more productive than rural areas. This is defined in conventional economic terms, which excludes informal economic activity.

TABLE 10: National, urban, and rural summary statistics

	National	Urban	Rural
Mean population density[1]	83	381	43
Mean employment density[2]	18	114	6
Population : employment ratio[3]	5	3	7
Mean GVA density[4]	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 km^2 2 = Number of people employed per km^2
3 = Number of people/number of jobs 4 = Output per km2 5 = Share of the population with matric

In addition, there were twice as many people per job in the rural than in the urban areas. This gives an indication of the extra pressure on the productive population in rural areas. And the proportion of people with matric in urban areas was twice as high as that in rural areas. Urban municipalities experienced stronger growth than rural areas between 1996-2010 across all three indicators, but particularly in terms of employment.

5.2. BUILT-UP URBAN AREAS

In section 3.3.3 it was noted that many urban municipalities have generous boundaries, so the analysis of density was refined to focus on the built-up area of the 27 urban municipalities. Table 11 presents the descriptive statistics for these areas against the total land area of the same municipalities. This procedure clearly makes a big difference to all density measures.

TABLE 11: Built-up area summary statistics

	Urban built-up	Urban
Mean population density[1]	5630	381
Mean employment density[2]	1337	114
Mean GVA density[3]	R342m4	R14.2m

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

5.3. HISTORICAL AND ADMINISTRATIVE CLASSIFICATION

In order to test for the influence of institutional and political factors on economic performance, we sub-divided rural areas into the former Bantustans and commercial farming areas. We also sub-divided urban areas into metros and secondary cities, since the metros have distinctive powers and responsibilities. Table 12 presents summary statistics for these four groups of municipalities. The metros have about six times higher population densities and eight times higher employment densities than secondary cities. The population:jobs ratio is more similar. The metros are best placed of all areas in terms of the key economic indicators: GVA density, GVA growth and employment growth.

TABLE 12: Summary statistics for municipalities by historical administrative classification

	Metros	Secondary Cities	Commercial farming areas	Former Bantustans
Mean population density[1]	1081	182	25	72
Mean employment density[2]	365	42	6	5
Mean population:employment[3]	3	4	4	15
Mean GVA density[4]	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 with matric

Comparing the population densities of the former Bantustans and commercial farming areas is very striking. The former is nearly three times higher than the latter. This is not matched by equivalent employment differences. Consequently, there are nearly four times as many people per job in the former Bantustans as in the commercial farming areas, with all the attendant pressures associated with this. With slower growth in employment in these areas, it is perhaps not surprising that population growth has lagged substantially behind other parts of the country, presumably because of net out-migration.

5.4. INDUSTRIAL COMPOSITION

Different industries tend to grow at different rates over time, and this may outweigh the effects of density or agglomeration. Table 13 presents descriptive statistics of the position of different municipalities grouped according to their dominant economic sector. Manufacturing areas have much higher population and employment densities than other areas. They have also had higher GVA and employment growth rates. Municipalities dominated by community services have the highest ratio of population to employment of all areas, suggesting a big shortfall in jobs and weak local economies, perhaps compensated to a small extent by public sector employment. Mining areas have not performed well over the last 15 years.

TABLE 13: Summary statistics for municipalities grouped by industrial composition

	Manufacturing	Agriculture	Mining	Community services
Mean population density[1]	262	32	56	95
Mean employment density[2]	69	5	16	6
Mean population:employment[3]	4	6	4	15
Mean GVA density[4]	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 4 = Output per km² 5 = Share of the population with matric

SECTION 6

EMPIRICAL ANALYSIS: Regression results

6.1. INTRODUCTION

The purpose of the regression analysis is to establish how growth relates to density. We do this by estimating the average value of growth over the period 1996-2010 in terms of density in 1996. Regression implies (without proving) causality between the independent (or explanatory) variable *density* and the dependent variable *growth*. Correlation implies no causality but refers simply to the degree of association between two variables. For example, density and growth may be correlated because another variable affects them both.

We present statistically significant regressions and the graphical correlations for some of them. Different combinations of density and growth measures are presented to illustrate the range of analyses that were undertaken. GVA is the key growth measure in the analysis. The other growth measures produce similar results. The choice of which growth and density indicators to present was influenced by the desire to convey a rounded picture of all the evidence.

6.2. DENSITY RESULTS

The results obtained using different measures of density and growth are consistent. The basic message is that when the analysis covers all 237 municipalities there is no relationship between density and growth. This finding is surprising considering the body of evidence from elsewhere in the world. It suggests that spatial proximity does not inevitably create positive externalities that raise productivity and increase growth. This may be because other factors play a more important role in shaping local growth and development, and perhaps even in masking the effects of agglomeration in some instances. These could include the industrial structure, institutional arrangements, inherited conditions or macro-economic circumstances.

Before leaping to conclusions, another important finding is that, when separate regressions are run on different kinds of municipality, there is at least one significant relationship between density and growth in each of the following categories: 'metros', 'commercial farming areas' and 'community services areas'.

6.2.1. National, Urban, Rural and Built-up Urban area

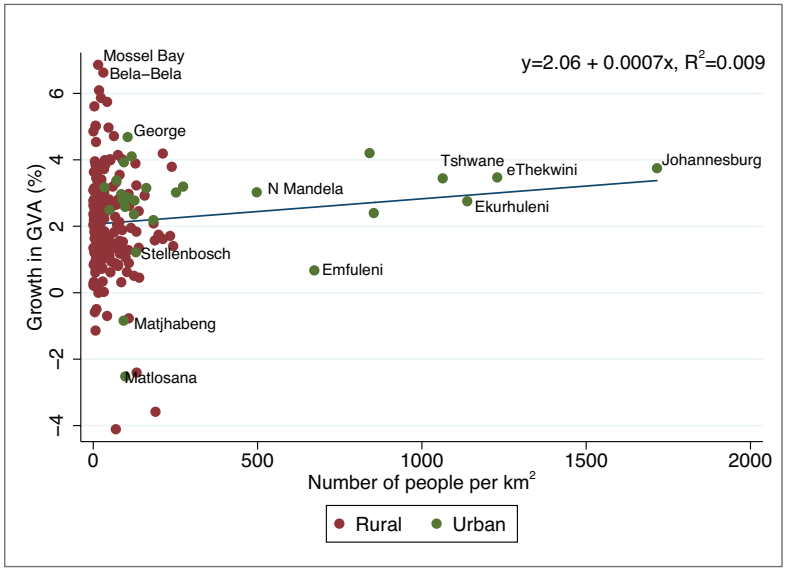
6.2.1.1. National, Urban and Rural

Appendix C presents the regressions run on all 237 municipalities and on the urban and rural categories. There is no significant relationship between density and growth for any of these groups. Graph 6 shows the

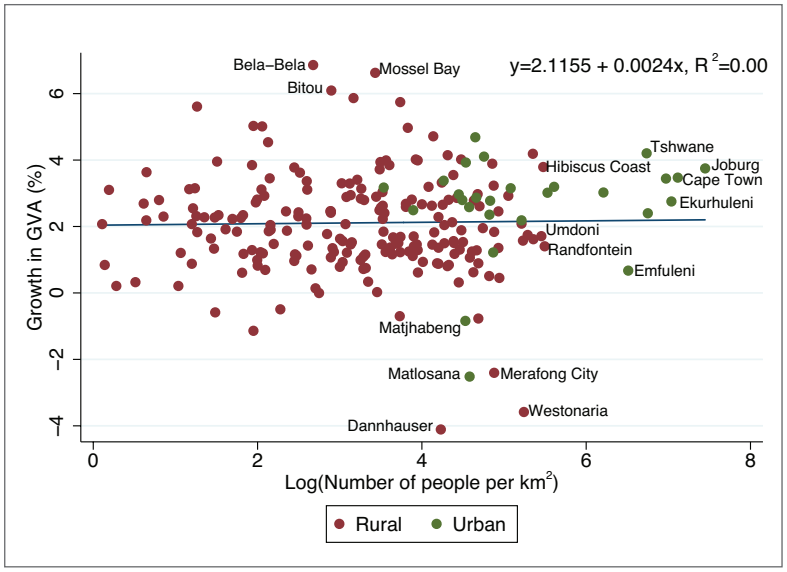
simple correlation between population density and GVA growth for all 237 municipalities, without using the log scale to begin with. It distinguishes between rural areas (red dots) and urban areas (green dots). Although there is a slight upward gradient on the line of best fit between the observations, its gradual slope and the wide scatter of observations indicate that density and growth are not strongly related. Areas with the highest densities have grown no faster than many areas with much lower densities. This finding holds when any measure of density is regressed against any measure of growth.

In graph 6 it is difficult to see the distribution of areas in the 0 to 200 people per km² range clearly. The remaining graphs in this section therefore use the log scale instead. This also allows us to interpret the slope coefficient as an elasticity. Graph 7 presents the same correlation, but on a log scale. This spreads out the distribution along the horizontal axis, and confirms the absence of a relationship between density and growth.

GRAPH 6: Population density versus economic growth (GVA)



GRAPH 7: Population density versus economic growth (GVA)



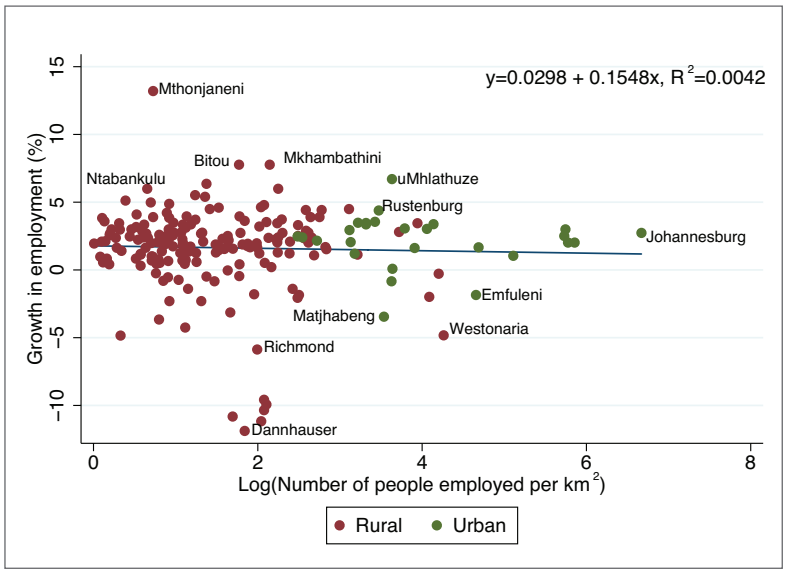
There are about a dozen rural areas that have grown faster than all the urban areas, led by Bela-Bela (Limpopo), Mossel Bay and Bitou (both in the Western Cape). All three have strong tourism sectors and well-connected transport routes. Bela-bela is located off the N1 highway between Tshwane and Polokwane and is known for its mineral springs (warmbaths). Mossel Bay and Bitou (formerly Plettenburg Bay) are on the south-east coast (the Garden route) and served by the N2 coastal highway.

Urban areas obviously have a higher population density than rural, although there are several exceptions. The relatively high density rural areas of Hibiscus Coast, Umdoni and Randfontein are served by major national or provincial roads. Hibiscus Coast and Umdoni are situated in the Ugu district municipality on the KZN South Coast, about 150km south of eThekwini on the N2 highway. It is part rural and part urban, and houses some major industrial complexes. Hibiscus Coast is the most concentrated economic hub in Ugu district. Randfontein is a gold mining town about 40km West of Johannesburg and is served by the N12 and R41 highways.

The rural areas of Merafong City (North West), Westonaria (Gauteng) and Dannhauser (Kwazulu Natal) are some of the municipalities that have experienced declining GVA. Merafong City and Westonaria are on the West Rand where gold mining is the principal activity and Dannhauser (located halfway between eThekwini and Johannesburg) is surrounded by some of the largest coal mines in KZN. The decline in GVA may be linked with shrinking mining activities. The urban areas of Matjhabeng (Free State) and Matlosana (North West) are also experiencing declining GVA. Both are administrative districts.

The correlation between employment density and employment growth in Graph 8 yields similar results. There is no significant relationship between these variables. The growth leaders and laggards consist of a few select rural areas. The municipalities of Mthonjaneni and Ntabankulu experienced relatively high jobs growth over the period, but 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 jobs growth in these places was probably linked to their low starting point in 1996.

GRAPH 8: Employment density versus employment growth



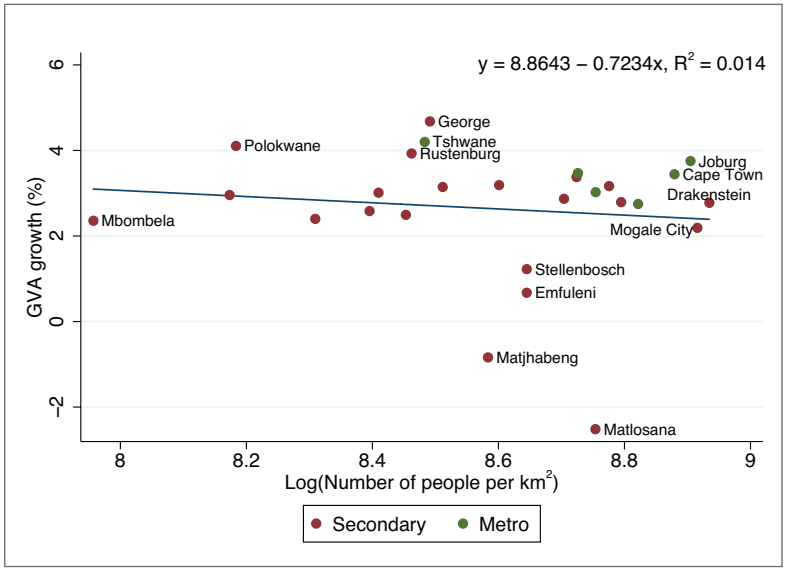
6.2.1.2. Built-up urban areas

Appendix D presents the results for the regressions focused on the built-up area of the urban municipalities. No statistically significant relationship was found between density of the built-up area and the subsequent

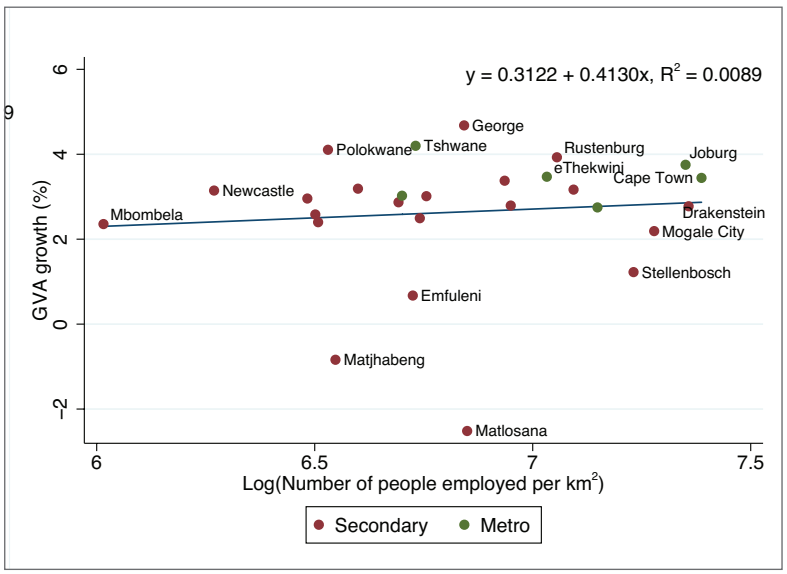
growth of the municipal area as a whole. Graphs 9 and 10 illustrate two of the correlations, involving population density and employment density. Statistical 'insignificance' aside, it is notable that the relationship between population density and GVA growth is marginally negative, while that between employment density and GVA growth is the opposite, perhaps hinting that employment density may have more influence on GVA growth than population density.

The former industrial city of George (Western Cape) has the highest GVA growth rate among urban municipalities. It is situated on the Garden route, promotes itself as a 'tourism mecca' and is regarded as the administrative capital of the Southern Cape. Matlosana (North West) and Matjhabeng (Free State) have the lowest GVA growth rates, perhaps because they are located in largely rural provinces. Drakenstein (Western Cape) has the highest population density and is situated in the Cape Winelands district municipality. It is made up of a concentration of towns and farming communities. Mbombela (Mpumalanga) covers an extensive area including Nelspruit, and a mixture of agricultural, commercial and manufacturing activities.

GRAPH 9: Employment density versus economic growth



GRAPH 10: Employment density versus economic growth (GVA)



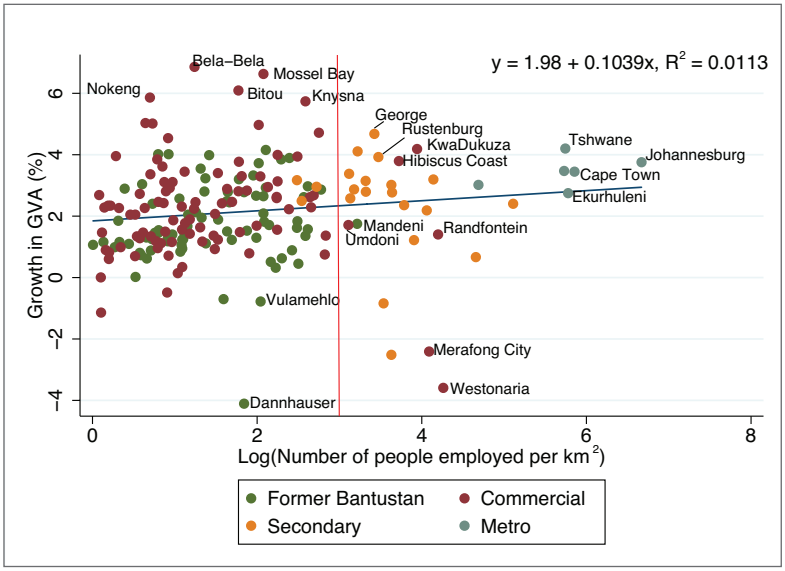
6.2.1.3. Summary

This section considered the relationship between density and growth across four groups of municipality: national, urban, rural and built-up urban area. The essential finding is that there is no apparent relationship between density and growth. Municipalities with higher population or economic densities have grown no faster than municipalities with lower densities.

6.2.2. Historical administrative classification

It has been established that there is no relationship between density and growth when all 237 municipalities are included. Graph 11 shows this again, while distinguishing between former Bantustans (red dots), commercial farming areas (green dots), secondary cities (orange dots) and metros (blue dots). This highlights the relatively low employment density of the rural areas. Beyond a pronounced threshold, illustrated by the red line, there lies only one former Bantustan and six commercial farming areas. The actual value represented by this line is 22 people employed per km^2 of land. The maximum employment density is in Johannesburg, with 787 jobs per km^2. This is 10 times the highest employment density for a rural area (Westonaria, also in Gauteng).

GRAPH 11: Employment density versus economic growth (GVA)



Appendix E presents the regressions run on each of the four sub-groups based on the historical administrative classification: former Bantustans, commercial farming areas, secondary cities and metros. This allows for some control over the country's unusual economic geography as a result of apartheid spatial engineering. Statistically significant results were obtained in the 'metros' and 'commercial farming' categories.

6.2.2.1. Metro results

The association between population growth and population density in the six metros is positive and statistically significant at the 10% level. This may be the result of higher natural growth rates in these areas, given their relatively young populations, and/or higher net migration to the metros because they seem to offer better employment opportunities and greater access to education and health amenities. Interpreting the coefficient of density as an elasticity, we find that, holding all else constant, a 1% increase in population density increases population growth by about 0.4%. Or a 10% increase in population density increases population growth by about 4%. Standard errors are in parentheses[2]. Note that there is no statistically significant relationship between any measure of density and economic growth in the metros.

Population growth = -1.2269 + 0.3653*(Log(Population density)), N=6, R^2=0.5726 (1)
(1.0937) (0.1578)

6.2.2.2. Commercial farming area results

For the 127 commercial farming areas, employment growth is positively related to all three density measures. These relationships are all statistically significant at the 1% level. Holding all else constant, increasing any one of the three measures of density by 1% increases employment growth by about 0.4%. Or increasing density in commercial farming areas by 10% increases the rate of employment growth by about 4%.

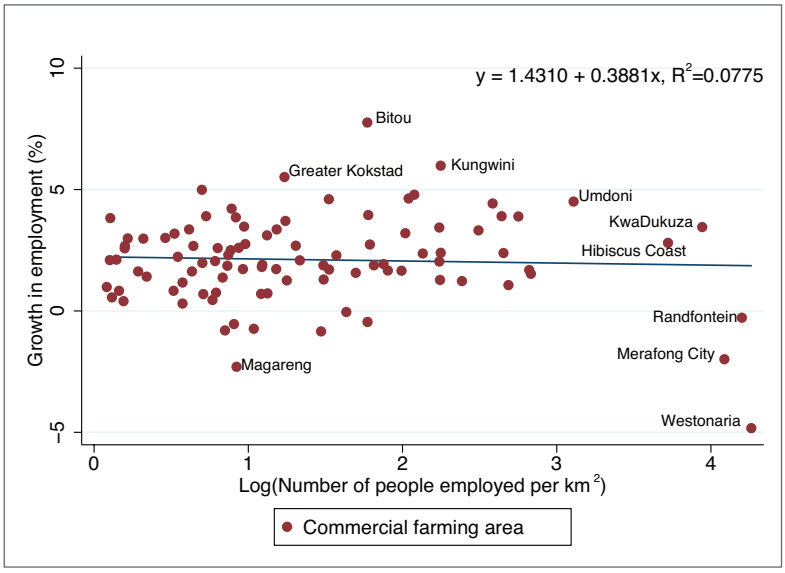
Employment growth = 0.9019 + 0.36*(Log(Population density)), N=83, R2=0.0645 (2)
(0.3325) (0.1227)

Employment growth = 1.4310 + 0.3881*(Log(Employment density)), N=83, R2=0.0775 (3)
(0.1921) (0.1198)

Employment growth = -2.7084 + 0.3676*(Log(GVA density)), N=83, R2=0.0769 (4)
(1.3652) (0.1118)

Graph 12 shows the relationship between employment growth and employment density for the commercial farming areas. The relationship is positive and statistically significant. Areas with higher concentrations of employment (towns) are growing faster than villages and dispersed rural areas. Several areas have experienced employment decline, including Randfontein, Merafong City and Westonaria. All three are located in Western Gauteng or on the West Rand. Gold mining is the main activity and the job losses in these areas may be attributable to mining contraction.

GRAPH 12: Employment density versus employment growth



6.2.2.3. Summary

This section considered the relationship between density and growth across the four historical categories of municipality. Statistically significant relationships were found between density and growth in the metros and commercial farming areas. The latter seems more important because all three measures of density were linked with subsequent employment growth.

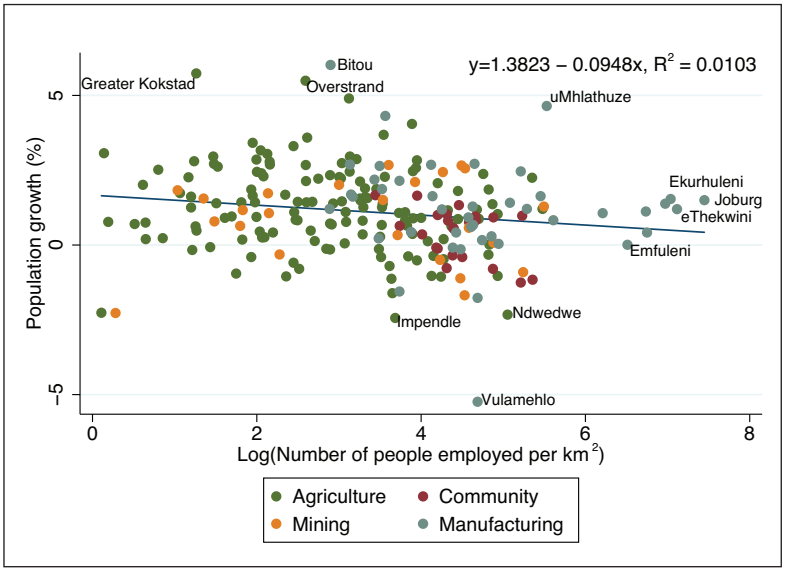
6.2.3. Local Economic Structure

This section disaggregates the municipalities by industrial structure to assess whether the relationship between density and growth is influenced by the composition of the local economy. Each municipality is categorised into one of four subgroups: agriculture, mining, manufacturing and community services.

Graph 13 shows the correlation between population density and subsequent population growth for all 237 municipalities. The graph distinguishes between agricultural areas (green dots), mining areas (red dots), community services (orange dots) and manufacturing areas (blue dots). As shown before, the municipalities with the highest density grew no faster than the areas with the lowest density.

Municipalities with the highest rate of population growth are Greater Kokstad (Kwazulu Natal), Bitou (Western Cape) and Overstrand (Western Cape). These are predominantly agricultural or manufacturing and well-connected tourism hubs. Greater Kokstad, for example, is located on the main transport arterial linking KZN 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. Vulamehlo, Impendle and Ndwedwe are three municipalities with declining populations. Impendle and Ndwendwe are administrative districts and Vulamehleo has very little formal economic activity.

GRAPH 13: Population density versus population growth



Appendix F presents the regression results when each of the sectors 'agriculture', 'mining', 'manufacturing' and 'community services' is treated separately. Statistically significant relationships between density and growth are only found in the community services sample. It is surprising that no relationship is found in manufacturing, where it would be most expected.

6.2.3.1. Community services

There were some contradictory relationships among the 23 community services municipalities.

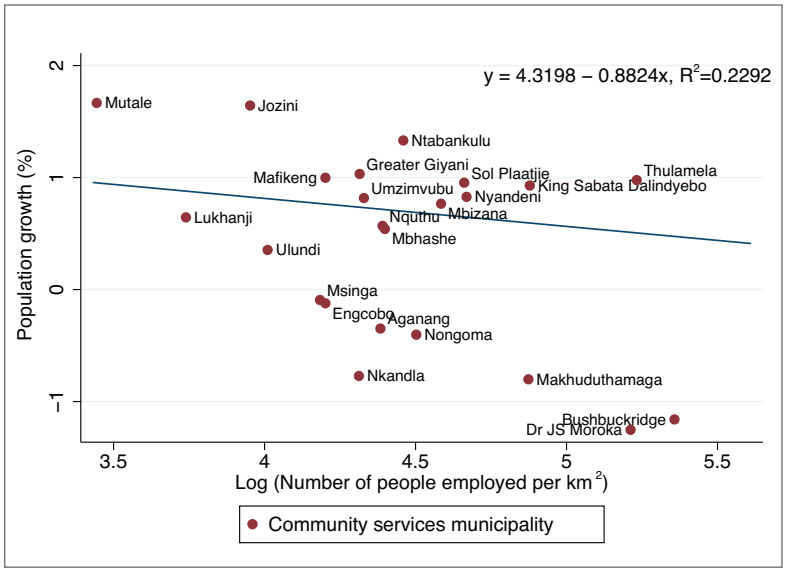
Population growth = 4.3198 - 0.8824 (Log(Population density)), N = 23, R2 = 0.2292 (5)
(1.5785) (0.3531)

GVA growth = 1.1451 + 0.4130 (Log(Employment density)), N = 23, R2 = 0.1378 (6)
(0.2254) (0.3706)

GVA growth = 3.3036 + 0.3917 (Log(GVA density)), N = 23, R2 = 0.1774 (7)
(2.3708) (1.840)

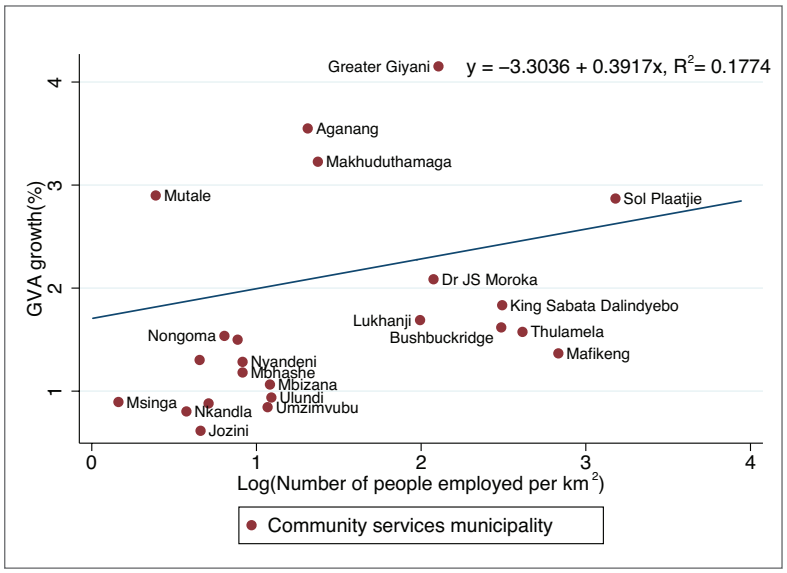
A negative relationship was apparent between population density and population growth (see also Graph 14). This is statistically significant at the 5% level. Increasing population density by 1% resulted in a decline in population of 0.88%. The population decline experienced by the densely populated municipalities may be attributable to the weak economy of these areas and the pressure on resources. This is possible bearing in mind that 22 of these 23 municipalities are rural, 18 are former Bantustans and four are commercial farming areas. People may have migrated out of these municipalities in search of better economic opportunities elsewhere.

GRAPH 14: Population density versus population growth



The relationship between employment density and GVA growth is positive and statistically significant at the 10% level. All else being equal, a 1% increase in employment density in 1996 saw a 0.4% increase in GVA growth subsequently. The relationship between GVA density and GVA growth is also positive and statistically significant at the 5% level. A 1% increase in GVA density in 1996 increased GVA growth subsequently by 0.4%. Graph 15 shows the relationship between employment density and GVA growth.

GRAPH 15: Employment density versus economic growth (GVA)



6.2.3.2. Summary

This section analysed the relationship between density and growth for municipalities grouped by economic structure: agriculture, mining, manufacturing, community services. Statistically significant relationships were only found in the community services category. The results suggest that community services municipalities with higher levels of economic output and employment to begin with experienced higher rates of growth subsequently. One explanation may be that places with higher economic densities offered larger consumer markets which attracted more private investment. Another explanation is regional centres of public services have continued to attract public investment because they are good locations for adminstering such services. A combination of both explanations is also possible.

6.2.4. Skills

The simple message of the preceding analysis is that the relationship between density and growth is weak or non-existent, and only appears in particular circumstances. This section examines the relationship between an area's skills and its subsequent growth, to see whether this relationship is stronger. Skills is measured by the proportion of people with matric.

The regressions of skills on growth are presented in the bottow rows of Appendices C, E and F. Across 10 of the 12 groups of municipalities and across all three measures of growth there is a positive relationship between skills and growth. The higher the share of people with matric in an areas, the stronger its growth rate. The only exceptions are in the 'urban' and 'metro' categories. This may have something to do with small sample sizes in these categories.

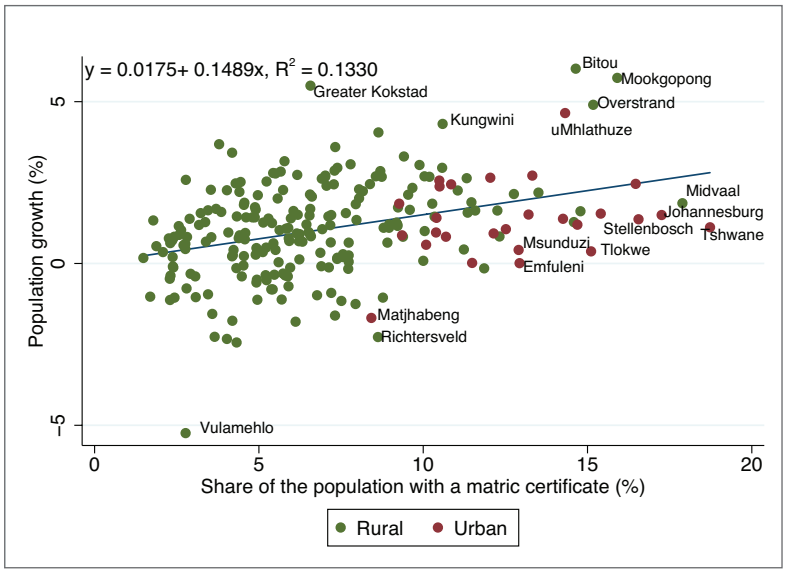
The results presented below are for all 237 municipalities. The positive relationship between skills in an area and its subsequent growth in population, employment and GVA are shown below. They are statistically significant at the 1% level.

Population growth	=	0.0175 + 0.1489(Skills share), N = 237, R^2 = 0.1330 (0.1967) (0.0248)	(8)
Employment growth	=	0.0312 + 0.1991(Skills share), N = 237, R^2 = 0.0563 (0.4216) (0.0531)	(9)
GVA growth	=	0.9778 + 0.1621 (Skills share), N = 237, R^2 = 0.1502 (0.1994) (0.0251)	(10)

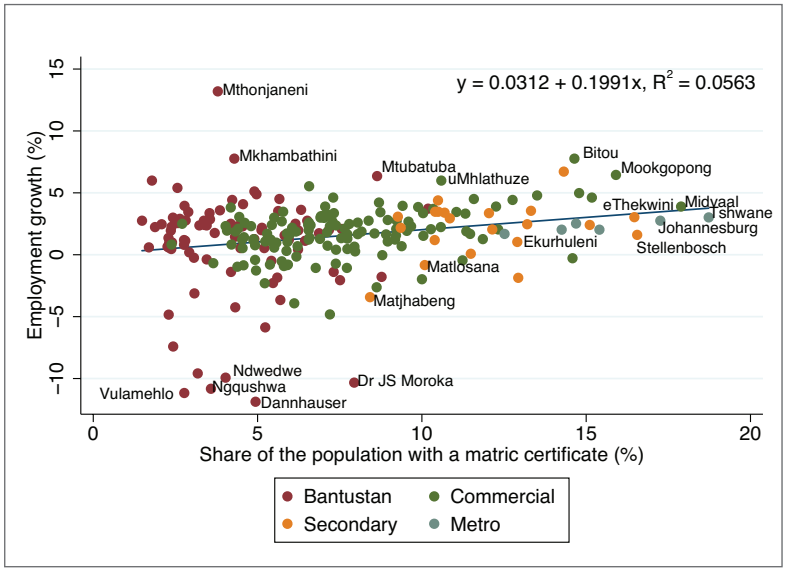
Holding all else constant, a 1% increase in a municipality's skills share is associated with a 0.15% increase in its population growth rate. Graph 16 shows the correlation between skills and population growth. Rural municipalities have green dots and urban municipalities red dots. Urban areas generally have more skilled people, although several rural areas are comparable, including Mookgopong (in Limpopo) and Bitou and Overstrand (both in the Western Cape).

An increase in skills share is also associated with faster employment growth. A 1% increase in the proportion of people with matric increases employment growth by 0.2%. The correlation between skills and employment growth is shown in Graph 17. The former Bantustans and some commercial farming areas have relatively low skill levels.

GRAPH 16: Employment density versus economic growth (GVA)



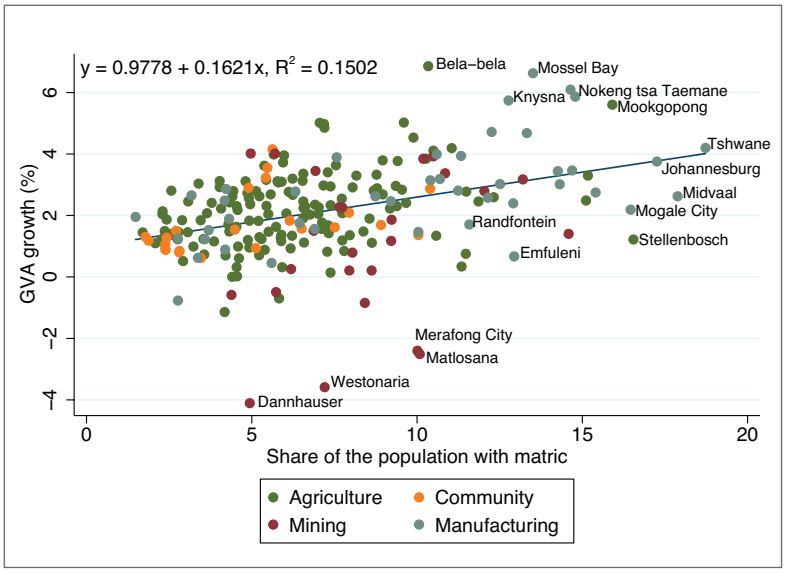
GRAPH 17: Skills share versus employment growth



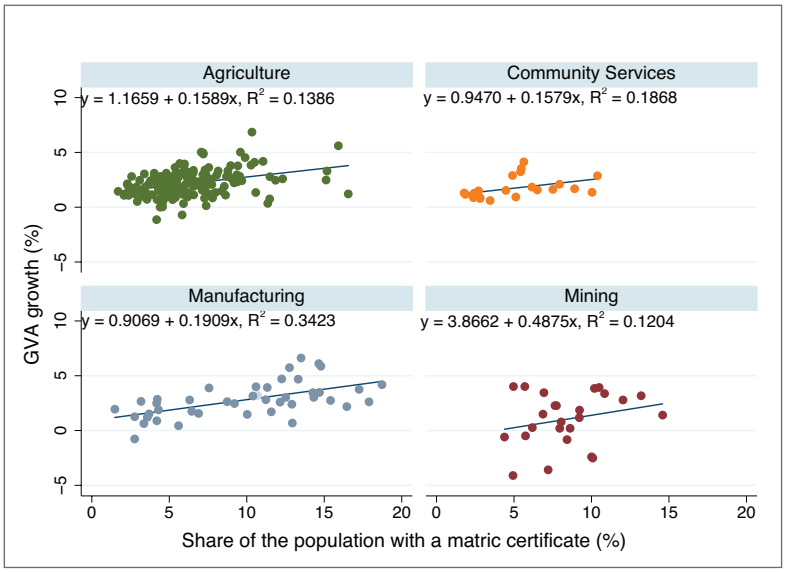
Higher skills also means faster GVA growth. Doubling the proportion of people with matric is associated with a 16% increase in GVA growth (Graph 18). Manufacturing municipalities tend to have higher skills and to have grown more strongly than other types of area.

Graph 19 shows the relationship between skills and GVA growth analysed separately by sectoral composition of the area. The association is positive for all types of area and statistically significant for all except mining. Increasing the share of people with matric has the strongest effect on manufacturing municipalities.

GRAPH 18: Share of the population with matric versus economic growth (GVA)



GRAPH 19: Skills share versus economic growth (GVA)



NOTE

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

SECTION 7

CONCLUSION

There is growing interest among governments around the world in the contribution of cities to local and national economic development. Researchers are also beginning to find evidence that larger and higher density settlements generate higher levels of productivity and growth. However, this relationship is best interpreted as a tendency rather than a universal law because the research suggests that there are sizeable differences in the nature and magnitude of this effect, depending on the context and the way in which density and growth are measured. It seems premature to argue that concentrated economic activity through urbanisation necessarily increases national economic growth.

This paper examines whether the density of population and economic activity influences the rate of local economic development in South Africa. Municipalities are the basic units of analysis and the time frame is 1996-2010. Contrary to expectations, no statistically significant relationship is found between density and development when the analysis covers all 237 local municipalities. There is no evidence that municipalities with higher densities of population or economic activity in 1996 grew any faster than municipalities with lower densities over the subsequent 15 year period.

Searching hard for a relationship we examined particular types of municipality on their own to isolate other factors. This resulted in some evidence of a relationship between density and growth emerging for a few select groups. Statistically significant relationships between density and economic growth are apparent for the commercial farming areas and for municipalities dominated by community services sectors. Once again, this is not what one would have expected. Previous research suggests that agglomeration effects should be most apparent in (large) urban areas and in areas with sizeable industrial sectors.

By way of a comparison, the paper also examines the influence of human skills on local economic growth. The relationship between skills and growth is found to be more robust than density. There are positive, statistically significant relationships across most groups of municipalities. When all 237 municipalities are considered, a 1% increase in the proportion of the population with matric is associated with a 0.2% increase in employment and GVA growth. It seems clear that skills is strongly linked with economic growth.

An important message from the analysis is that spatial proximity does not inevitably or automatically contribute to local economic growth. There is no necessary connection between the density of activity within an area and its rate of economic growth.

There are several possible reasons why the relationship between density and growth is weak or non-existent in South Africa. First, the legacy of the colonial and Apartheid spatial policies, including forced removals and restrictions on mobility, may have disrupted conditions by creating artificially high population densities

in the former Bantustans. Many of these areas are physically isolated, agriculturally infertile and economically unproductive. Second, the impact of racial segregation and residential restrictions within cities and towns may have resulted in more spatially fragmented and inefficient urban areas, thereby undermining their economic performance. Third, the equitable sharing of government tax revenues and fiscal transfers to compensate poorer districts may mask the impact of density and lift the performance of weak local economies. Fourth, there may be reliability problems with the dataset, bearing in mind its uncertain origins. The requirement that the local statistics are adjusted to add up to the national totals may also introduce some kind of systematic distortion. Against this, the discovery of a significant relationship between skills and growth provides some reassurance that the dataset should not be discounted.

Further research is required to evaluate the relevance of these factors and to assess whether there is an underlying relationship between density and growth once these influences have been discounted. The research could also be extended through multivariate regression. This would enable the various influences to be incorporated into the analysis simultaneously, thereby identifying their relative importance and the ways in which they interact. An additional refinement would be to incorporate the detailed industrial composition of each area without the simplification of creating four municipal categories of manufacturing, mining, agriculture and community services.

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APPENDICES

APPENDIX A

Population

Global Insight determines national population projections by five primary factors:

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

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

Global Insight 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 economic activity (i.e. the supply side). They do this because data from employers is 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 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

Where:

- EAP = Total Economically Active Population
- U = Number of people unemployed
- E = Number of people employed (formal + informal 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 sector 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

Categorisation of municipalities by their economic base

The overriding principle is that municipalities are classified according to their dominant tradable sector. We start off by identifying municipalities with more than 10% of their jobs in mining. In 1996, there were 34 municipalities with this characteristic (referred to below as group 1). To establish whether these are classified as mining or another sector, we compare their share of jobs in mining with their share of jobs in agriculture and in manufacturing. If the mining share exceeds the other sectors, these areas are classified as mining.

1. Of the 34 municipalities in group 1, eight have both
   - agricultural share of employment **less** than 10% and
   - manufacturing share of employment **less** than 10%.

   Therefore these municipalities 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. Of the remaining 26 municipalities from group 1, five have
   - Manufacturing share of employment **greater** than 10% and
   - Agricultural share of employment **less** than 10%.

   These municipalities are therefore classified as manufacturing or mining depending on which sector was larger. Four were classified as mining and one 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. Of the remaining 21 municipalities from group 1, 16 municipalities have
   - Agricultural share **greater** than 10% and
   - Manufacturing share of employment **less** than 10%

   These municipalities are therefore classified as mining or agriculture depending on which sector was larger. 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 five remaining municipalities in group 1 had both
   - Agricultural share of employment **greater** than 10% and
   - Manufacturing share of employment **greater** than 10%

   These municipalities are therefore classified as manufacturing, mining or agriculture depending on which sector was the largest. 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**

The 203 remaining municipalities all have less than 10% of employment in mining.

5. Group 2 consists of these municipalities with more than 10% of jobs in agriculture. Of these 157 municipalities, 100 have less than 10% of their jobs in manufacturing. So 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%
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%
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%, and
   - Manufacturing share of employment **greater** than 10%.

   These municipalities are therefore classified as agriculture or manufacturing depending on which sector was larger. Stellenbosch is categorised as agriculture.

Municipality	Sector	Agriculture	Mining	Manufacturing	Community
Bergrivier	Agriculture	54%	0%	11%	10%
Breede River/Winelands	Agriculture	51%	0%	13%	11%
Swellendam	Agriculture	47%	0%	10%	11%
uMshwathi	Agriculture	44%	1%	22%	11%
Mooi Mpofana	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%
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 consists of municipalities with more than 10% of their jobs in manufacturing. All of these 23 areas have less than 10% of their jobs in agriculture, so they 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%
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**

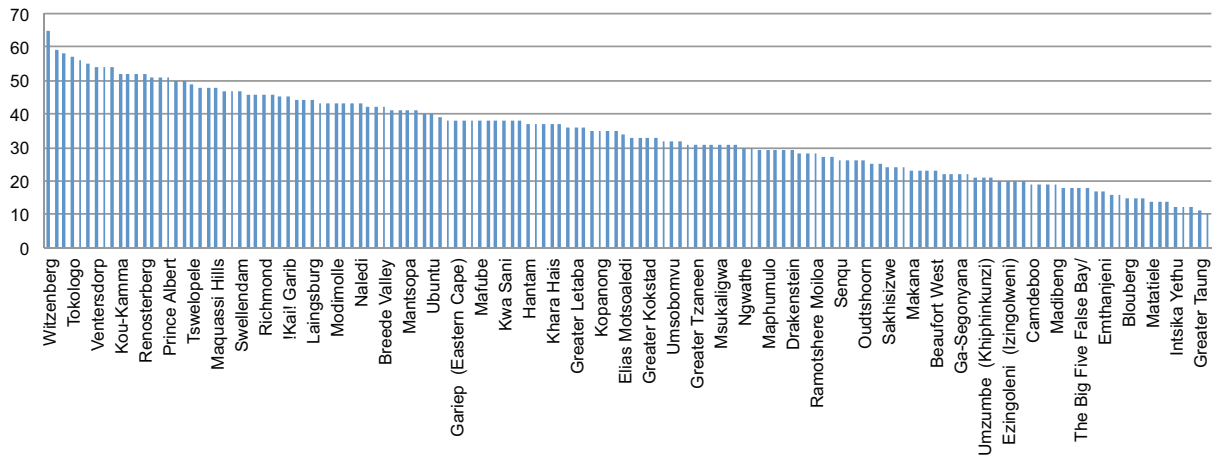
8. The 23 remaining municipalities have less than 10% of their jobs in agriculture, mining and manufacturing, and more than 10% of their jobs in community services, so they are classified in the latter category.

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%

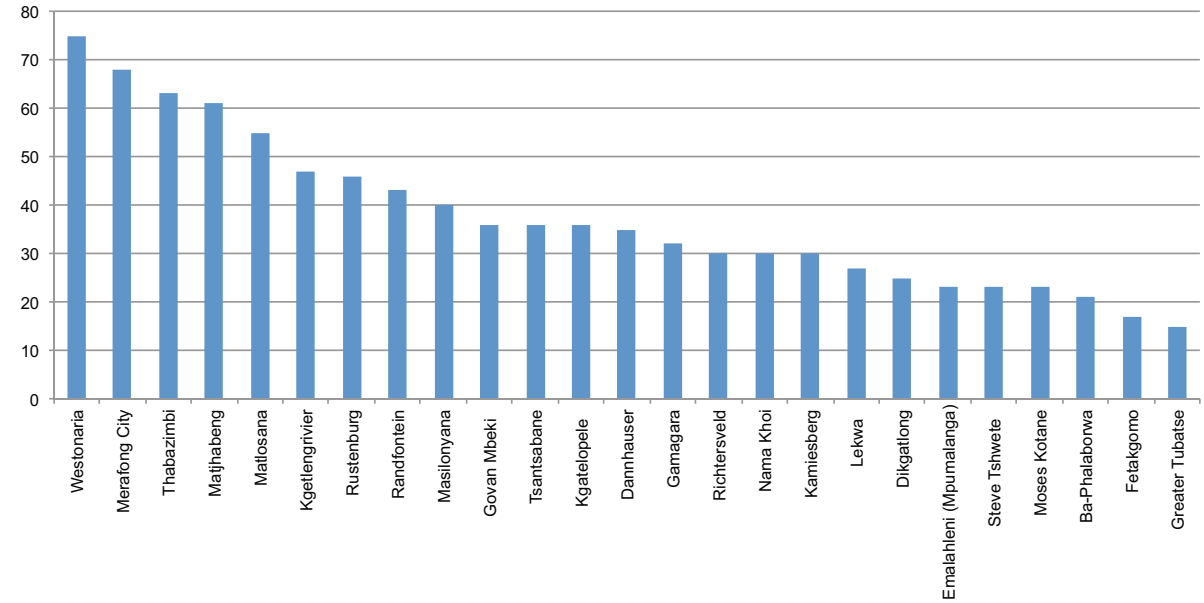
Nyandeni	Community	7%	0%	6%	43%
Jozini	Community	9%	1%	6%	40%
Engcobo	Community	5%	0%	5%	41%
Nkandla	Community	8%	0%	5%	57%
Ulundi	Community	4%	6%	4%	49%
Greater Giyani	Community	9%	1%	4%	39%
Mutale	Community	8%	4%	4%	47%
Nquthu	Community	9%	1%	4%	48%
Mbizana	Community	4%	1%	3%	39%
Msinga	Community	6%	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.

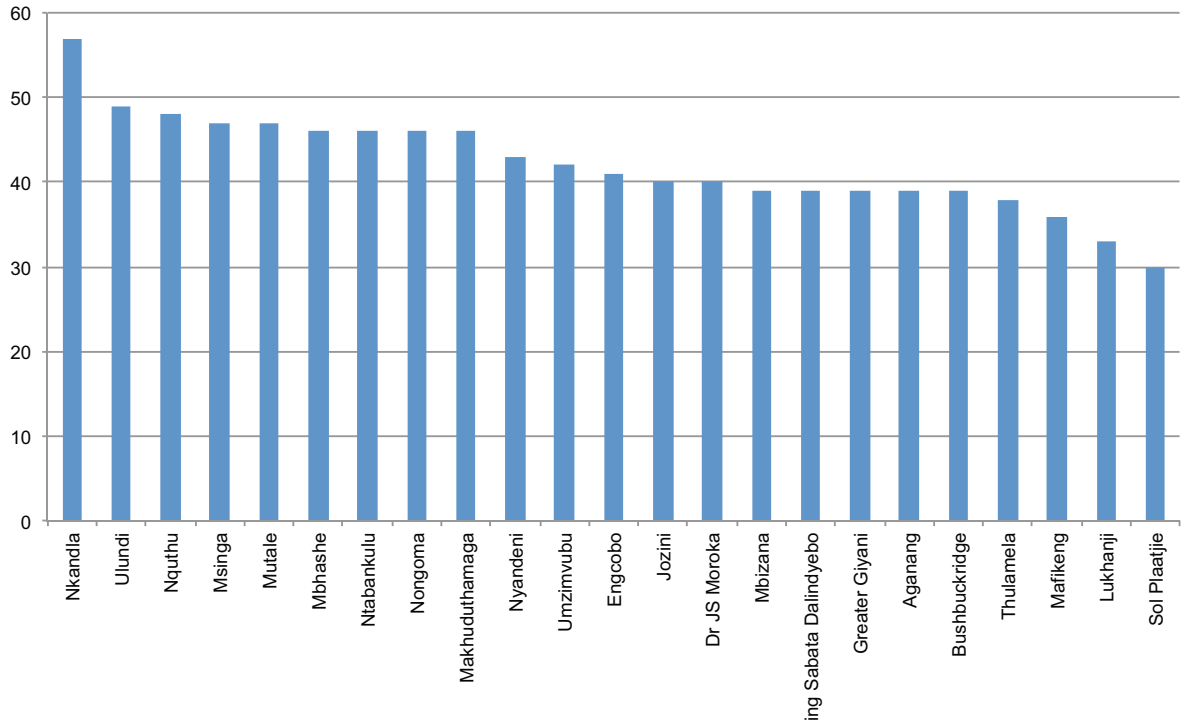
GRAPH B1: Share of employment in agriculture for 'agriculture' municipalities. N=146



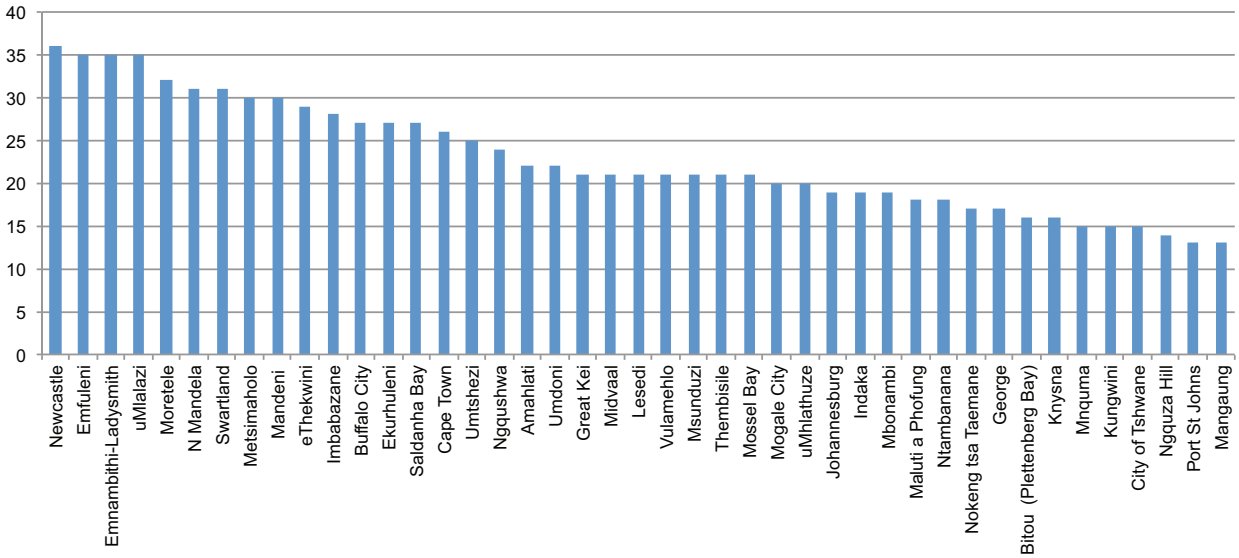
GRAPH B2: Share of employment in mining for mining municipalities. N=25



GRAPH B3: Share of employment in comunity services for “community services” municipalities. N=23



GRAPH B4: Share of employment in manufacturing for :manufacturing’ municipalities. N=43



APPENDIX C

	National N=237			Rural N=210			Urban N=27		
Dependent variable	**popgrowth**	**emptgrowth**	**Gvagrowth**	**popgrowth**	**emptgrowth**	**gvagrowth**	**Popgrowth**	**emptgrowth**	**gvagrowth**
log (popdensity)	-0.0948	0.0118	0.0024	-0.1701	-0.0856	-0.0892	-0.0593	-0.0404	0.2334
	(0.0608)	(0.1255)	(0.0626)	(0.0722)	(0.1519)	(0.0725)	(0.2118)	(0.3559)	(0.2699)
Constant	1.3823	1.3994	2.1155	1.5461	1.6050	2.3276	1.6896	2.3720	1.3960
	(0.2214)	(0.4573)	(0.2279)	(0.2413)	(0.5079)	(0.2426)	(1.5029)	(1.9325)	(1.4659)
R^2	0.0103	0.0000	0.0000	0.0260	0.0015	0.0072	0.0031	0.0005	0.0290
log(emptdensity)	0.0799	0.1548	0.1039	0.7329	0.1031	0.0347	-0.0837	-0.1073	0.1776
	(0.0621)	(0.1276)	(0.0634)	(0.0849)	(0.1766)	(0.0846)	(0.2078)	(0.3492)	(0.2669)
Constant	0.9604	-0.0298	1.9806	0.9554	1.2393	2.0215	1.7104	2.5879	1.9239
	(0.1280)	(1.4889)	0.1309	(0.1359)	(0.2829)	(0.1356)	(0.8661)	(1.4551)	(1.1122)
R^2	0.0070	0.0042	0.0113	0.0036	0.0016	0.0008	0.0064	0.0038	0.0174
log(gvadensity)	0.0714	0.1150	0.0881	0.0536	0.0305	0.0136	0.0262	0.0497	0.2454
	(0.0562)	(0.1156)	(0.0574)	(0.0774)	(0.1610)	(0.0771)	(0.2063)	(0.3461)	(0.2619)
Constant	0.1589	-0.0298	0.9993	0.3674	0.9676	1.8890	0.9609	1.3731	-1.2266
	(0.7236)	(1.4888)	(0.7400)	(0.9637)	(2.0054)	(0.9606)	(3.2579)	(5.4659)	(4.1364)
R^2	0.0068	0.0042	0.0099	0.0023	0.0002	0.0001	0.0006	0.0008	0.0339
Share_matric	0.1489***	0.1991***	0.1621***	0.2032***	0.2375***	0.1993***	0.0959	0.1862	0.1576
	(0.0248)	(0.0531)	(0.0251)	(0.0315)	(0.0699)	(0.0315)	(0.0854)	(0.1421)	(0.1086)
Constant	0.0175	0.0312	0.9778	-0.2575	-0.1601	0.7940	0.1536	-0.2137	0.6299
	(0.1967)	(0.4216)	(0.1994)	(0.2216)	(0.4909)	(0.2213)	(1.1110)	(1.8482)	(1.4120)
R^2	0.1330	0.0563	0.1502	0.1661	0.0525	0.1611	0.0479	0.0642	0.0778

Notes: Bivariate regression takes the form y= b1x + u. Popgrowth, emptgrowth and GVAgrowth are calculated using the equation growth= (ln (Xi10 /Xi96)/15)*100 Log(popdensity) = Log(Number of people per km2) Log(emptdensity)= Log(Number of people employed per km2), Log(GVAdensity)= Log(Rand value of economic output per km2) Share_matric= Proportion of the population with matric
Level of significance *** =1%, **= 5%, *= 10%

APPENDIX D

	Built up area N=27		
Dependent variable	**Popgrowth**	**Empt growth**	**GVA growth**
log(popdensity)	-0.4850	-1.8719	-0.7234
	(0.9425)	(1.5449)	(1.2148)
Constant	5.5485	18.2696	8.8643
	(8.1158)	(13.3039)	(10.4612)
R^2	0.0105	0.0555	0.014
log(emptdensity)	0.4657	0.0323	0.4130
	(0.6725)	(1.1390)	(0.8727)
Constant	-1.9518	1.9260	-0.3122
	(4.8081)	(8.1441)	(6.2400)
R^2	0.0188	0	0.0089

Notes: Bivariate regression takes the form y= b1x + u. Popgrowth, emptgrowth and GVAgrowth are calculated using the equation growth= (ln (*Xi10 /Xi*96)*/15)*100* Log(popdensity) = Log(Number of people per km^2) Log(emptdensity)= Log(Number of people employed per km^2),

Level of significance *** =1%, **= 5%, *= 10%

APPENDIX E

	Metro N=6			Secondary N=21			Commercial N=83			Former bantustan N=127		
	Popgrowth	emptgrowth	gvagrowth	Popgrowth	emptgrowth	gvagrowth	popgrowth	emptgrowth	gvagrowth	popgrowth	emptgrowth	gvagrowth
log (popdensity)	0.3653*	0.6204	0.2822	-0.1159	0.3493	-0.2385	0.1405	0.36*	0.0043	-0.3544	-0.828	0.0836
	(0.1578)	(0.5194)	(0.6002)	(0.4065)	(0.6760)	(0.4963)	(0.0923)	(0.1227)	(0.1057)	(0.2201)	(0.6778)	(0.1988)
Constant	-1.2269	-1.9639	1.4874	1.9586	3.8064	3.5687	1.1169	0.9019	2.2400	1.8388	4.1038	1.4228
	(1.0937)	(3.5989)	(4.1594)	1.9996)	(3.3252)	(2.4413)	(0.2501)	(0.3325)	(0.2864)	(0.9088)	(2.7986)	(0.8206)
R^2	0.5726	0.2629	0.0523	0.0043	0.0139	0.0120	0.0182	0.0645	0.0000	0.0310	0.0181	0.0022
log(emptdensity)	0.228	0.5161	0.3556	-0.2793	-0.8527	-0.6874	0.2295	0.3881*	0.0580	-0.0534	-0.6055	0.194
	(0.1122)	(0.3066)	(0.3678)	(0.4789)	(0.7832)	(0.5708)	(0.0893)	(0.1198)	(0.1038)	(0.1909)	(0.5806)	(0.1686)
Constant	-0.0087	-0.0636	1.3969	2.3792	5.1133	4.8313	1.2598	1.4310	2.2029	0.4699	1.5679	1.4956
	(0.6476)	(1.7702)	(2.1231)	(1.7136)	(2.8029)	2.0426)	(0.1431)	(0.1921)	(0.1664)	(0.3054)	(0.9285)	(0.2697)
R^2	0.5081	0.4146	0.1895	0.0176	0.0587	0.0709	0.0502	0.0775	0.0025	0.0010	0.0133	0.0161
log(gvadensity)	0.2383	0.6168	0.4531	0.1974	-0.2003	-0.4345	0.2139	0.3676*	0.0253	-0.0515	-0.7306	0.186
	(0.1453)	(0.3559)	(0.4232)	(0.4877)	(0.8171)	(0.5920)	(0.0834)	(0.1118)	(0.0971)	(0.1604)	(0.4842)	(0.1413)
Constant	-2.8765	-8.4831	-4.5024	-1.6133	5.1607	9.0311	-1.1451	-2.7084	1.9438	1.0542	10.0735	-0.6153
	(2.5487)	(6.2417)	(7.4215)	(7.4388)	(12.4642)	(9.0300)	(1.0185)	(1.3652)	(1.1851)	(2.0562)	(6.2076)	(1.8116)
R^2	0.4020	0.4288	0.2227	0.0085	0.0032	0.0276	0.0499	0.0796	0.0005	0.0013	0.0273	0.0210
share_matric	0.0174	0.2082*	0.1737*	0.1823	0.2495	0.0790	0.1795	0.2841***	0.2226***	0.0749	-0.0533	0.2263***
	(0.0445)	(0.0457)	(0.0767)	(0.1273)	(0.2164)	(0.1632)	(0.4136)	(0.0548)	(0.0462)	(0.0829)	(0.2550)	(6.9829)
Constant	0.0103	-0.8936	0.7522	-0.7840	-0.8747	1.4639	0.0680	-0.4357	0.5406	0.0747	0.9627	0.7914
	(0.0069)	(0.7143)	(1.9198)	(1.5474)	(2.6312)	(1.9842)	(0.3389)	(0.4491)	(0.3787)	(0.3883)	(1.1934)	(0.3267)
R^2	0.0371	0.8380	0.5612	0.0975	0.0654	0.0122	0.1309	0.1769	0.1565	0.0100	0.0005	0.1148

Notes: Bivariate regression takes the form y= b1x + u. Popgrowth, emptgrowth and GVAgrowth are calculated using the equation growth= (ln (Xi10 /Xi96)/15)*100 Log(popdensity) = Log(Number of people per km2) Log(emptdensity)= Log(Number of people employed per km2), Log(GVAdensity)= Log(Rand value of economic output per km2) Share_matric= Proportion of the population with matric

Level of significance *** =1%, **= 5%, *= 10%

APPENDIX F

	Manufacturing N=43			Agriculture N=146			Mining N=25			Community Services N=23		
	popgrowth	emptgrowth	gvagrowth	popgrowth	emptgrowth	gvagrowth	popgrowth	emptgrowth	gvagrowth	popgrowth	emptgrowth	Gvagrowth
log (popdensity)	-0.2324	-0.1574	-0.1793	-0.0609	0.1588	-0.0418	-0.0065	-0.0065	-0.1128	-0.8824*	-3.3279	0.1860
	(0.2157)	(0.4930)	(0.1955)	(0.0874)	(.15122)	(0.0737)	(0.1792)	(0.1792)	(0.3129)	(0.3531)	(1.2996)	(0.4541)
Constant	2.2952	2.5357	3.6451	1.3993	1.1323	2.2866	0.8901	0.8901	1.3959	4.3198	16.0906	0.8989
	(1.0565)	(2.4149)	(0.9577)	(0.2653)	(0.4587)	(0.2236)	(0.6308)	(0.6308)	(1.1015)	(1.5785)	(5.8100)	(2.0300)
R^2	0.0275	0.0025	0.0201	0.0034	0.0076	0.0022	0.0001	0.0001	0.0056	0.2292	0.2379	0.0079
log(emptdensity)	0.0727	0.2469	0.1124	0.1512	0.3506	0.1029	0.0639	-0.0978	-0.21282	-0.0046	-0.9516	0.4130*
	(0.1818	(0.4093)	(0.1635)	(0.0944)	(0.1624)	(0.0797)	(0.1695)	(0.4490)	(0.2945)	(0.2141)	(0.7651)	(0.2254)
Constant	0.9809	1.0680	2.4670	1.0453	1.2614	2.0856	0.7593	0.4218	1.4073	0.4021	2.6291	1.1451
	(0.5954)	(1.3404)	(0.5356)	(0.1444)	(0.2485)	(0.1220)	(0.4054)	(1.0733)	(0.7041)	(0.3521	(1.2578)	(0.3706)
R^2	0.0039	0.0088	0.0114	0.0175	0.0313	0.0114	0.0061	0.0021	0.0222	0.0000	0.0686	0.1378
log(gvadensity)	0.04320	0.1232	0.1146	0.14634	0.3090	0.0637	0.1656	0.1374	-0.03156	0.0476	-0.6532	0.3917*
	(0.1693)	(0.3820)	(0.1520)	(0.0885)	(0.1527)	(0.0751)	(0.1761)	(0.4733)	(0.3142)	(0.1787)	(0.6471)	(0.1840)
Constant	0.5648	-0.0041	1.1282	-0.5934	-0.0220	1.4033	-1.3833	-1.6160	1.4696	-0.2160	9.6773	-3.3036
	(2.4787)	(5.5913)	(2.2249)	(1.0763)	(-2.1732)	(0.9131)	(2.4108)	(6.4793)	(4.3010)	(2.3021)	(8.3361)	(2.3708)
R^2	0.0016	0.0025	0.0137	0.1006	0.0277	0.0050	0.0371	0.0037	0.0004	0.0034	0.0463	0.1774
share_matric	0.1893***	0.3970***	0.1909***	0.1790***	0.1790***	0.1589**	0.1894*	0.4875*	0.2268	-0.2601	-0.4434	0.1579**
	(0.0480)	(0.1112)	(0.0413)	(0.0395)	(0.0716)	(0.0330)	(0.1036)	(0.2748)	(0.1883)	(0.0701)	(0.2417)	(0.0719)
Constant	-0.6784	-2.1371	0.9069	0.0398	0.4267	1.1659	-0.7311	-3.8662	-0.8766	0.5239	3.4780	0.9470
	(0.5281)	(1.2221)	(0.4540)	(0.2748)	(0.4984)	(0.2297)	(0.9143)	(2.4246)	(1.6617)	(0.3906)	(1.3468)	(0.4006)
R^2	0.2742	0.2369	0.3423	0.1247	0.0415	0.1386	0.1269	0.1204	0.0594	0.0065	0.1381	0.1868

Notes: Bivariate regression takes the form y= b1x + u. Popgrowth, emptgrowth and GVAgrowth are calculated using the equation growth= (ln (Xi10 /Xi96)/15)*100 Log(popdensity) = Log(Number of people per km2) Log(emptdensity)= Log(Number of people employed per km2), Log(GVAdensity)= Log(Rand value of economic output per km2) Share_matric= Proportion of the population with matric
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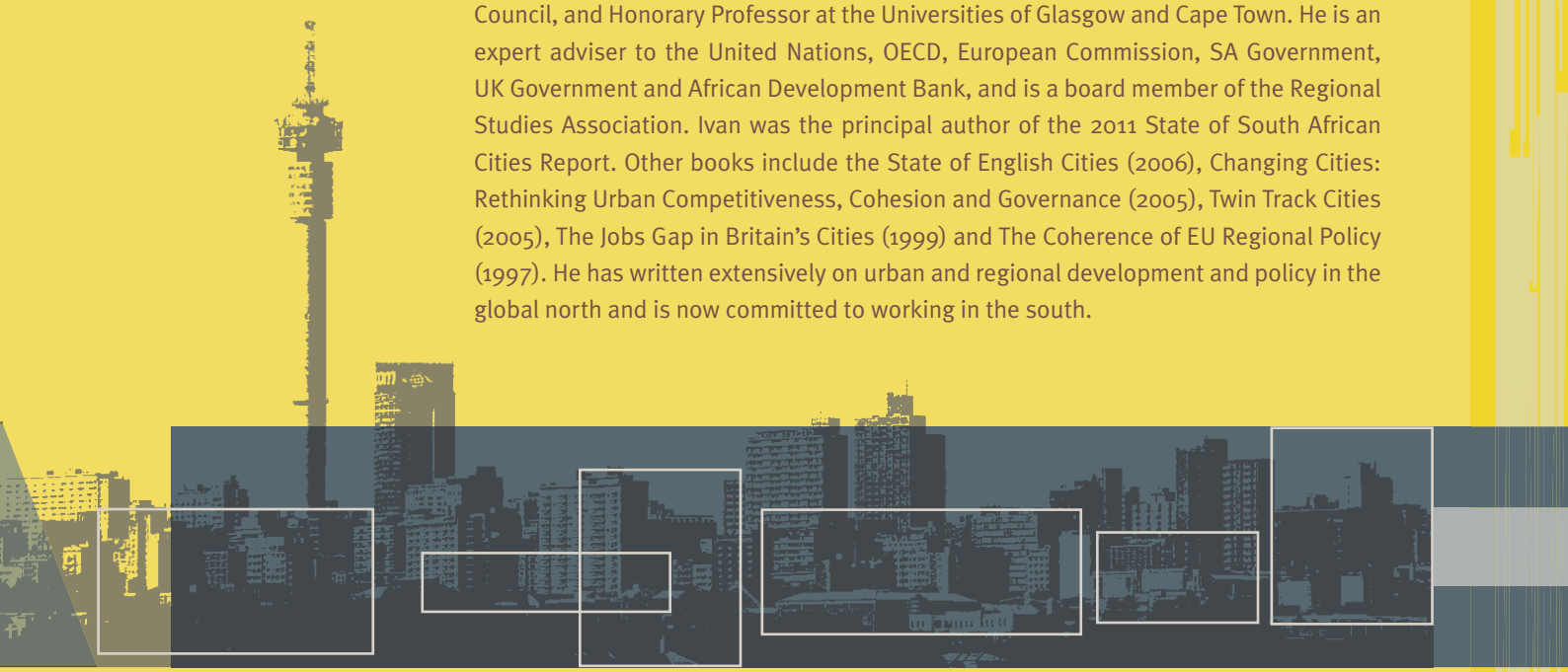

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