# CONVERGENCE OR DIVERGENCE OF SOUTH AFRICAN CITIES AND TOWNS?

by

E.M. Bosker[1] & W.F. Krugell[2]

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## ABSTRACT

A particular characteristic of economic activity across South Africa is its spatial lumpiness, but recent economic growth may mask significant differences in relative economic performance across cities and towns. Recent work examined the determinants of economic growth at sub-national level in South Africa, looking at cross-locality growth rate differentials between 354 magisterial districts over the period 1998 to 2002. Earlier results obtained using a dynamic panel data regression model suggested slow beta convergence (Naudé & Krugell, 2003). To the contrary, an exploratory distribution dynamics approach indicated that divergence occurred (Krugell, Koekemoer & Allison, 2005). This paper builds on the previous work by using a Markov chain process to describe the evolution of the entire cross-section income distribution in terms its intra-distributional characteristics. As a first in the case of South Africa, there are also controls for spatial interdependence between magisterial districts. The results indicate a heavily diverging income distribution with increasing polarization. Conditioning for space results in a distribution that is less skewed to the left, but a small number of regions still earn much more than their neighbours. Also, the richer a region is compared to its neighbours, the greater is the probability for it to move up in the South Africa-relative income distribution.

**Key words:** growth, convergence, agglomeration, Markov chains, spatial econometrics, South Africa

**JEL Classification numbers:** C21, o38, O49, O53

[1] Utrecht School of Economics, Vredenburg 138, 3511 BG Utrecht, m.bosker@econ.uu.nl

[2] School of Economics, Risk-Management & International Trade, North-West University, South Africa, eknwfk@puk.ac.za

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## 1. Introduction

The South African economy has been growing steadily since 1994 and by the end of last year experienced 24 quarters of uninterrupted expansion. At times in 2005 the real growth rate accelerated to an annualized rate of 5 per cent. A particular characteristic of economic activity across South Africa is however its spatial lumpiness. In 2004 only 48 magisterial districts out of 354 (or 13 per cent) produced approximately 50 per cent of output, 71 places produced 60 per cent of the country's output and the top 100 places produced 70 per cent of GDP. Thus, the robust growth of the national economy masks significant differences in relative economic performance across cities and towns. Over the period 1996 to 2004 only 53 magisterial districts grew at rates faster than the national average of 2,9 per cent. Of those, only eight places (towns such as Rustenburg, Randburg and George) recorded growth in per capita GDP in excess of 5 per cent per annum. At the same time, 81 places grew by less than one per cent per annum and in 78 places GDP per capita fell. This is significant for the decentralisation of economic decision making that has taken place since democratisation in 1994. A recent report by the Centre for Development and Enterprise shows that "middle SA" is characterised by slow, jobless economic growth, little external or local investment and emigration or internal migration of the young and educated (Bernstein & Johnston, 2005). Most of the country's municipalities have struggled to cope with their constitutional responsibility of the development of their areas, as was clearly marked by protests against poor service delivery in the run up to recent local elections.

A first step to addressing the challenges of low growth, poverty and inequality in the communities where they occur would be to examine spatial economic growth patterns and to determine which are the fast growing places, which the slow growers, what are their characteristics and whether the poorer places are catching up or falling behind.

Recent work has examined the determinants of economic growth at sub-national level in South Africa, looking at cross-locality growth rate differentials between 354 magisterial districts over the period 1998 to 2002. Earlier results obtained using a dynamic panel data regression model suggested slow beta convergence (Naudé & Krugell, 2003). To the contrary, an exploratory distribution dynamics approach indicated that divergence occurred (Krugell, Koekemoer & Allison, 2005).

This paper builds on the previous work by using a Markov chain process to describe the evolution of the entire cross-section income distribution in terms its intra-distributional characteristics. As a first in the case of South Africa, there are also controls for spatial interdependence between magisterial districts.

The paper is structured as follows. Section 2 presents a brief history of the South African spatial economy, highlighting the role which trade and natural resources played in the initial location of economic activity and showing how that was later reinforced by policy. Section 3 paints the current picture of unequal growth by describing the characteristics of the 25 fastest and slowest growing magisterial districts. The empirical analysis of the cross-section income distribution is presented in section 4. Section 5 concludes.

## 2. The South African spatial economy

To understand the spatial patterns of economic growth in South Africa one first has to explain the unequal distribution of economic activity and how this has been shaped by geography and policy.

### 2.1 A brief history of spatial inequality

An explanation of the unequal distribution of economic activity in South Africa is an explanation of the development of the country's six large cities, namely Johannesburg, the East Rand (Ekurhuleni metropolitan government) Durban, Cape Town, Pretoria (Tshwane metropolitan government) and Port Elizabeth (Nelson Mandela metropolitan government). Their role in the economy and the consequent spatial inequality can be explained by looking at trade, extraction, climate and culture, along with Apartheid's social engineering.

Cape Town and Durban were first developed in the 17th and 18th centuries as trading posts on the shipping route between Western Europe and Asia. During the 19th century this role changed with the discovery of diamonds and gold in the interior. The port cities developed from being stop-over and service points providing shipping services, to being ports through which commodities were handled. Today this dominance continues due to the importance of sea transport for South Africa's international trade. Approximately 98 per cent of the volumes of South Africa's exports are conveyed by sea.

The mineral wealth determined the location and growth of the other two dominant cities, Johannesburg and Pretoria. The location of minerals as well as the extraction technology required in mining then influenced the pattern of South Africa's inland development. Where railways and electric power were provided for mining, they also contributed to the development of the manufacturing sector. Suleman and Naudé (2003) shows that today, basic metals and fabricated metal products are concentrated in the historic mining areas of the Gauteng Province around Johannesburg and Pretoria. Chemical industries are found in the KwaZulu-Natal Province, around Durban, where the majority of the country's crude oil imports are obtained. Food processing and textiles are concentrated in the Western Cape Province around Cape Town.

The unequal development determined by trade and extraction was reinforced by climate and culture. Recently Acemoglu *et al*. (2001:1370) argued that: *"Colonies where Europeans faced higher mortality rates are today substantially poorer than colonies that were healthy for Europeans….settler colonies had representative institutions which promoted what the settlers wanted and what they wanted was freedom and the ability to get rich by engaging in trade"*.

Following this argument, the location of South Africa's southern ports and the Mediterranean climate around Cape Town translated into better subsequent economic performance. The persistence of British institutions (Westminster-style democracy, property rights and education system) in South Africa had a further favourable impact on settler mortality. These effects persist and provide explanation for the sizes and functions of the major cities and the associated spatial inequality whereby a few places dominate the economic landscape and most places produce very little.

In the 20th century, Apartheid aimed to change the historical regional development patterns induced by the mineral-energy complex of the 19th century.

The homelands policy restricted black communities to their traditional tribal areas and aimed to limit migration to the cities. To this end incentives were provided for industrial development and job creation in far flung rural areas. In related policy the Group Areas Act restricted the settlement and movement of black people in urban areas. This left them in informal settlements on the periphery of cities and towns.

The historical dominance of the six large cities, however, remained largely unaltered. In 1991 Rogerson (1991:364) remarked that: *"the new industrial geographies of post-Apartheid South Africa appear set to be dominated by a re-focusing of manufacturing activity around the large metropolitan centres, (and) the demise of the industrial base of several favoured decentralised growth points"*.

Support of inefficient industries in the homelands and the segregation of cities have however created a spatial economy characterised by inefficient land use, excessive transport costs, and under-investment in transport infrastructure, telecommunications and electric power. It also resulted in segmented labour and consumption markets and created artificial internal barriers to trade (Krugell & Naudé, 2005).

These costs of Apartheid's policies have even influenced the strength of the traditional core areas of economic activity. Nel (2002:86) cites the closure of textile firms in Cape Town, and the Witwatersrand area of Gauteng that is experiencing a contraction of its manufacturing economy as examples that all is not well. Nel (2002) also identified a number of factors that have influenced the location of economic activity since democratisation in 1994 (p.87-88):

- Trade liberalisation has benefited industries and locations that have expanded to new markets, such as the motor industry in the Eastern Cape, but it has harmed sectors and locations that have struggled to cope with international competition, such as textile manufacturers in the Western Cape.
- Foreign direct investment, in sectors such as IT and telecommunications, energy and oil, food and vehicles, as well as a shift towards serviced-based and knowledge-intensive activities has benefited the large cities where these activities are located.
- Finally, new growth areas such as Midrand, the development corridors and special Industrial Development Zones all impact on the location of economic activity.

The spatial aspects of government policies since 1994 that are mentioned last are of particular significance to future developments. These can be discussed in two parts: the spatial characteristics of industrial policy and the local government transition process.

## 2.2 The policies since 1994

In 1994 the new government started out with an 'aspatial' industrial policy. For example, in 1997 a tax holiday scheme was introduced to encourage industrial development throughout the country. In recent years, however, thinking has swung back to spatially focused policies in the form of Spatial Development Initiatives (SDI) and Industrial Development Zones (IDZ) (Nel, 2002:90).

With the SDIs, government seeks to encourage investment, manufacturing and other economic activities along a series of defined transport corridors. Here, bottlenecks to investment, such as inadequate infrastructure, are to be removed and strategic opportunities for private sector investment identified. The IDZs are industrial

zones with a defined export focus and are all planned to be sited at major ports and airports.

With both these initiatives, development has however been slow and it does not yet appear that the initiatives have brought about dramatic economic transformation in their areas. Along with the spatial focus of industrial policy, the South African space economy has recently also been shaped by the local government transition process.

In 1994 the newly elected democratic government inherited a system of local government made up of 843 municipalities, many of which were financially unsustainable. According to surveys in 2000, about 100 municipalities in South Africa were unable to pay or service their debts to banks, while another 100 were in some form of financial distress. Then, in terms of the Demarcation Act (1997), the Demarcation Board, was mandated to demarcate South Africa's local governments' areas of jurisdiction. In deciding on the boundaries for new municipalities the following factors were considered:

- The interdependence of people, communities and economics such as employment, public transport, human settlement, migration patterns and access to services and recreational facilities
- The relationship to districts, voting areas, health, police, population, existing or expected land use, type of land in the area and environmental implications.

The result was that the number of municipalities was reduced to 284[3] from 5 December 2000. The demarcation process, together with the organizational restructuring due to the Municipal Structures Act, and the way in which municipalities function in terms of the Municipal Systems Act, has revolutionised local government in South Africa – they have become the primary institutional vehicle for economic development in South Africa.

Most of the country's municipalities have however struggled to cope with their constitutional responsibility of the development of their areas, as was clearly marked by protests against poor service delivery in the run up to recent local elections.

In conclusion, this brief historical overview shows the complexity of the location of economic activity in South Africa in terms of history and institutions. The next section describes the recent patterns of growth of the spatial economy.

## 3. Space and growth

The previous section described a spatial economy characterised by inequality. The details of this become evident in analysis of the data currently available for cities and towns in South Africa. In section the focus is on sub-national growth experiences over the period 1996 to 2004. The data paint a picture of economic growth that is much more varied than that presented by the national aggregates.

This data on sub-national economies comes from a system of integrated databases known as the Regional Economic Focus (REF). The REF database is compiled by Global Insight Southern Africa and draws together many different sources of sub-national economic information from Statistics South Africa,

[3] Spatially, 237 municipalities constitute so-called wall-to-wall local government in South Africa. These are 231 local municipalities of various sizes but with less than a million inhabitants, and the six metropolitan municipalities, all with more than a million people. There are also 47 District Municipality areas, but they coincide with the local municipalities and can perhaps be seen as a higher level of local government.

government departments, development agencies and Regional Services Councils. This information is however not available at the level of the municipalities described in the previous section. Rather, the data are presented at the lower level of magisterial district of which there are 354. The magisterial districts also cover the whole of the country and as such define the location of cities or towns. The following sections describe economic growth from the sub-national perspective, focusing on the characteristics of the fastest and slowest growing cities and towns.

### 3.1 The fastest growing places

Over the period 1996 to 2004 only 53 magisterial districts grew at rates faster than the national average of 2,9 per cent. Of those, only eight places recorded growth in per capita GDP in excess of 5 per cent per annum. The characteristics of the 25 fastest growing magisterial districts in South Africa over the period 1996 to 2004 are summarised in Table 1 in the appendix. This presents a diverse profile.

A number of the fast growing places form part of the large metropolitan areas. Pretoria is part of the greater Tswane metropolitan area, Randburg is adjacent to the greater Johannesburg, Pinetown is adjacent to Durban and Boksburg, Kempton Park, Alberton and Nigel are all in the East Rand, or Ekurhuleni metropolitan area. These places have large populations that are almost completely urbanised. They are also characterised by high literacy rates and a large share of value added that is exported. Lower Umfolozi may also be regarded as part this group, being close to Durban, but the population is more rural and not as well educated.

Three of the other fast growers are further from the large hubs, but have benefited from growth of specific industries. The economies of Rustenburg and Phalaborwa are dominated by mining – platinum and phosphates respectively. Though not strictly involved in the extraction of minerals, Sasolburg also falls into this category as the heart of the South African petrochemical industry.

Then there are the smaller places where the economies have grown fast, particularly those in the Western Cape. This group includes George, Knysna, Mosselbay, Wellington, Tulbach and Montague. These places typically have smaller populations and lower population growth rates, slightly lower literacy rates and they tend to export less (with Montague and Wellington being exceptions on the last point). A closer look at a sectoral breakdown of gross value added (GVA) shows that these towns have experienced particular growth in construction, retail trade, and services sectors such as post and telecommunication, finance and insurance and real estate activities. Along the west coast, Vredenburg has characteristics similar to this group, but with a more diversified (albeit small) manufacturing base.

When looking at the names of the remaining fast growing places one might wonder, why them? They are typically quite small and have grown fast off a small base. A sectoral breakdown of GVA shows that often the growth can be ascribed to a single industry. In the case of Volksrust it is electricity. In Warmbad and Waterberg the growth came from construction as well as wholesale and retail trade and the service sectors. Potgietersrus and Sekhukhuneland benefited from the extension of platinum mining in the region. Similarly, Cullinan saw growth in other mining and quarrying activities related to its historic diamond mining activities.

In contrast to the fast growers the next section presents the slow growers, or those places whose economies contracted most over the period 1996 to 2004.

### 3.2 The slowest growing places

Of the 354 magisterial districts 78 places recorded negative GDP per capita growth over the period 1996 to 2004. In the 25 slowest growing places the economies contracted at rates between 1,5 per cent and 7,7 per cent per annum. The characteristics of these towns are summarised in Table 2 in the appendix and again it shows a diverse profile.

Generally the slowest growing places have smaller populations, which are less urbanised, have lower literacy rates, high poverty rates and little is exported from the economies. There are however two main groups to distinguish.

The first are the towns that have been exposed to the declining fortunes of the South African gold mining industry. These are Klerksdorp, Westonaria, Oberholzer, Odendaalsrus, Welkom, Hennenman, Virginia and Theunissen. These towns used to be relatively large and the population urbanised and educated, but their economies have contracted significantly over the period. Similarly there are the places where coal mining was in decline. The examples include Estcourt, Utrecht, Dannhauser, Vryheid and Mahlabathini.

Second, there are the towns where manufacturing contracted. Specifically, this occurred in the so-called decentralised growth points that received industrial promotion subsidies under the Apartheid government and were hard hit when these were suspended. In the Free State province the examples include Harrismith, Fickburg and Reitz that were close to the former Qua-Qua homeland. In the Eastern Cape places like Maclear, Wodehouse and Komga used to benefit from the support related to the former Transkei and Ciskei, and their economies subsequently contracted. In rural KwaZulu-Natal declines in manufacturing in places such as Babanago, Hlabisa, Mtunzini and Mahlabathini made for the reductions in GDP per capita. A similar explanation holds for Bochum and Thabamoopo in the Limpopo province.

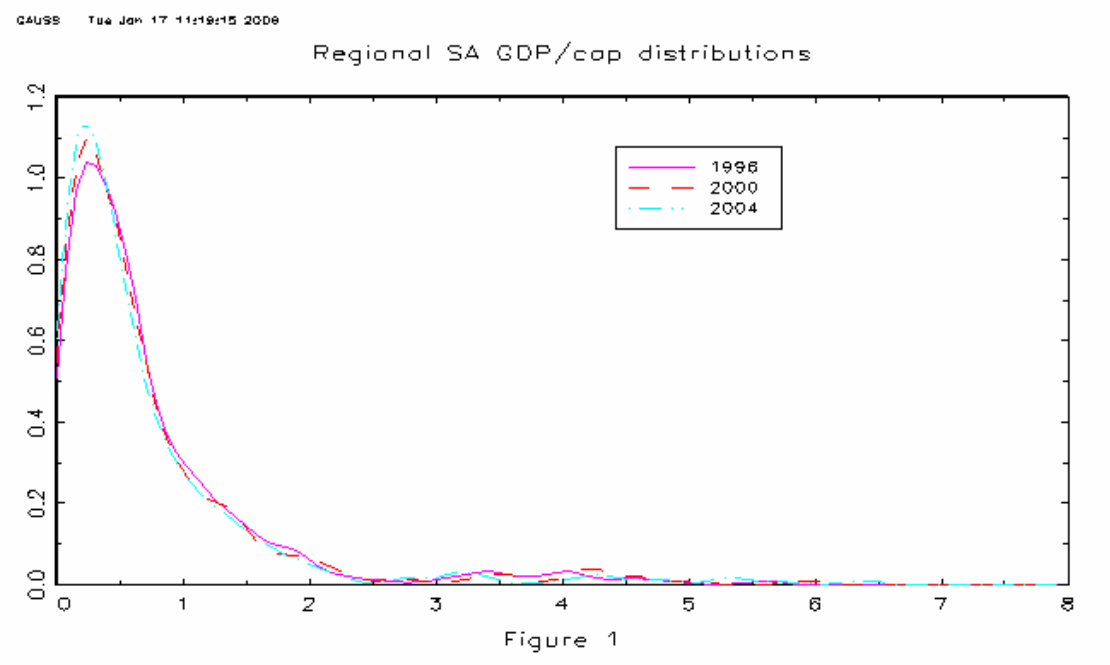
In conclusion, this description of the spatial economy shows that national average economic growth rates obscure interesting variation between cities and towns. The profile of fast and slow growers illustrates that there may be specific reasons why some places grow and others contract. It is not however clear that agglomeration forces dominate, or that smaller, poorer places have been catching up with the better-off ones. Recent work by Naudé and Krugell (2003) examined the determinants of economic growth at sub-national level in South Africa, looking at cross-locality growth rate differentials between 354 magisterial districts over the period 1998 to 2002. The results from a dynamic panel data regression model suggested slow beta convergence. To the contrary, an exploratory distribution dynamics approach indicated that divergence occurred (Krugell, Koekemoer & Allison, 2005). The remainder of this paper builds on the previous work by using a Markov chain process to describe the evolution of the entire cross-section income distribution in terms of its intra-distributional characteristics.

# 4. Empirics

## 4.1 Estimated kernel densities for 1996, 2000, 2004

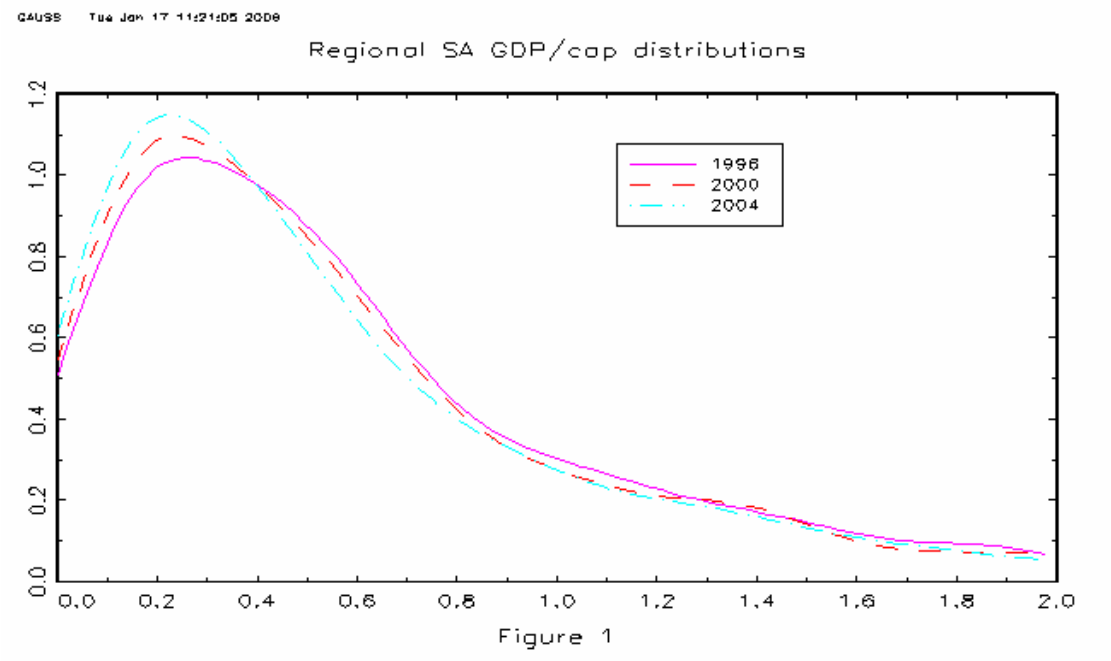
The figure below shows the estimated distribution (Gaussian kernel) of magisterial district GDP per capita relative to total South African GDP, where 1, > 1, < 1 indicate a magisterial district that has a GDP per capita that is equal to, larger or smaller than South African GDP respectively. This relative GDP per capita is shown to control for general South-African wide trends (e.g. business cycle effects).

*Figure 1: The Gaussian kernel of magisterial district GDP per capita relative to total South African GDP*



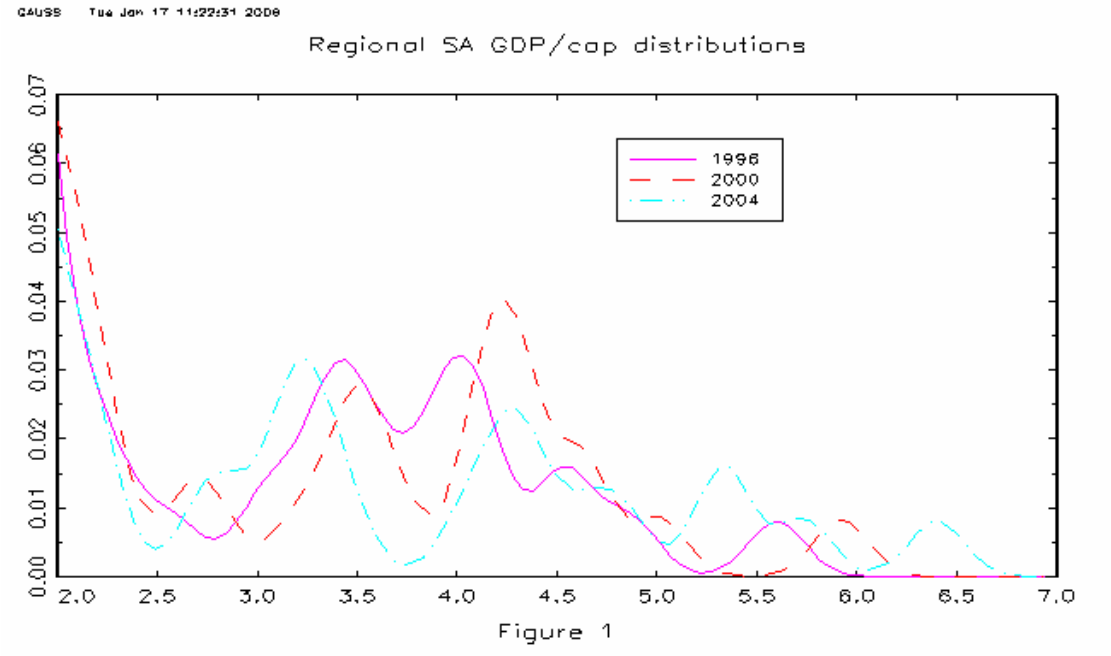

It is immediately clear that South Africa is characterized by very many magisterial districts that have a GDP per capita far (< 0.5 times SA GDP per capita) below the national level and relatively few magisterial districts with a GDP per capita far above the national level. Due to the wide dispersion as observed in the figure above it is difficult to clearly see the evolution of the size of the distribution. Therefore the following two figures zoom in on the left (0 – 2) and the right (2 – 7) of the estimated kernel respectively to give some clearer view of the dynamics of the external shape of the distribution.

*Figure 2: Zoomed in on the left (0 – 2 times South African GDP per capita)*




Note that between 1996 and 2004 the distribution gains mass in the left tail, i.e. the number of magisterial districts with a GDP per capita level below 0.4 times the national level increases. Also (but less profound) the distribution loses mass in the range 0.4 – 0.8 times the national average over that period.

*Figure 3: Zoomed in on the right (2 – 7 times South African GDP per capita)*




In the zoom on the right of the distribution it is difficult to discern a clear pattern.

## 4.2 Markov chain analysis

In itself looking at the evolution of the external shape of the magisterial district per capita GDP distribution does not give any idea about the evolution of regions within this distribution. In other words, one does not know if the increase in number of poorest magisterial districts is due to richer magisterial districts becoming poor, or other already poor magisterial districts becoming even poorer. It is these intra-distributional movements that are of particular interest. In order to quantify them a Markov chain analysis is performed.

This requires the distribution to be discretized, i.e. each magisterial district is assigned to one of a pre-specified number of groups based on its GDP per capita level. This is necessary in order to allow the evolution of the external shape of the income distribution to be quantified in terms of its intra-distributional dynamics. The number of groups is chosen to be 5 and the cutoff-points for each group are chosen such that the number of magisterial districts initially in each of the groups is the same. Table 3 below shows the discretized distribution that was shown in figure 1:

*Table 3: The discretized distribution*

| x SA GDP/cap | 1996 | 2000 | 2004 |
|---|---|---|---|
| < 0.17 | 0,189 | 0,206 | 0,229 |
| 0.17 < < 0.36 | 0,186 | 0,201 | 0,209 |
| 0.36 < < 0.575 | 0,218 | 0,195 | 0,198 |
| 0.575 < < 1.05 | 0,209 | 0,209 | 0,181 |
| > 1.05 | 0,198 | 0,189 | 0,184 |

The numbers mean the percentage of magisterial districts that are assigned to each of the respective groups, e.g. in 1996 18.9% of the magisterial districts had a GDP per capita below 0.17 times SA GDP per capita.

The table suggests a similar movement as shown in figure 2 with the distribution zoomed in on the left, i.e. magisterial districts below the national GDP per capita level becoming poorer in terms of relative to SA GDP per capita. However again this does not give a complete picture therefore Table 4 below shows the estimated Markov **1-yr** transition probabilities (italic means not significant at the 10% level):

*Table 4: Estimated Markov 1-year transition probabilities*

| x SA GDP/cap | < 0.17 | 0.17 < < 0.36 | 0.36 < < 0.575 | 0.575 < < 1.05 | > 1.05 |
|---|---|---|---|---|---|
| < 0.17 | 0,997 | *0,003* | 0 | 0 | 0 |
| 0.17 < < 0.36 | 0,028 | 0,961 | 0,011 | 0 | 0 |
| 0.36 < < 0.575 | 0 | 0,048 | 0,931 | 0,021 | 0 |
| 0.575 < < 1.05 | 0 | 0 | 0,048 | 0,936 | 0,016 |
| > 1.05 | 0 | 0 | 0 | 0,026 | 0,974 |

Each of the numbers in the table shows the probability that a magisterial district in a particular income group moves to another income group the next year. For example, a magisterial district in the lowest income group has a probability of 0.3% to move one income group up, whereas a magisterial district in the 2nd highest income group has a probability of 1.6% to make the transition to the highest income group.

The estimated probabilities show some interesting features of the distribution, namely that the chance of one of the poorest magisterial districts to move up in the income distribution is not significantly different from zero, indicating that these areas

might be caught in a poverty trap. Furthermore comparing the off-diagonal elements of the matrix with each other, it is quite striking to note that the probability of moving a group down is for all groups higher than moving up, hereby quantifying the initial thought when looking at the evolution of the external shape of the distribution. Also note that magisterial districts with a GDP per capita higher than the national level are the least likely to move a group down in the discretized income distribution.

Given the estimated Markov chain transition probabilities several interesting questions can also be answered.

### *4.2.1 How accurate are the estimated transition probabilities?*

Given the estimated 1-yr transition probabilities shown earlier, the accuracy of these estimated probabilities can be assessed by comparing the true 2004 discretized distribution with the one predicted by the estimated transition probabilities and the true 1996 discretized distribution. To calculate this 'estimated' 2004 distribution multiply the estimated 1-yr transition probability matrix 8 times by itself and multiply the resulting 8-year transition matrix with the 1996 discretized distribution, or mathematically:

$$\hat{f}_{2004} = M^8 * f_{1996}$$

where M is the estimated 1yr-transition matrix. Table 5 below shows this estimated 2004 distribution along with the true one.

*Table 5: Comparing the true and estimated 2004 distributions*

| x SA GDP/cap | 2004 | est.2004 | ergodic |
|---|---|---|---|
| < 0.17 | 0,229 | 0,228 | 0,855 |
| 0.17 < < 0.36 | 0,209 | 0,211 | 0,106 |
| 0.36 < < 0.575 | 0,198 | 0,195 | 0,023 |
| 0.575 < < 1.05 | 0,181 | 0,182 | 0,010 |
| > 1.05 | 0,184 | 0,183 | 0,006 |

The estimated distribution does not differ substantially from the true 2004 distribution, hereby giving confidence in the estimation.

### *4.2.2 If the dynamics of the distribution remain as quantified by the estimated transition probabilities, will the income distribution converge and if so what will it look like in the limit?*

Assuming that the dynamics of the income distribution remain as during the period 1996-2004 it can be inferred from the estimated transition probability matrix if this continuation will result in a steady state income distribution and if so what it looks like. The income distribution will converge if the second largest eigenvalue of the estimated transition matrix is smaller than one. In this case this second largest eigenvalue equals 0.988 and thus the income distribution will converge to a 'steady-state' income distribution. This so-called ergodic distribution can be calculated as follows: if F is the steady state distribution it has to hold that multiplying this distribution by the transition matrix, M, will give F back or mathematically:

$$M*F = F \quad \text{or} \quad (I-M)*F = 0$$

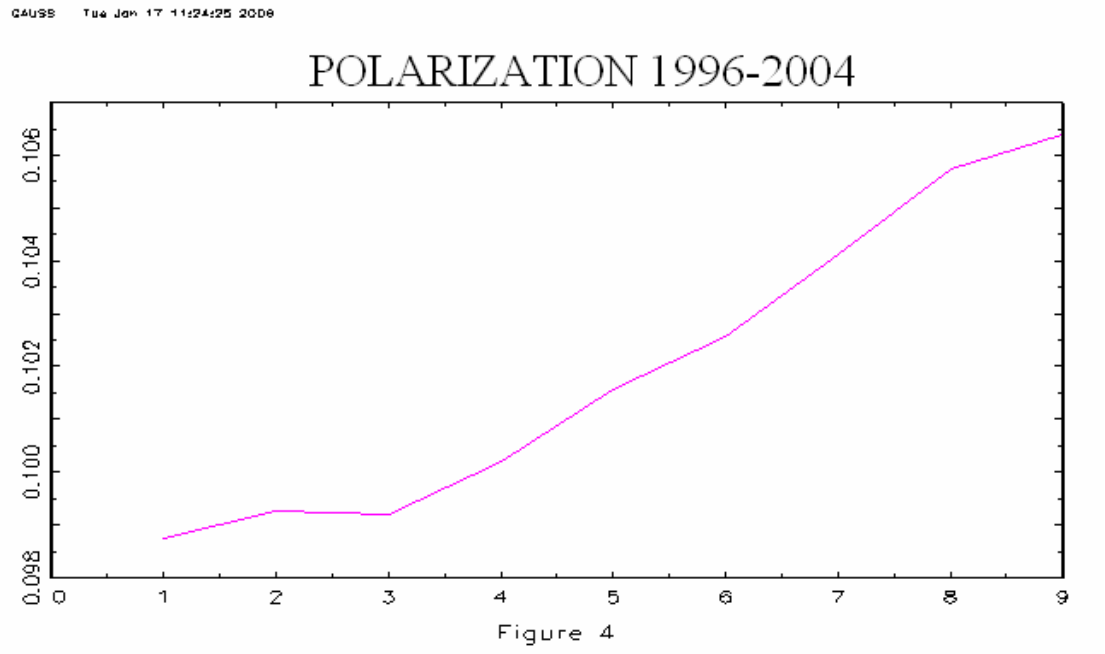
Which show that F is the eigenvector of matrix M associated with the eigenvalue of 1.

Table 5 shows this steady state distribution. It is quite striking to note that if the income distribution continues to evolve as it did between 1996 and 2004, this will result in an income distribution where 98 per cent (95%) of the magisterial districts earn less than (0.36 times) the national level of GDP per capita and 2 per cent (5%) of the magisterial districts more than that, suggesting a heavily diverging income distribution.

### *4.2.3 Does the quantification of the distribution obscure some dynamics within each group and can one say something about it?*

The discretization of the income distribution can hide some aspects of the evolution of the income distribution that are not captured due to the discretization. A somewhat 'extreme' example can illustrate this quite clearly, suppose that the resulting estimated transition matrix would be the identity matrix, suggesting that the income distribution is quite stable. At the same time it could be the case that all magisterial districts in the highest income group earn twice as much, and all magisterial districts in the lowest income groups twice as little, such that overall SA GDP per capita does not change. This fact would not be picked up by the Markov chain analysis, as no magisterial district shifts between groups. Of course this example is quite extreme and would surely show up in the estimated kernel density, but it merely serves illustrational purposes. Such patterns not picked up by the Markov chain analysis could be picked up by looking at the (evolution of) mean relative income in each of the income groups. More specifically it is possible to calculate a measure of polarization following Esteban and Rey (1994). Their proposed polarization is a weighted sum of the difference between all possible income groups in log GDP per capita. Thus the higher the index, the more polarized the income distribution. The figure below shows the evolution of this index over the period 1996-2004.

*Figure 4: The polarization index*




Note: 1 = 1996, …., 9 = 2004

The polarization index shows that after being quite stable up to 1998, it gradually increases over the period after that (i.e. 1998-2004), suggesting that besides the

movement shown in the discretized distribution (more magisterial districts in the poorer income classes) the difference between groups in terms of average GDP per capita has also increased over the sample period.

#### *4.2.4 Is mobility within the distribution high or low, and how fast does the transition take place?*

Given the estimated transition probabilities one can also calculate several interesting mobility indices. These can be divided into indices telling something about the degree of mobility in the process of moving towards the steady state and indices giving an indication of the degree of mobility once the steady state is reached[4]. The table below shows these indices:

*Table 6: Mobility indices*

| Mobility towards steady state | | Mobility in steady state | |
|---|---|---|---|
| Shorrocks | Half life | Bartholomew | UPLCG |
| 0,050 | 58,28 | 0,009 | 0,012 |

Mobility towards the steady state

The Shorrocks index takes on values between 0 and k/(k-1), with k the number of income groups thus in our case 1.25, with higher values corresponding to higher mobility. Intuitively the higher this index the lower the diagonal elements of the transition matrix and thus the more cross income groups movement. Thus the value of 0.05 in this case indicates low mobility (over the period of 1 year!).

The half-life is the number of years it takes for the distribution to be halfway towards its steady state, which in our case is 58 years. This is quite some time, suggesting that before the highly dispersed steady-state income distribution is realized there is some time for policymakers to turn the tide.

Mobility in the steady state

The Bartholomew index denotes the expected number of group crossings per year once the steady state is reached, the value of 0.009 indicates that a group crossing is very unlikely in the steady state, indicating that in the steady state not only the overall distribution is stable but also the regions making up the different income groups does not change very often.

The UPLCG index measures the Unconditional Probability of Leaving one's Current income Group. In this case it is 0.012 indicating that there is only a 1% chance that a particular magisterial district will shift to a different income group once the steady state is reached. Hereby indicating the same as the Bartholomew index, namely low mobility across income groups in the steady state.

[4] Here the steady in steady state refers to the fact that the discretized income distribution remains constant, but this does not mean that magisterial districts cannot move between income groups once the steady state is reached – they can move between income groups but they do so such that the overall distribution does not change. In other words, two magisterial districts swapping income groups will leave the overall discretized distribution unchanged.

## 4.3 What about space?

So far the analysis has ignored the spatial context of the data set at hand. Recently several authors (Rey and Montouri, Quah, etc, etc) have shown that taking explicit account of the spatial context in spatial data set can reveal quite interesting things about evolution of regional incomes.

**[Insert figure 5/map 1 here]**

A first pass at looking for spatial dependence in the Markov chain analysis is the calculation of the Cliff and Ord (1981) BB-statistic for the case of both upward and downward mobility. This statistic tests for spatial dependence in upward or downward movement of magisterial districts in the discretized income distribution. That is it checks if a magisterial district moves up in this distribution its neighbours are also more likely to do so (positive spatial correlation) or less likely to do so (negative spatial correlation). Table 7 below shows the BB-statistic in case of both upward and downward mobility along with the bootstrapped 5% critical values:

*Table 7: BB-statistics for upward and downward mobility*

| | BB-statistic | 2.5% | 97.5% |
|---|---|---|---|
| UP | 0,033 | 0,095 | 5,738 |
| DOWN | 5,872 | 0,006 | 4,673 |

The results show something very interesting, the UPward statistic is significant indicating negative spatial correlation in upward moves, i.e. if your neighbour moves up in the distribution, you are less likely to make a similar move. For the DOWNward statistics the opposite holds, if your neighbour moves down, you are also likely to do so, i.e. it indicates significant positive spatial correlation in downward moves.

Having established the relavance of spatial dependence in the data set, there are several ways to incorporate space in the Markov chain analysis:

1. Following the evolution of a regionally conditioned instead of the SA-wide conditioned relative income distribution (see o.a. Quah).
2. Calculating spatially conditioned Markov Chains (see o.a. Rey).

### *4.3.1 Regionally conditioned Markov Chains*

Instead of looking at the evolution of magisterial district GDP per capita relative to national SA GDP per capita, one can look at the evolution of magisterial district GDP per capita relative to 'regional GDP per capita', i.e. a distance weighted sum of neighbouring magisterial districts' GDP per capita. The three figures below show this regionally conditioned distribution for South African magisterial districts as a whole and zoomed in on the right and left tail.

*Figure 6: The regionally conditioned distribution*

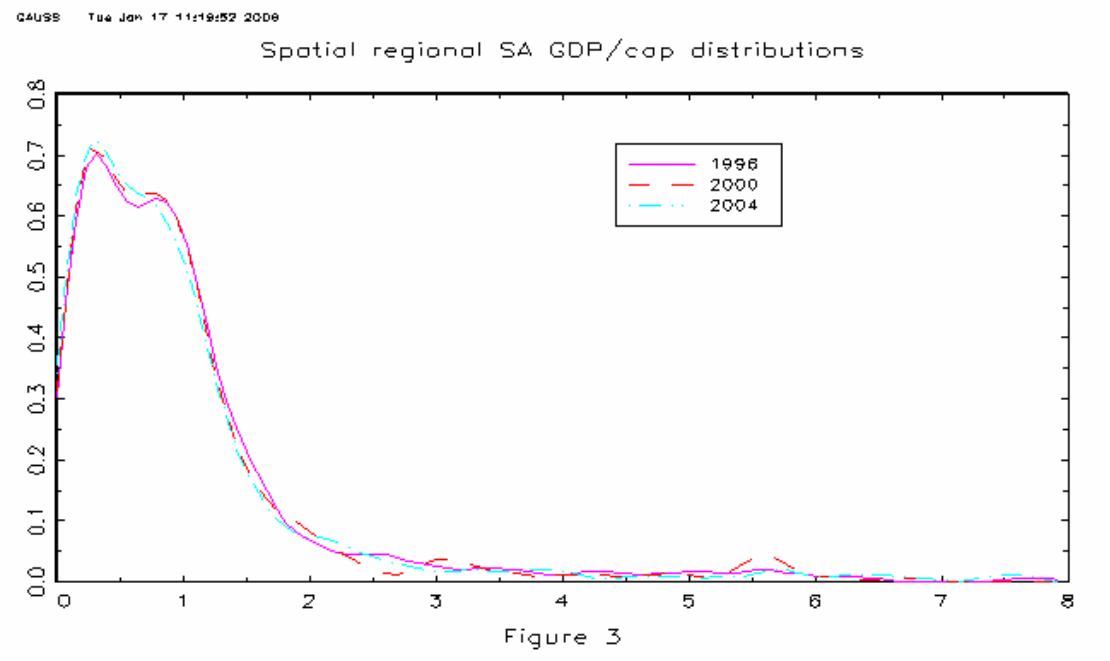



*Figure 7: Zoomed in on the left (0 – 2 times 'regional' GDP per capita)*

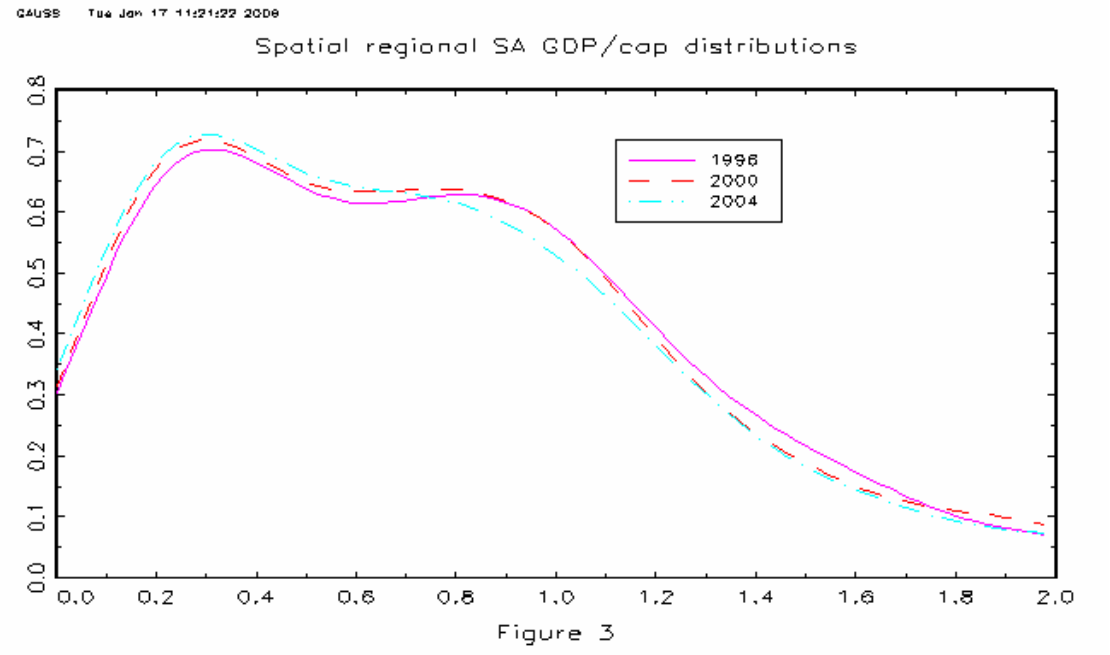
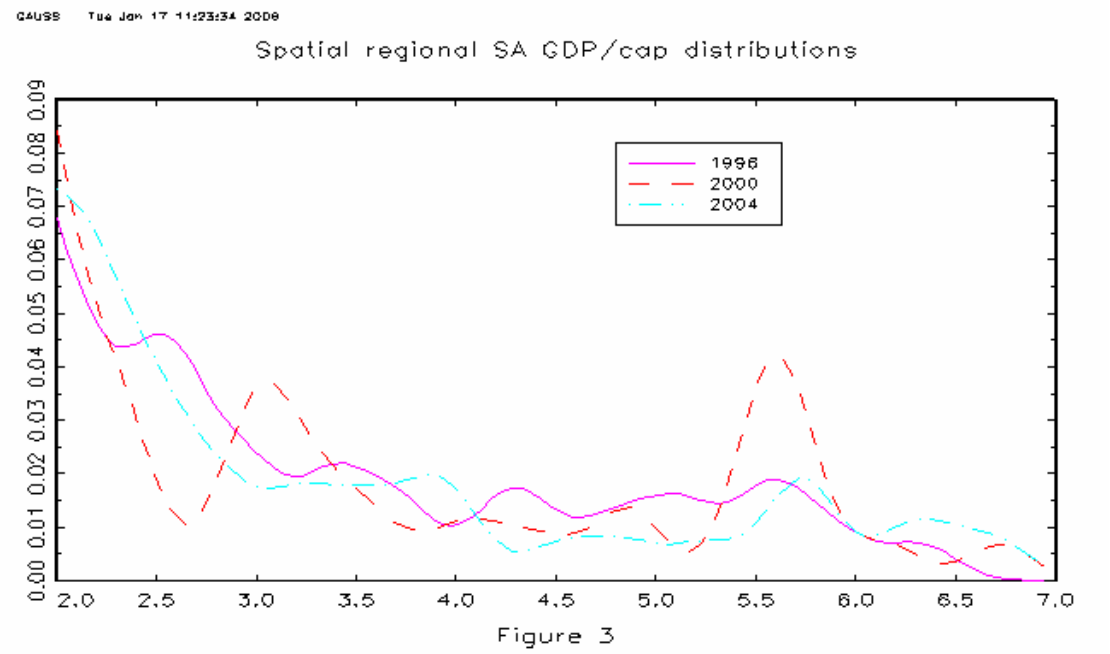


*Figure 8: Zoomed in on the right (2 – 7 times 'regional' GDP per capita)*




Interestingly the distribution is less skewed to the left than the SA-GDP per capita conditioned income distribution, most clearly seen by comparing the zoomed in left part of the distribution. However, there is still a small number of magisterial districts that earn much more than their neighbours. With the pattern in the left tail quite similar as in the SA-total distribution. This could be an indication that rich magisterial districts are scattered around the country, whereas the poorer magisterial districts tend to cluster together.

**[Insert figure 9/map 2 here]**

However merely comparing the two differently conditioned distributions does not give any clue about whether the same magisterial districts are rich compared to their neighbours as those magisterial districts that are rich compared to the South African level of income. As in the case of Markov chain transition probabilities, this can be clarified quantitatively by estimating a matrix. Not a matrix describing the evolution over time in this case, but a matrix that tells what the probability of a magisterial district is to be rich compared to its nearby neighbours given its income level compared to the South African total. Table 8 below shows this matrix that compares the SA-relative distribution to the regionally conditioned one (where the regional distribution cutoff points are set in the same manner as in the SA-relative distribution).

*Table 8: Comparing the SA-relative and regionally conditioned distributions*

| SA \ REG | < 0.27 | 0.27 < < 0.59 | 0.59 < < 0.9 | 0.9 < < 1.3 | > 1.3 |
|---|---|---|---|---|---|
| < 0.17 | 0,798 | 0,202 | 0 | 0 | 0 |
| 0.17 < < 0.36 | 0,172 | 0,491 | 0,287 | 0,050 | 0 |
| 0.36 < < 0.575 | 0 | 0,508 | 0,349 | 0 | 0,144 |
| 0.575 < < 1.05 | 0 | 0,070 | 0,298 | 0,455 | 0,177 |
| > 1.05 | 0 | 0 | 0,061 | 0,234 | 0,706 |

Each of the numbers in the table shows the probability that a magisterial district in a particular SA-relative income group is also located in a particulate regional-relative income group. For example, a magisterial district in the lowest SA-relative income group has a probability of 80% to also be in the

lowest regional-relative income group, whereas a magisterial district in the 2nd lowest SA-relative income group has a probability of 20% to be in the lowest regional-relative income group.

Several interesting things can be said about these probabilities, only 6% of the SA-relative magisterial districts have income levels below 90% that of their 'neighbours'. Second all of the poorest SA-relative magisterial districts have income levels below 60% that of their neighbour. Also interesting is the fact that 14% of the magisterial districts with income levels between 0.36 and 0.575 times the national GDP per capita level have income levels that are more than 1.3 times that of their 'neighbours'.

### *4.3.2 Spatially conditioned Markov Chains*

To calculate these matrices one first groups magisterial districts according to their neighbour-relative GDP per capita. Next, given its ordering based on neighbour-relative GDP per capita, one looks at the evolution of SA-relative GDP per capita for only those magisterial districts within a certain spatial income group. This results is 5 (given 5 neighbour-relative income groups) 1-yr transition matrices that are of dimension 5x5 (given 5 SA-relative income groups). The Tables below show each of these matrices (note: italic numbers mean not significant at the 10% level).

*Neighbour-relative income group 1 ( GDPcap < 0.27 that of its neighbours)*

| x SA GDP/cap | < 0.17 | 0.17 < < 0.36 | 0.36 < < 0.575 | 0.575 < < 1.05 | > 1.05 |
|---|---|---|---|---|---|
| < 0.17 | 0,998 | *0,002* | 0 | 0 | 0 |
| 0.17 < < 0.36 | 0,087 | 0,913 | 0 | 0 | 0 |
| 0.36 < < 0.575 | , | , | , | , | , |
| 0.575 < < 1.05 | , | , | , | , | , |
| > 1.05 | , | , | , | , | , |

*Neighbour-relative income group 2 ( 0.27 < GDPcap < 0.59 that of its neighbours)*

| x SA GDP/cap | < 0.17 | 0.17 < < 0.36 | 0.36 < < 0.575 | 0.575 < < 1.05 | > 1.05 |
|---|---|---|---|---|---|
| < 0.17 | 0,991 | *0,009* | 0 | 0 | 0 |
| 0.17 < < 0.36 | 0,025 | 0,971 | *0,004* | 0 | 0 |
| 0.36 < < 0.575 | 0 | 0,068 | 0,917 | *0,015* | 0 |
| 0.575 < < 1.05 | 0 | 0 | 0 | 1 | 0 |
| > 1.05 | , | , | , | , | , |

*Neighbour-relative income group 3 (0.59 < GDPcap < 0.9 that of its neighbours)*

| x SA GDP/cap | < 0.17 | 0.17 < < 0.36 | 0.36 < < 0.575 | 0.575 < < 1.05 | > 1.05 |
|---|---|---|---|---|---|
| < 0.17 | , | , | , | , | , |
| 0.17 < < 0.36 | 0 | 0,981 | 0,019 | 0 | 0 |
| 0.36 < < 0.575 | 0 | 0,044 | 0,931 | 0,025 | 0 |
| 0.575 < < 1.05 | 0 | 0 | 0,096 | 0,886 | 0,018 |
| > 1.05 | 0 | 0 | 0 | 0,091 | 0,909 |

*Neighbour-relative income group 4 (0.9 < GDPcap < 1.3 that of its neighbours)*

| x SA GDP/cap | < 0.17 | 0.17 < < 0.36 | 0.36 < < 0.575 | 0.575 < < 1.05 | > 1.05 |
|---|---|---|---|---|---|
| < 0.17 | , | , | , | , | , |
| 0.17 < < 0.36 | 0 | 0,926 | *0,074* | 0 | 0 |
| 0.36 < < 0.575 | 0 | 0,061 | 0,914 | 0,025 | 0 |
| 0.575 < < 1.05 | 0 | 0 | 0,019 | 0,973 | *0,008* |
| > 1.05 | 0 | 0 | 0 | 0,047 | 0,953 |

*Neighbour-relative income group 5 ( GDPcap > 1.3 that of its neighbours)*

| x SA GDP/cap | < 0.17 | 0.17 < < 0.36 | 0.36 < < 0.575 | 0.575 < < 1.05 | > 1.05 |
|---|---|---|---|---|---|
| < 0.17 | , | , | , | , | , |
| 0.17 < < 0.36 | , | , | , | , | , |
| 0.36 < < 0.575 | 0 | 0 | 0,988 | *0,013* | 0 |
| 0.575 < < 1.05 | 0 | 0 | 0,059 | 0,901 | 0,040 |
| > 1.05 | 0 | 0 | 0 | 0,013 | 0,987 |

A first thing to notice is that for magisterial districts with a GDP per capita level of only 60% of lower that of their neighbouring magisterial districts, the probability of moving up in the SA-relative income distribution is not significantly different from zero at the 10% level. Also magisterial districts that are richer than the SA-average, that is in income group 5 of the SA-relative discretized distribution, have a lower probability of moving to a lower income group the richer they are compared to their neighbouring magisterial districts. More generally, it is mostly, but not always, the case that the richer (poorer) a magisterial district compared to its neighbours, the higher (lower) probability is has to move up in the SA-relative income distribution.

The overall suggestion given by the results is thus that of localized growth poles, whereby several rich magisterial districts absorb economic activity from their neighbours, leaving them behind with relatively much lower income levels.

## 5. Conclusions

At the start it was argued that the South African economy is characterised by significant spatial inequality, but that this may be masked by recent robust economic growth. To address challenges of low growth, poverty and inequality in the cities and towns where they occur, required an examination of spatial economic growth patterns to determine which are the fast growing places, which the slow growers and whether the poorer places are catching up or falling behind.

Analysis of the external shape of the distribution of magisterial districts' GDP per capita showed a skewed distribution with a large number of magisterial districts that have GDP per capita far below the national average. The analysis also indicated that between 1996 and 2004 the number of magisterial districts with GDP per capita below 0,4 times the national level, increased.

Subsequently, Markov chain techniques were used to quantify the intra-distributional movements of cities and towns. It showed that the chance of one of the poorest magisterial districts to move up the income distribution is practically zero. For all income groups of magisterial districts the probability of becoming poorer is greater than the probability of becoming richer. This is however not true for the

magisterial districts with a GDP per capita higher than the national average – they are the least likely to move a group down. The calculation of a polarization index supported these results, indicating that the difference between the rich and poor magisterial districts increased between 1996 and 2004. In fact, if the distribution continues to evolve as it did over the period the result will be an income distribution where 98 per cent of the magisterial districts earn less than 0,36 times the national level of GDP per capita (which implies only R7965 per capita) and 2 per cent of the magisterial districts earn more than that!

In the first application of spatial econometric techniques in the South African context, the analysis also showed that space matters. The results indicate significant spatial correlation in downward moves of magisterial districts between income groups. Conditioning for space then results in a distribution that is less skewed to the left. However, the richer (poorer) a magisterial district is, compared to its neighbours, the higher (lower) probability it has to move up in the SA relative income distribution.

In conclusion it can be said that this paper found that recent economic growth in South Africa has been driven by a few core cities and towns while ever more places on the periphery have been producing even less. This clearly sets a daunting challenge for local governments that have to fulfill their constitutional responsibility of the development of their areas.

## List of references


Acemoglu, D. Johnson, S. & Robinson, J.A. (2001). "The colonial origins of comparative development: An empirical investigation". *American Economic Review*, 91(5).

Bernstein, A. & McCarthy, J. 2005. "Thinking big in small-town South Africa". *Business day*, Aug. 5.

Cliff & Ord (1981).

Esteban & Ray (1994).

Krugell, W.F., Koekemoer, G. & Allison, J. (2005). "Convergence or divergence of South African cities and towns? Evidence from kernel density estimates". Paper presented at the Biennial Conference of the Economic Society of South Africa: Development Perspectives: Is Africa Different?, Elangeni Holiday Inn, Durban, 7-9 September.

Krugell, W.F. & Naudé, W.A. (2005). "The geographical economy of South Africa". *Journal of Development Perspectives*, 1(1).

Naudé, W.A. & Krugell, W.F. (2003). "An inquiry into cities and their role in sub-national economic growth in South Africa". *Journal of African Economies*, 12(4).

Nel, E. (2002). "South Africa's manufacturing economy: Problems and performance". (*In*: Lemon, A. & Rogerson, C.M. *eds*. Geography and economy in South Africa and its neighbours. Aldershot: Ashgate. p. 81-94.)

Rey, & Montouri,

Rogerson, C.M. (1991). "Beyond racial Fordism: Restructuring industry in the "new" South Africa". *Tijdschrift voor economische en sociale geografie*, 82.

Suleman, A. & Naudé, W.A. (2003). "The competitiveness of South African manufacturing: A spatial view", *Journal for Studies in Economics and Econometrics,* 27(2).

Quah, D.

*Table 1: Fast growers, 1996-2004*

| | Annual growth rate 96-04 | GDP-R per capita | Total population | Population growth rate | Poverty rate | Functional literacy | Urbanisation rate | Unemployment rate | % Exports |
|---|---|---|---|---|---|---|---|---|---|
| Phalaborwa | 8.2% | 141,580 | 37,118 | 1.2% | 15.5% | 71.0% | 53.4% | 3.6% | 14.0% |
| Volksrust | 8.0% | 20,170 | 36,854 | 1.7% | 53.6% | 60.8% | 85.2% | 27.6% | 1.2% |
| Lower Umfolozi | 7.1% | 48,166 | 286,902 | 1.5% | 41.9% | 67.2% | 30.0% | 35.8% | 78.3% |
| Randburg | 6.7% | 117,434 | 445,772 | 1.6% | 14.0% | 89.5% | 93.3% | 19.0% | 21.8% |
| Warmbad | 6.4% | 20,278 | 58,941 | 1.4% | 33.1% | 68.1% | 64.8% | 22.3% | 5.7% |
| Rustenburg | 6.1% | 72,116 | 446,234 | 1.6% | 26.7% | 69.1% | 46.0% | 27.5% | 30.6% |
| George | 5.5% | 32,499 | 130,990 | 1.5% | 17.6% | 78.8% | 89.8% | 20.6% | 1.4% |
| Knysna | 5.3% | 31,398 | 71,905 | 1.7% | 18.5% | 80.5% | 88.9% | 19.9% | 5.9% |
| Waterberg | 4.9% | 15,031 | 67,255 | 1.4% | 43.7% | 61.2% | 50.6% | 9.9% | 0.8% |
| Pretoria | 4.8% | 102,671 | 825,868 | 1.1% | 11.7% | 92.9% | 89.5% | 14.6% | 51.3% |
| Wellington | 4.7% | 27,054 | 49,660 | 1.0% | 15.6% | 80.0% | 81.3% | 14.3% | 28.1% |
| Sekhukhuneland | 4.7% | 3,403 | 473,456 | 1.3% | 56.4% | 56.5% | 4.2% | 60.1% | 0.0% |
| Boksburg | 4.7% | 35,961 | 324,282 | 1.8% | 19.6% | 88.7% | 98.1% | 31.0% | 17.1% |
| Kempton Park | 4.6% | 39,238 | 551,602 | 2.0% | 29.8% | 85.6% | 97.6% | 42.7% | 18.9% |
| Tulbagh | 4.5% | 16,714 | 33,011 | 1.0% | 22.1% | 68.4% | 57.9% | 18.6% | 5.0% |
| Cullinan | 4.4% | 8,756 | 97,601 | 1.5% | 35.9% | 80.6% | 89.4% | 39.8% | 2.6% |
| Potgietersrus | 4.4% | 29,532 | 58,867 | 1.3% | 35.9% | 66.6% | 62.1% | 15.8% | 0.2% |
| Nigel | 4.4% | 18,456 | 130,017 | 2.0% | 36.1% | 78.9% | 94.5% | 42.6% | 7.8% |
| Laingsburg | 4.3% | 14,723 | 6,298 | 0.7% | 30.5% | 57.8% | 60.8% | 15.7% | 0.0% |
| Sasolburg | 4.0% | 93,625 | 116,186 | 0.8% | 28.4% | 79.2% | 89.1% | 33.2% | 2.6% |
| Montagu | 3.9% | 20,140 | 26,156 | 1.3% | 27.6% | 70.1% | 75.3% | 28.0% | 15.8% |
| Alberton | 3.9% | 19,740 | 503,046 | 2.0% | 28.6% | 85.6% | 100.0% | 44.1% | 7.6% |
| Mosselbay | 3.9% | 28,242 | 65,955 | 1.3% | 24.6% | 81.1% | 88.5% | 30.5% | 3.9% |
| Vredenburg | 3.8% | 44,262 | 51,638 | 1.0% | 9.7% | 80.2% | 97.4% | 17.1% | 88.0% |
| Pinetown | 3.8% | 38,117 | 534,444 | 1.6% | 29.0% | 83.9% | 99.9% | 34.0% | 7.7% |

*Table 2: Slow growers, 1996-2004*

| | Annual growth rate 96-04 | GDP-R per capita | Total population | Population growth rate | Poverty rate | Functional literacy | Urbanisation rate | Unemployment rate | % Exports |
|---|---|---|---|---|---|---|---|---|---|
| Dannhauser | -7.7% | 2,876 | 84,137 | 1.0% | 90.4% | 65.7% | 5.6% | 68.4% | 0.2% |
| Theunissen | -6.7% | 15,202 | 41,278 | 0.3% | 71.2% | 59.5% | 69.7% | 32.6% | 0.6% |
| Odendaalsrus | -5.2% | 7,420 | 107,252 | 0.9% | 72.7% | 69.8% | 92.1% | 52.0% | 0.2% |
| Virginia | -4.5% | 11,336 | 87,064 | 0.4% | 49.4% | 71.7% | 74.5% | 39.0% | 22.1% |
| Welkom | -3.6% | 16,613 | 294,562 | 1.1% | 35.1% | 73.3% | 89.4% | 35.3% | 1.5% |
| Hennenman | -3.3% | 7,514 | 30,742 | 1.1% | 53.9% | 68.1% | 86.8% | 50.0% | 41.3% |
| Vryheid | -2.9% | 8,394 | 101,760 | 1.1% | 62.6% | 63.9% | 43.8% | 45.7% | 0.1% |
| Oberholzer | -2.8% | 27,363 | 202,120 | 1.6% | 30.8% | 76.0% | 98.2% | 22.7% | 0.1% |
| Klerksdorp | -2.4% | 18,958 | 382,898 | 0.9% | 56.6% | 70.1% | 88.2% | 42.2% | 0.6% |
| Komga | -2.3% | 5,357 | 15,702 | 0.9% | 78.6% | 46.7% | 48.1% | 38.0% | 0.1% |
| Mtunzini | -2.2% | 5,665 | 232,336 | 1.4% | 66.7% | 69.5% | 26.9% | 55.6% | 8.9% |
| Hlabisa | -2.1% | 2,614 | 233,953 | 1.6% | 84.4% | 53.3% | 5.6% | 58.2% | 0.6% |
| Utrecht | -2.0% | 6,947 | 29,329 | 1.2% | 77.7% | 46.4% | 16.3% | 45.7% | 1.1% |
| Aliwal North | -2.0% | 12,781 | 32,142 | 1.1% | 67.8% | 64.9% | 86.7% | 41.5% | 0.0% |
| Harrismith | -1.9% | 8,465 | 70,027 | 1.0% | 68.0% | 63.4% | 78.5% | 42.9% | 9.0% |
| Maclear | -1.9% | 4,835 | 21,404 | 0.9% | 82.9% | 50.4% | 72.6% | 37.8% | 0.0% |
| Ficksburg | -1.8% | 7,941 | 53,516 | 1.2% | 73.1% | 67.4% | 0.0% | 25.3% | 1.1% |
| Westonaria | -1.7% | 11,027 | 193,723 | 1.6% | 29.1% | 72.3% | 97.8% | 29.9% | 0.8% |
| Babanango | -1.7% | 686 | 47,132 | 1.5% | 84.8% | 53.1% | 8.8% | 83.7% | 0.0% |
| Estcourt | -1.7% | 3,768 | 186,681 | 1.5% | 66.8% | 66.4% | 13.3% | 62.7% | 2.8% |
| Bochum | -1.6% | 2,654 | 181,339 | 1.2% | 89.0% | 53.3% | 0.0% | 70.6% | 0.0% |
| Reitz | -1.6% | 9,196 | 31,651 | 0.6% | 74.5% | 55.5% | 58.4% | 27.7% | 0.4% |
| Mahlabathini | -1.6% | 3,229 | 169,788 | 1.4% | 88.6% | 55.1% | 11.5% | 75.5% | 0.0% |
| Wodehouse | -1.5% | 6,175 | 14,595 | 0.8% | 88.3% | 50.2% | 60.6% | 39.2% | 0.0% |
| Thabamoopo | -1.5% | 3,583 | 414,501 | 1.6% | 74.3% | 72.1% | 14.1% | 58.5% | 0.0% |