CONVERGENCE OR DIVERGENCE OF SOUTH AFRICAN CITIES AND TOWNS? EVIDENCE FROM KERNEL DENSITY ESTIMATES

by

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ABSTRACT

A particular characteristic of economic activity across South Africa is its spatial lumpiness. Geographically, economic activity tends to be unequally distributed and concentrated – an estimated 70 per cent of GDP is produced in only 20 per cent of places. The recent strong economic growth performance, however, masks significant differences in the performance of the economy across cities and towns. Earlier work by Naudé and Krugell (2005) examined the determinants of economic growth at sub-national level in South Africa, looking at cross-locality medium-term (five-year) growth rate differentials between 354 magisterial districts. The period in question was 1998 to 2002. From the dynamic panel data regression model no evidence of absolute convergence could be found over the five-year period, rather the tentative evidence suggested slow beta convergence. This paper extends the work by using a distribution dynamics approach to analyse convergence. Kernel estimators are used to examine the shape of the relative income distribution and how it has evolved over the period 1996 to 2004.

Key words: growth, convergence, agglomeration, South Africa

JEL Classification numbers: C21, o38, O49, O53

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1. Introduction

A particular characteristic of economic activity across South Africa is its spatial lumpiness. Geographically, economic activity tends to be unequally distributed and concentrated – an estimated 70 per cent of GDP is produced in only 20 per cent of places. Yet research into economic growth in South Africa has focussed mainly on the level of the national economy and the strong growth performance over the past few years has masked the differences in the performance of the economy across South Africa's cities and towns. This may however soon have to change. 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 countries municipalities have also struggled to cope with their constitutional responsibility for the development of their areas, as is being clearly marked by ongoing protest against poor service delivery.

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 determine which are the fast growing places, which the slow growers, what are their characteristics and are the poorer places catching up or falling behind.

Growth theories predict convergence whereby poorer places catch up with richer ones, either in absolute terms, or conditional on a range of determinants of growth. Earlier work by Naudé and Krugell (2005) examined the determinants of economic growth at sub-national level in South Africa, looking at cross-locality medium-term (five-year) growth rate differentials between 354 magisterial districts over the period 1998 to 2002. From the dynamic panel data regression model no evidence of absolute convergence could be found over the five-year period. Rather, the tentative evidence suggested slow beta convergence.

Such results, however, do not provide a complete picture of the shape of the distribution of income across localities, or how it has evolved over the years. This paper extends the previous work by using a distribution dynamics approach to analyse convergence (see Quah, 1996).

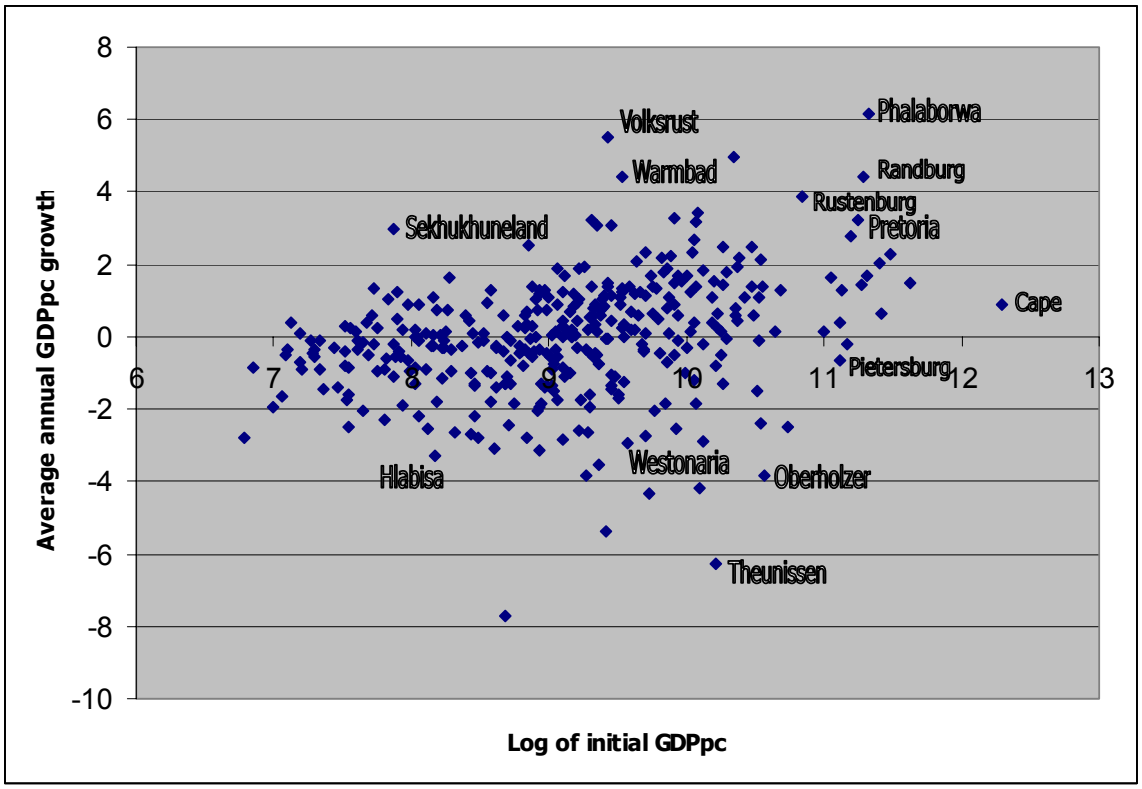
The paper is structured as follows. Section 2 provides an overview of spatial economic growth in South Africa over period 1996 to 2004, looking at the fast and slow growers. In section 3 the shape of the distribution of income across localities is examined through the use of kernel density estimates. Section 4 studies magisterial district distribution dynamics. Section 5 concludes.

2. Spatial economic growth, 1996 to 2004

Over the period 1996 to 2004 the average national growth rate of GDP per region was 2,8 per cent per annum. Though, as said in the introduction, this obscures the differences in the performance of the economy across South Africa's cities and towns. Figure 1 shows a scatter plot of initial per capita GDP per magisterial district in 1996 (at constant 2000 prices) and the average annual real growth rate of per capita GDP over the period 1996 to 2004.

Over the period 175 magisterial districts experienced positive growth rates, but only 28 achieved growth in excess of 2 per cent per annum. This group of fast growers includes Johannesburg, Kempton Park, Boksburg, Randburg, Pretoria and Durban. Sasolburg and Rustenburg were also fast growers along with smaller places such as Montagu, Mosselbaai, Wellington and George. The high-growth cities and towns are a mix of large, urbanised centres with a literate population and large share of exports in the economy, as well as smaller towns. Johannesburg, Pretoria and Durban are obvious examples of large cities that have grown fast over the period. There, the population is more urbanised and educated and exports make up a substantial share of economic activity.

Figure 1: GDP per capita and growth



There are also smaller places like Mossel Bay, Wellington and Montagu that fall in this league. Rustenburg and Phalaborwa were also fast growers with significant export shares, but are less urbanised, with resource extraction making up a significant part of the economy. Smaller places like Waterberg, Potgietersrus, Laingsburg, Humansdorp, Knysna, Witrivier, Nigel, Postmasburg, Riversdal and Warmbad also managed high average growth rates.

The slow growers are the 197 magisterial districts where the economies contracted over the period. Some for the worst-hit places include Welkom, Virginia, Westonaria, Klerksdorp, Somesetwest, Wodehouse, Kuilsrivier, Mitchellsplain, Hlabisa and Mtunzini. The low-growth cities and towns again present a varied profile. Amongst the slow growers there are former centres of resource extraction (especially areas dependent on gold mining) that have contracted significantly, for example Welkom, Klerksdorp and Westonaria. There are also localities close to the major metropolitan centres that have struggled, for example, Mitchells Plain and Kuilsrivier near Cape Town.

The greater share of the towns and cities are however on average small, more rural than urban, with low levels of human capital and insignificant export shares.

As Naudé and Krugell's (2005) earlier analysis indicates, there is little evidence that the smaller, poorer places in South Africa have been growing faster than the larger, better-off places, as the theory would predict. At best, regression results indicate slow beta convergence conditional on the initial capital stock in the magisterial district, human capital, the openness of the economy and the magisterial district's distance from Johannesburg.

The growth regression results do not, however, provide information about the shape of the distribution of income across localities, or how it has evolved over the years. The following sections aim to shed more light on those aspects by using a distribution dynamics approach to analyse convergence.

3. The income distribution of magisterial districts

To analyse the shape of the distribution of income across localities, and how it has evolved over the years, requires a distribution dynamics approach as proposed by Quah (1996). This involves estimating kernels of magisterial district incomes in different time periods so that their shapes and intertemporal dynamics can be studied. A kernel estimator of a set of observations is an estimated distribution function from which the observations are likely to have been drawn. In this case the observations are per capita GDP at magisterial district level, drawn from Global Insight's Regional Economic Focus. The kernel estimator *f(x)* is defined as:

$$f(x) = \frac{1}{Nh}\sum_{j=1}^{N} K\left(\frac{x - X_j}{h}\right) \qquad (1)$$

Where X_i is the observations of per capita GDP at magisterial district level, N is the number of data points, h is the window width or smoothing parameter and K is the kernel or weighting function.

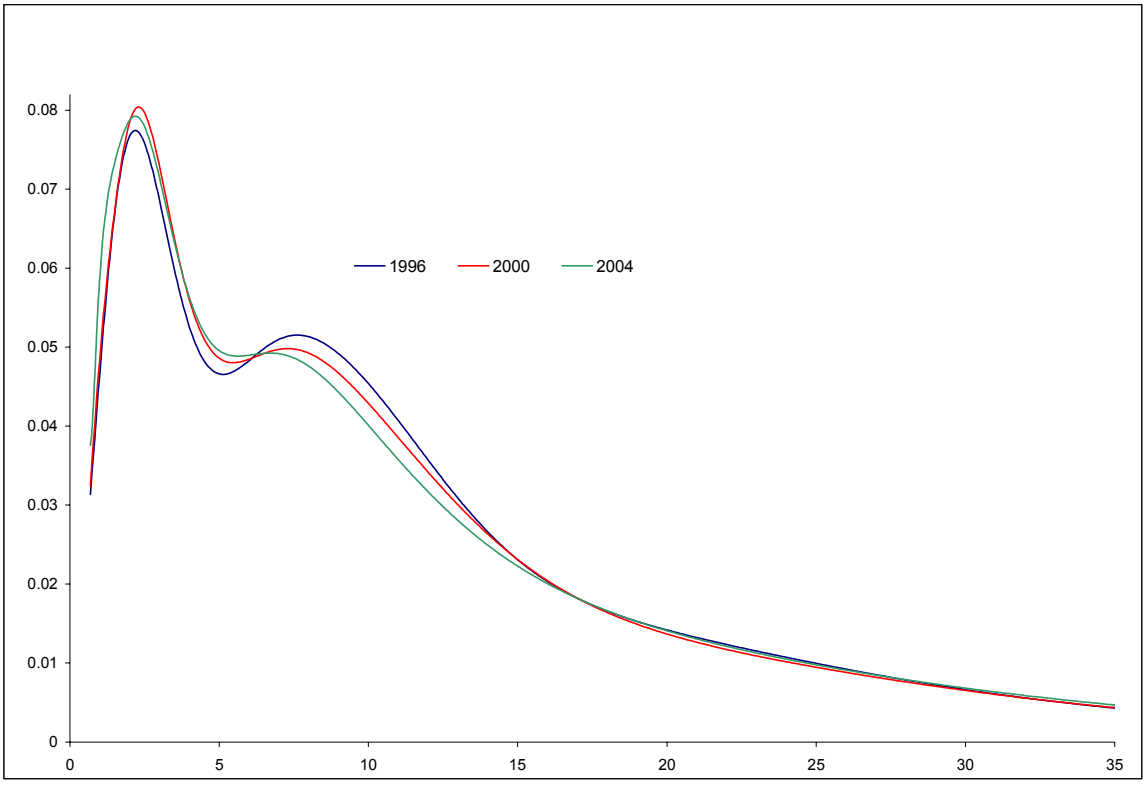
The kernel is estimated as follows. First, the relative frequency, in other words the unconditional probability, with which each of the values of per capita GDP at magisterial district level could have occurred, was estimated. The probability of each

point was computed as the weighted average of the distance of that point from the given incomes of all the magisterial districts, with weights drawn from a Gaussian distribution centred at that point. Second, the relative frequencies of these points were filtered for noise. The collection of the filtered relative frequencies forms the kernel of magisterial district incomes in that year.

The interpretation of the kernel estimators is that they provide information about the mass of the distribution of per capita GDP. Based on the growth experience of the magisterial districts, they show how likely it is that per capita GDP was below a certain level in a particular year (Aziz & Duenwald, 2001).

Figures 2 and 3 display the kernels of the magisterial district incomes in 1996, 2000 and 2004, zoomed in on the modes and tails. These can be interpreted as above with the help of a distribution function (not shown, but available from the authors). For example, in 1996, 50 per cent of the mass of the income distributions was below R9 500 per capita. In other words, the unconditional probability that a magisterial district's per capita GDP was less than R9 500 per annum, was approximately 50 per cent. In 2004 this probability increased to 51 per cent. In 2004, 70 per cent of places' per capita GDP was below R15 800 and 90 per cent of places' per capita GDP was below R35 000.

Figure 2: Density of per capita GDP (1996, 2000, 2004)



Examining the kernels together reveals interesting changes. 1996 shows an almost twin-peaked distribution with a higher density of magisterial districts with per capita GDP between R5 200 and R9 800 per annum. The 2000 and 2004 distributions indicate that that mass subsequently diminished. Figure 2 shows that the 2004 distribution lies further to the left with more places having lower per capita GDP.

Figure 3: Density of per capita GDP (1996, 2000, 2004)

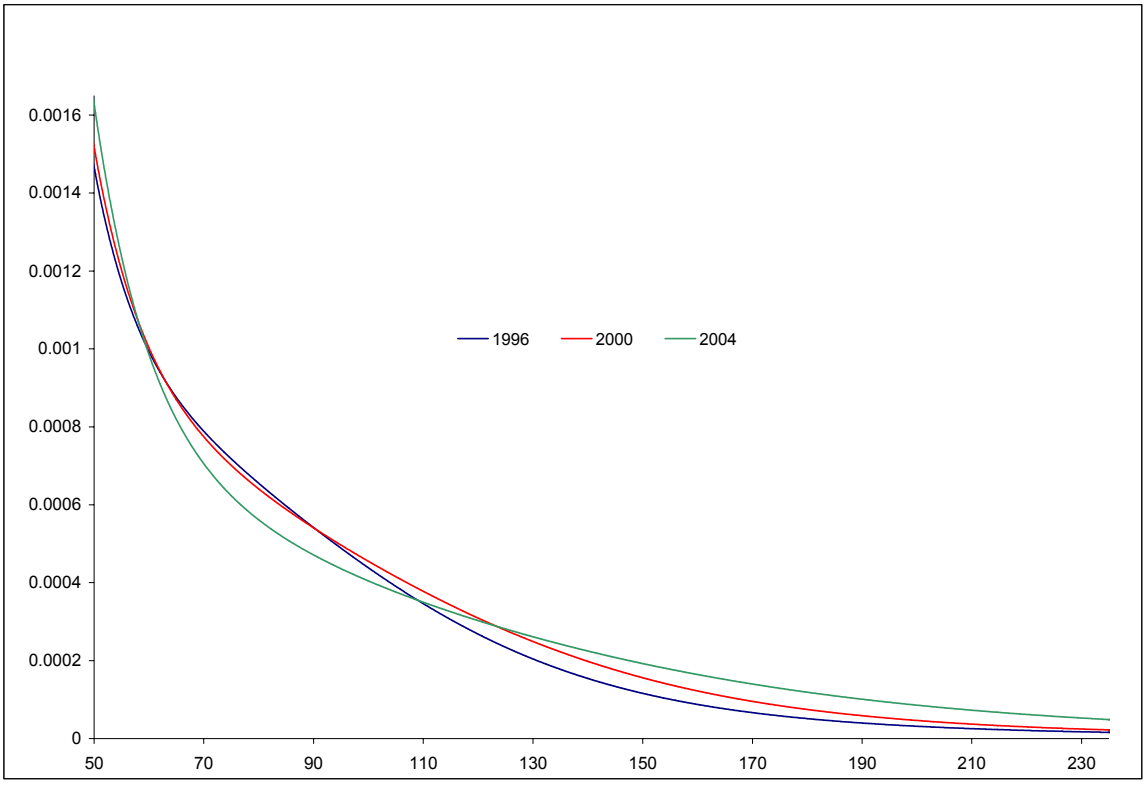


Figure 3 is a zoom of the tails of the kernels and shows that the decline of magisterial districts with per capita GDP between R5 200 and R9 800 per annum was not only the result of more places growing poorer, but also of a few places growing richer. The mass of magisterial districts with per capita GDP in the range R130 000 to R230 000 per annum clearly increased.

These stylised facts are consistent with some of the results of the growth regression work undertaken by Naudé and Krugell (2005). When using the coefficient of variation as measure of σ-convergence it indicates that the variation of income per capita among magisterial districts increased slightly over the period – in other words, divergence occurred. The standard deviation of the log of income per capita decreased somewhat between 1998 and 1999, but then increased again.

Finally, it is important to note that these income distributions reveal little about whether the poor provinces became richer or poorer in relative terms. Different movements of provinces over time are possible – movements that will preserve the

shape of the overall distribution, but reflect significantly different growth dynamics. To examine the distribution dynamics requires a look at bivariate density distributions.

4. Magisterial district distribution dynamics

This section examines intradistribution dynamics among South African magisterial districts. Figures 4 and 5 shows the kernel of the joint distribution of incomes in start and end years. The horizontal axes measure the incomes in the specific years and the vertical axis measures the frequency with which it occurs. Thus, the height of the distribution shows the frequency with which a particular growth experience occurred over the two time periods – in this case 1996-2000 and 2000-2004 (Aziz & Duenwald, 2001). Points of the distribution that lie along the north-south diagonal represent magisterial districts with unchanged relative incomes. A rise in relative incomes is represented by points to the right of the diagonal and a decline in relative incomes by points to the left.

Figure 4 shows that the bulk of magisterial districts had GDPs per capita of between R2 000 and R9 000 per capita in 1996 and by and large remained in that interval in 2000. It is, however, not a picture of complete immobility. The distribution is slightly skewed to the right which implies that there were some magisterial districts which experienced relative growth, particularly towards the higher end of the distribution.

Figure 5 shows a similar situation of limited intradistributional mobility of localities. The skewness of the joint distribution between 2000 and 2004 seems to be even less than in 1996 and 2000, in line with more places having relatively lower per capita GDPs.

Figure 4: Bivariate density of GDP-R per capita, 1996 and 2000

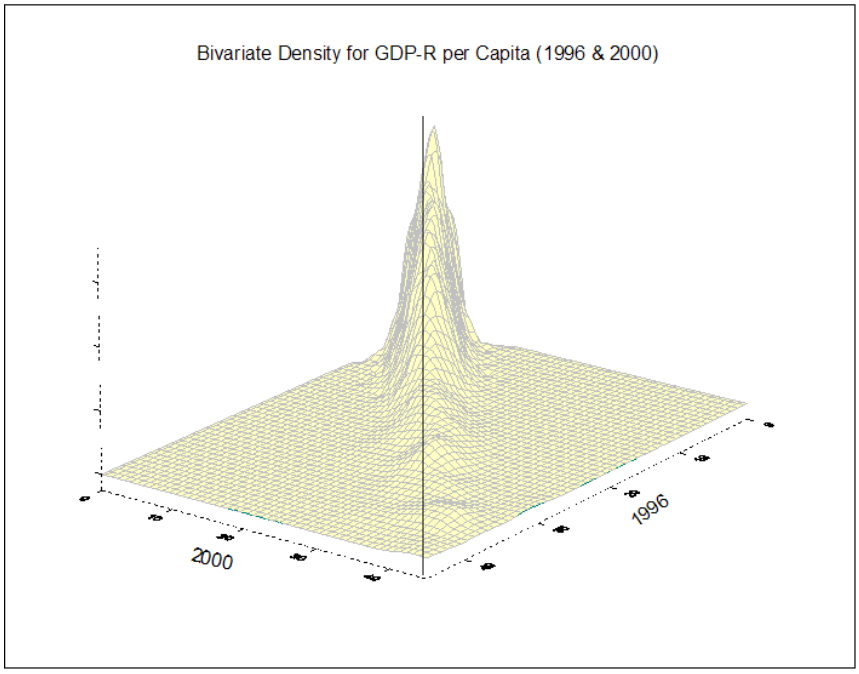
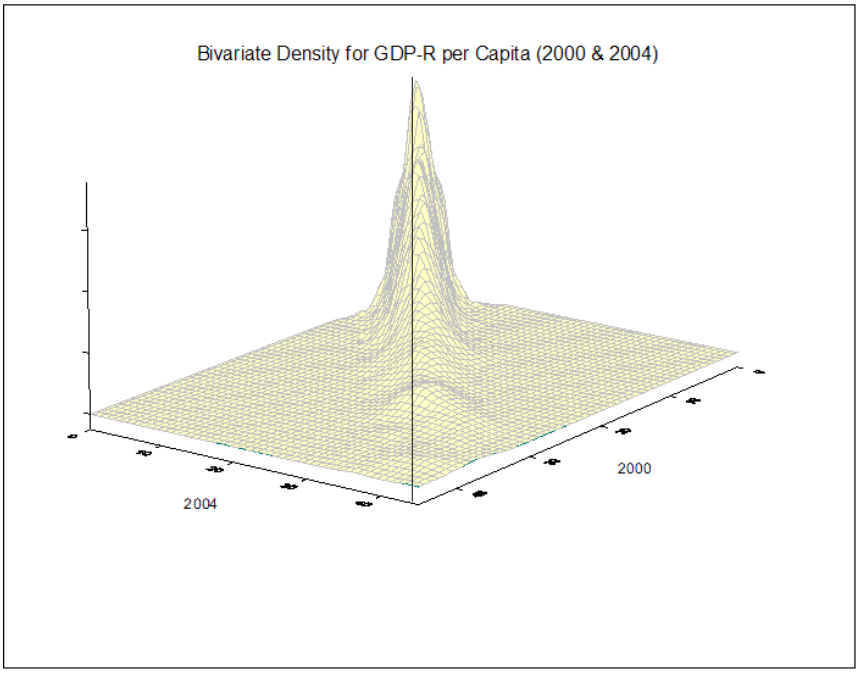


Figure 5: Bivariate density of GDP-R per capita, 2000 and 2004



5. Conclusions

The results from kernel density estimates confirm the suspicions raised earlier by growth regressions – that magisterial districts in South Africa have had diverse growth experiences, with some places growing richer in per capita GDP terms, but with many growing poorer.

Estimates of σ-convergence indicate that divergence occurred over the period 1996 to 2004 and this was confirmed by the kernels of magisterial district incomes. Figure 2 showed that the 2004 distribution lies further to the left with more places having lower per capita GDP, while figure 3 showed a few places also growing richer. The mass of magisterial districts with per capita GDP in the range R130 000 to R230 000 per annum increased. This clearly poses significant challenges to local authorities and their ability to address challenges of unemployment, poverty and inequality.

The next step in the analysis is to extend the distribution dynamics approach to condition for the determinants of spatial economic growth. Regression analysis found that the physical and human capital stock, openness of localities and their distance from major centres are significant determinants of growth. Taking account of these determinants would help to explain provincial growth dynamics.

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