The spatial persistence of population and wealth during apartheid: Comparing the 1911 and 2011 census

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Abstract

This article examines the spatial distribution of people and wealth in South Africa over the period 1911 to 2011. Economic development is typically characterised by agglomeration, but Apartheid policies tried to separate people and disperse economic activity. Zipf's Law is used to examine the balance of these forces. The results show that Apartheid's interventions could not stop agglomeration, which seems to have continued to the point of over-concentration today. Wealth has become increasingly concentrated in places of initial white settlement and the large urban agglomerations.

Keywords: apartheid, population, spatial development, agglomeration, Zipf's Law, South Africa

JEL classification: N97, R12

1 Introduction

Economic historians continue to debate the reasons for the rapid progress in standards of living over the last 200 years. One way to characterise development is through its spatial dimensions: not all regions have prospered equally, and within countries inequalities between urban and rural areas, and within city districts, persist. Urbanisation, the phenomenon of urban concentration of people and economic activities, is often used as a proxy for levels of development. Incomes increase when production shifts from the farm to the city because urban areas reduce the transport costs of people and goods and the transmission costs of ideas. Cities are necessary to capture the returns from specialisation

(Henderson, 2000: 1; Zhang, 2002: 91). A World Development Report (World Bank, 2009: xxi) summarises this well:

"...economic growth will be unbalanced. To try to spread out economic activity is to discourage it. But development can still be inclusive, in that even people who start their lives far away from economic opportunity can benefit from the growing concentration of wealth in a few places. The way to get both the benefits of uneven growth and inclusive development is through economic integration".

But is there an optimal level of agglomeration? Can cities be under-sized or over-sized for playing their role in development? Is there a point where congestion becomes a dispersion force? Economists have attempted to explain the spatial inequalities of development, and the reasons why these inequalities persist over time. Yet, interesting cases of the dispersion of economic activity are limited – with the exception of apartheid.

The history of economic development in South African is interesting for the many ways that government policies militated against economic integration and tried to inhibit agglomeration while ignoring the negative externalities of urbanisation. In South Africa, the initial unequal distribution of economic activity was the result of trade, extraction, climate and culture (Feinstein 2005). Apartheid's social engineering aimed to spread out and separate people and economic activity and included the Grand Apartheid policy of homelands and decentralised industrial development (Lipton 1989). Racially motivated inequalities created new kinds of spatial inequalities and limited the development of places. How much of today's low economic growth rate and unequal development is the consequence of the inefficient spatial structure of the economy? Do we have too many people spread over too many small places resulting in expensive and insufficient service delivery? Do we have too few big places resulting in congestion, pollution and crime? Naudé and Krugell (2005: 89) have argued that Apartheid policies contributed to inefficient land use, under-investment in infrastructure, excessive transport costs, and segmented labour and consumption markets. The end result is slow growth and high-cost economic development.

There exists a substantial literature on the South African spatial economy with contributions from urban and regional planners, economic geographers and economists. However, analysis of the convergence or divergence of places; cities and towns, is only available for the short time period following the democratic transition in 1994. This paper aims to add to this literature with analysis spanning the period 1911 to 2011. Specifically, we examine the persistence of population and economic activity across districts over the period. The data employed are city- and town-level data of population numbers as well as a proxy for wealth collected in the 1911 and 2011 censuses. We test spatial persistence by using the rank-size rule for places and use Zipf's Law to judge the optimal level of agglomeration.

The paper is structured as follows. Section 2 provides a brief overview of the literature on the spatial nature of development, on South Africa's spatial economic development and Apartheid policies that influenced urbanisation and industrialisation. Section 3 outlines the data from the 1911 and 2011 census

along with an explanation of the empirical methods used. The results of the analysis are presented in section 4. Conclusions and recommendations are presented in section 5.

2 The spatial nature of development and the case of South Africa

2.1 *Explanations of the location of economic activity*

Geography informs not only our standard questions about *where* economic activity occurs, but is also central to understanding *why* it does. First-nature geography explains the location of economic activity in terms of natural geography: natural harbours, navigable rivers and differences in resource allocation, climate and distance. It is well-known, for example, that sub-Saharan Africa lacks large, navigable rivers, which has been used frequently to explain the relatively slow growth of production and trade on the continent. However, while first-nature geography is vital to understand divergent development paths, so-called second-nature geography is also important: external economies of scale, those factors that create positive externalities for firms, are also location-specific and will therefore affect growth in a specific geographical region. A wide range of theories may be called upon to explain the agglomeration of production in specific places.

The benchmark model of urban economics is the monocentric city model of Von Thünen. Henderson (1988) put forward a version of the model that focuses on the forces that determine the size of cities and the interactions between them. Here, external economies of scale that are industry-specific make up the agglomerating forces. Thus, when a firm from a specific industry locates in a city where other firms from the same industry are located, it benefits from the positive spillovers of information sharing, a pooled labour market and the existence of specialised suppliers. The model does, however, also contain dispersion forces in the form of diseconomies of scale that depend on the overall size of the city – a large city implies relatively high commuting costs and land rents. Together, the agglomeration and dispersion forces make it possible to explain systems of cities, where different size cities cater to the needs of different industries and they trade with each other.

The field of regional economics explains the location of production in terms of the central place theory. It states that centrality determines the types of goods that a location provides. That is to say that the opposing forces of internal returns to scale and transport costs result in a hierarchy of locations that are evenly distributed across space. In the hierarchy the central place is a city that performs all functions (supplies all goods and services) and there are villages that perform only some functions. In Brakman *et al.*'s (2001: 32) example, there are many small locations where bakers sell bread (that has limited increasing returns) and relatively few larger locations where electronics firms sell television sets (that have more scope for increasing returns to scale and

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people buy television sets less frequently). To minimise transport costs, both locations are rather evenly distributed across space. In this way, central place theory deals explicitly with the location of economic activity as it is determined by the interplay of increasing returns to scale and transport costs.

Finally, geographical economics is specifically concerned with explanations as to what determines the location of production in space (Krugman, 1991). It provides a microeconomic foundation for understanding economies characterised by regional specialisation, cities, and trade by appealing to nature (the unevenness in the distribution of resources), to non-market institutions (such as externalities that give rise to endogenous spatial inhomogeneities), and to an imperfectly competitive paradigm (Fujita & Thisse, 2002:45).

The economy is modelled in a way creates a propensity for agglomeration. Internal economies of scale mean that increasing production at a plant would lower cost – and fragmenting production over more than one location is costly. Manufacturers will thus be inclined to produce more at a single location. But, producing in a single location only, has to be weighed up against transport costs. Selling in a region other than at home incurs transport costs and means having to charge a higher price. A manufacturer would thus choose location in order to maximise the cost savings from large-scale production and to minimise transport costs. But local demand will be large precisely where the majority of manufacturers choose to locate. Localisation, and in a larger scale, agglomeration leads to growth. The mechanism through which the agglomeration takes place may be labour mobility or inter-industry linkages. The core model of geographical economics integrates these insights into a general equilibrium framework of the location of economic activity.

Together, agglomeration and dispersion forces make it possible to explain systems of cities within and between countries, where different size cities cater to the needs of different industries and trade with each other. Empirically this idea of a balance between agglomeration and dispersion forces has been tested through the estimation of the rank-size rule. The rank-size distribution of cities throughout the world follows a law that states that the number of cities with a population larger than S is approximately proportional to S^{-q} (Gabaix, 1999). In other words, rank times population size is approximately the same constant for all cities. If q is equal to zero, all places have the same size. If q is equal to or close to 1 it is also known as "Zipf's Law", which is a special case of the rank-size distribution (Knudsen, 2001:125). A small value of q would be interpreted to mean that places are too small and similar in size – thus, likely to offer urbanisation economies (benefits from diversity) and not localisation economies (benefits from specialisation). Gabaix (1999) showed that Zipf's Law would hold if cities were characterised by constant returns to scale or by external economies of scale where positive and negative externalities cancel out. This could be interpreted as the point where positive and negative externalities, or the agglomeration forces and dispersion forces, cancel each other out (see also Brakman *et al.*, 2001).

Brakman *et al.* (1999) calculated q for the Netherlands for the periods 1600, 1900 and 1990, and note that industrialisation lead to an increase in q. By 1600

the value for q was much lower than 1 (0.55) and it subsequently rose as city sizes increased – by 1900 the value of q was 1.02 and by 1990 is back down to 0.71. But what happened in the case of South Africa where apartheid policies aimed to slow urbanisation and spread industrialisation?

2.2   The case of South Africa

The deep determinants of spatial economic development in South Africa is its first-nature geography, that is to say its basic geographic features which includes its long coastline along both the Atlantic and Indian Oceans, its harbours, climatic conditions which favours the eastern seaboard, and the inland location of precious metals and minerals (Naudé & Krugell, 2005: 88). South Africa suffers from the same geographic features as the rest of Africa: few navigable rivers, a large, arid soil in the west, and fertile, rugged terrain near the coast and in the east. Given the presence of minerals in the interior of the country and the historical concentration of people in these mining regions, the bulk of South Africa's manufacturing sector are located far from easily-accessible ports, which increases trade costs.

Fair (1982: 49-51) writes about the early development of the coastal cities. The preconditions for take-off, or transition phase started with the inland movement of people in the 1830's, the discovery of diamonds in 1867 and gold in 1886. This was accompanied by the concentration of White South Africans in towns and the development of infrastructure. Black South Africans also migrated to new job opportunities in the cities. Smit (1973, 99) described their migration to the Witswatersrand as a "Second Great Trek".

The period following the establishment of the Union of South Africa in 1910 is seen by Browett and Fair (1974) as the start of the industrialisation phase. From 1911, the White urban population started to grow at a faster rate than the White rural population. Over the period 1911 to 1921 the average annual population growth rate was 0.15 per cent in rural areas and 3.01 per cent in urban areas (Bos, 1992, 223). The first industrial census showed high levels of urbanisation and industrial development in the cities of Cape Town, Port Elizabeth, Johannesburg and Durban. The First World War limited the supply of imports which resulted in a growing demand for locally manufactured goods (Bos, 1992, 222). The years that followed were also marked by an expanding role for government, influencing the spatial distribution of people and industry.

The aim of this paper is not to provide a comprehensive review of the ways in which apartheid policies influenced urbanisation or industrialisation. These are literatures in their own right that explain numerous policies implemented over a forty year period. It would be impossible to account for this in any single analysis. Instead the aim is to provide an overview of some of the key policies, reports and events that shaped the apartheid spatial economy.

Davenport (1991) discusses the historical background to the apartheid city. He starts with the Lagden Commission that recommended the segregation of Africans and how its ideological vision was captured in the Native Reserve Locations Act in the Cape (1902), The Native Locations Act in Natal (1904) and the

Orange Free State Municipal Ordinance of 1903. He argues that before 1910, Milner's government tightened urban segregation and gave the native location regular status on the South African landscape. Davenport (1991: 2) argues that "by 1919 the Union's Department of Native Affairs would take it for granted that 'the ideal to be arrived at is the territorial separation of the races'", which resulted in the proclamation of the Native (Urban Areas) Act of 1923. This Act empowered local authorities to set aside land for African locations. The period following the Act saw an increase in the enforcement of so-called influx controls, pass laws and controls of migrant labour. On the eve of the 1948 election the Fagan Commission put forward proposals for the stabilisation of African labour, including a network of labour bureau to substitute for influx control. What followed instead, were the policies of Grand Apartheid.

Posel (1991) provides an overview of urbanisation and labour regulation in the 1950s and 60s. The aim was to slow the growth of the urban African population and reduce urban unemployment. The way to achieve this was to restructure the urban labour market in accordance with an 'urban labour preference principle'. This meant restricting urban employers' access to workers recruited from rural areas and giving preference to the 'detribalised' urban African population (Posel, 1991: 21). Urbanised people were given residential rights and were supposed to be channeled into available jobs ahead of tribalised migrant workers. However, this conflicted with economic realities "and took no account of workers' or employers' preferences, the specific labour requirements of different jobs, or workers' prior training and skill levels" (Posel, 1991: 24).

The national labour bureau system could not prevent 'illegal' employment and the government had almost no control over the employment of African women in urban areas. In the 1960s the notion of 'residential rights' was withdrawn and all Africans were seen to be 'tribalised at heart'. Everyone was vulnerable to expulsion and there were instances of mass removals. The apartheid government also tried to impose urban labour quotas, linked to the decentralisation of industries. In all, there was opposition from the workers, local authorities and the urban business community and the system was unable to slow rural to urban migration (Posel, 1991: 29).

The other side of the coin was the apartheid policy of decentralised industrial development. Bos (1992: 225) describes policies that started in the take-off phase of development between 1933 and 1945 with, for example, the establishment of the Industrial Development Corporation in 1940 and the appointment of the social and economic planning council. Other key points during the industrial development phase include:

- The Tomlinson report of 1954.

- The decentralisation policy announced in 1960.

- The law on physical planning of 1967.

- The agency system of 1968.

- The findings of the Riekert Commission and the White Paper on industrial development published in 1971.

- The finding of the Franzen Commission in 1972.

- The national physical development plan of 1975.

- The steps taken following the Carlton summit in 1979.

- The establishment of the small business development corporation in 1979.

- The "Goeie Hoop" proposals of 1982.

- The establishment of the Development Bank of Southern Africa in 1983.

- The Klue report of 1983 that served as background to the White Paper on industrial development of 1985, and finally,

- The urbanisation strategy of 1986.

Bos (1992) goes on to describe each of these plans and policies in detail. Suffice to say that the aim of the homelands and decentralised industrial development policies was to stem the flow of Black South Africans to the cities and to make the homelands economically viable. Wellings and Black (1986a, 1986b) describe the evolution of decentralisation policy and find that "growth points" in the Bantustans were severely disadvantaged and the developmental impact was limited. Pretorius *et al.* (1986) also provides a chronology of industrial decentralisation policies and concludes that the policies were followed despite a relatively rigid natural regional economic structure that developed historically, and then failed. Bos (1992: 270-281) and later Hartzenberg (2001: 770-771) point out that the border industries were a complete failure.

In the end, when growth takes place through agglomeration it has a place-dependent character (Martin, 1999). It means that many economic decisions and structures are difficult and expensive to reverse. It also means that economic shocks or interventions may have more than a once-off effect, but might have an impact on long-run capacity through cumulative changes that can bring about convergence or divergence between regions and localities. This speaks to the question that this paper seeks to answer: what has been the balance between agglomeration and dispersion forces, and what does it say about the efficiency of the spatial structure of the population in South Africa? The following section describes the data and analysis.

3 Data and analysis

The data used in the analysis are place-level data from the 1911 and 2011 censuses. The benefit of using start and end points one hundred years apart is that it neatly encapsulates the historical forces described above. The distribution of people in 1911 predates the 1913 Land Act as well as the large-scale

urbanisation of the population. This census was also the only one that provided comprehensive coverage of the black population – later censuses neglected the tribal and homeland areas.

To make the analysis possible, the 1911 census data was transcribed from the published volume. The 2011 census was obtained digitally from Statistics South Africa (2013). As can be expected, both censuses include information on population numbers at the level of districts. Unfortunately, there is much less information on individual wealth; we use a proxy in the form of vehicle ownership expressed per person and per place.

There are, of course, several methodological issues. In 1911 there were fewer census districts than there were enumerator areas in the 2011 census. To match places over time is a key challenge of this line of research and the options are to disaggregate the 1911 data to match modern boundaries and data, or to aggregate the 2011 data to match the 1911 boundaries. The second approach requires fewer and weaker assumptions than the first and in this paper the comparisons of population and wealth are for the 1911 district boundaries. Figure 1 shows a map of the municipalities or census districts in 1911 and their population density.

Figure 2 presents a box plot of the natural log of the population data and its distribution. It shows the increase in the population over time. The average number of people per place increased from approximately 29 000 to 252 000. It is clear that the spread of the population also increased with agglomeration in a number of places. One has to keep in mind, however, that the 2011 data are matched to 1911 boundaries – Zoutpansberg, for example, is not the modern-day magisterial district but a substantial area in the north of the Limpopo province, containing a number of municipalities.

Table 1 shows the places with the largest and smallest populations in 1911. All the large cities of today were already large in 1911. From today's greater Gauteng agglomeration Johannesburg, Pretoria, Krugersdorp, Boksburg, Germiston and Alexandra are there. Cape Town, Durban, East London, Port Elizabeth and Bloemfontein also feature. The modern day Lydenburg, Middelburg and Kimberley are not places that we would consider as particularly big, but they there high in the top 30 in 1911. Also, a number of the places with large populations were in Natal and the eastern Cape and many of the places with small populations were in the Free State.

Table 2 shows the top 30 places by vehicle ownership. The total number of vehicles (two and four wheeled) are shown with the motorised vehicles in a separate column.

Vehicle ownership is seen as a proxy for wealth. In both columns the places that also had large populations again make their appearance. Pretoria, Johannesburg, Cape Town, Bloemfontein are there, but Durban, Port Elizabeth and East London are not. There are also a number of relatively smaller places, that clearly has some wealth, for example, Oudtshoorn, Stellenbosch, Paarl, Winburg or Boshof.

The aim of the analysis is to examine the persistence of population and economic activity across districts over the period. Is the South African spatial

economy characterised by the urbanisation and concentration of economic opportunity found elsewhere in the world, or did apartheid policies inhibit growth though agglomeration? Van der Merwe (1983: 50) wrote in *The city and its environment*: "it seems that the South African urban system is burdened with too many small towns with too few people and too few cities with too many people".

One way to examine this is to estimate the rank-size distribution of places in 1911 and 2011. As explained in section 2, the rank-size distribution states that there is an inverse relationship between the logarithmic size of a city and its logarithmic rank. Zipf's law is a special case of this relationship. Brakman et al. (1999, 185) states that the rank-size distribution "performs surprisingly well for the (historical) size distribution of cities in most industrialised countries". Fujita *et al* (1999:216) report a coefficient of 1.004 for 130 large USA cities. Brakman et al. (1999) go on to derive a model for the rank-size distribution from a general equilibrium economic model that includes congestion in a Krugman-type geography model. Section 2 also explained that Zipf's law can be interpreted as the point where the agglomeration forces and congestion (dispersion) forces cancel one another out.

To examine the persistence of wealth, only vehicle ownership expressed per person and per place is available for both years. A simple Spearman rank correlation can be used to get an idea of whether the richer places in 1911 stayed rich into 2011.

4   Results

A simple linear regression model is used to estimate the rank-size rule. The natural log of the population per place is explained by the logarithmic rank of the place.

Thus, in 1911 the q was 0.783 and notably smaller than one. This means that in 1911 South Africa's towns were too small and similar in size and that they offered urbanisation economies as opposed to localisation economies. The model explains approximately 88 per cent of the variance in population per place. The 2011 results show a q value of 1.356. The model explains approximately 86 per cent of the variance in population per place.

The large q in 2011 is unusual and one needs to carefully consider what it means. It is clear that apartheid's interventions could not stop agglomeration forces. In fact, despite the concerted efforts of apartheid policies to promote rural development in the homelands, economic forces drove people to migrate to urban areas. To test whether these large q is not only a post-1994 phenomenon, a similar estimate with data from the 1996 population census finds $q =$ 1.25. Agglomeration was not only an apartheid-era phenomenon, but has since continued to the point of over-concentration.

Post-Apartheid agglomeration can be linked to recent research into trade liberalisation and urban concentration. Karayelcin & Yilmazkuday (2014:8) argues that the question of whether trade liberalisation favours forces of urban agglom-

eration or dispersion is an empirical one. On the one hand, when trade barriers are high, monopolistically competitive firms may choose to locate close to large domestic demand and its forward and backward linkages. In South Africa, this would be the story of the greater Gauteng agglomeration. Trade liberalisation will reduce the strength of these linkages. However, it will favour growth in the cities that have better access to international markets. In South Africa, this would explain the post-Apartheid growth of the population in Durban and the contribution to GDP of Cape Town (Naudé & Krugell, 2003:177).

Figure 4 shows scatterplots of the log of population per place and rank in 1911 and 2011. A more vertical line indicates a more unequal distribution of population between cities. In 2011 there is greater dispersion at both ends of the distribution; there are more people in only a few places, accompanied by a thinning of the population elsewhere.

This would confirm Van der Merwe's (1983) view that in South Africa, too many small towns exist, with too few people while too few cities with too many people exist. Naudé and Krugell (2005) have argued that the pattern of dispersal of South African cities may be inefficient and the size of the Johannesburg-East Rand urban agglomeration might be relatively too large.

Considering Martin's (1999) view of the place-dependent character of growth and development, where interventions can have a long-run impact through cumulative changes, one can speculate about the counterfactual. What would South Africa's q have been had apartheid policies not been enforced? On the one hand, the Zipf's law suggests that it would have been closer to one where the agglomeration forces and dispersion forces cancel out. Thus, without apartheid, South Africa would have had more 'large' cities.

We have only considered population concentration so far, but could the same also true of wealth? Did the overt racial policies of the apartheid government to segregate poor, Black South Africans from more affluent White South Africans have any effect on the spatial geography of wealth?

Unfortunately only vehicle ownership expressed per person and per place is available for both years. A simple Spearman rank correlation coefficient shows a positive and significant relationship per person per place in 1911 and 2011. The relationship is significant at the one per cent level and the coefficient is bigger when motorised vehicles per person per place in 1911 are used.

The results suggest two conclusions. The Spearman coefficient suggests that not only did people agglomerate against the intentions of apartheid policymakers, but wealth became increasingly concentrated in places of initial white settlement and the large urban agglomerations. There is little indication that wealth spread to the border regions which provides further support for the suggestion that the policies of homeland development failed.

A second conclusion is that wealth was already highly unequally spread in 1911. This shifts the emphasis on the cause of inequality in South Africa today from the apartheid period to the period before unification. While apartheid is often the popular scapegoat in explaining the large disparities between rich in poor, the evidence from the 1911 census suggests that the roots of inequality go much deeper (Fourie & Von Fintel 2011; Wilson 2011). While apartheid

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policies exacerbated these differences, it certainly was not the origin of South Africa's unequal divide. The high correlation between the 1911 and 2011 census in wealth concentration attests to that.

5   Conclusion

This paper has argued that economic development is characterised by spatial inequality. External economies and cumulative causation reinforces agglomeration. South Africa's Apartheid policies tried to separate people and disperse economic activity. The results show that homelands, decentralised industrial development and urban segregation could not stop agglomeration forces. However, it seems to have continued to the point of over-concentration: South Africa has too many small towns with too few people and too few cities with too many people. One expects economic growth to be uneven between places, but the growth has also been low due to inefficient land use, high transport costs, and segmented markets. The connective infrastructure and basic services delivery necessary to ensure inclusive development are costly in the many small places and suffer from congestion in the few big places. Wealth has become increasingly concentrated in places of initial white settlement and the large urban agglomerations.

One can only speculate if, without apartheid, the economy would have been more open and diversified with more people and economic activity at the coast. Or, if the inland concentration of mineral resources and consequently manufacturing and the spatial variation in climate and geography, would always favour agglomeration in the greater Gauteng area. While the counterfactual remains debatable, the lesson that rural development policies can do little to affect economic forces provides a sobering perspective on South Africa's current rural development initiatives.

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Table 1: Largest and smallest places in 1911 by population

Largest 30 places		Smallest 30 places	
Zoutpansberg	336075	Port Nolloth	2834
Johannesburg	241131	Sutherland	3841
Cape	187831	Jacobsdal	3929
Pretoria	157444	Hanover	4045
Lydenburg	114757	De Aar	4105
Kingwilliamstown	106474	Murraysburg	4723
Krugersdorp	103473	Richmond	5295
Boksburg	86922	Richmond	5295
Umlazi	75856	Philippolis	5418
Waterberg	73901	Philipstown	5484
Durban	72512	Britstown	5489
Potchefstroom	69360	Steynsburg	5625
Rustenburg	64902	Laingsburg	5901
Germiston	64805	Van Rhynsdorp	6047
Kimberley	64352	Hopetown	6408
Middelburg	64251	Montagu	6515
Engcobo	62055	Prins Albert	6797
Inanda	59222	Steytlerville	6934
Bloemfontein	58451	Bethulie	7033
Alexandra	52578	Maclear	7193
Glen Grey	50597	Edenburg	7417
Harrismith	49553	Victoria West	7514
East London	47711	Tulbagh	7530
Ixopo	47262	Prieska	7593
Umtata	45678	Ceres	7757
Lusikisiki	44754	Wepener	7969
Lower Tugela	44416	Fraserburg	8059
Port Elizabeth	44101	Smithfield	8060
Bizana	42719	Carnarvon	8116
Willowvale	41672	Molteno	8171

Table 2: Top-30 places by number of vehicles

Total vehicles		Motorised vehicles	
Pretoria	1562	Johannesburg	362
Johannesburg	1529	Cape	136
Cape	1462	Pretoria	67
Bloemfontein	1160	Boksburg	55
Boshof	1047	Krugersdorp	48
Bethlehem	944	Durban	43
Harrismith	930	Kimberley	42
Heidleberg	913	Germiston	42
Winburg	901	Port Elizabeth	37
Malmesbury	898	Oudtshoorn	29
Rouxville	880	City (Pietermaritzburg)	24
Potchefstroom	842	Albany	21
Hay	816	Potchefstroom	19
Calvinia	808	East London	17
Rustenburg	804	Paarl	13
Krugersdorp	785	Bloemfontein	11
Frankfort	760	Fanresmith	11
Fanresmith	755	Barkly West	11
Bethulie	735	Stellenbosch	10
Fraserburg	721	Umlazi	7
Riversdale	720	Ficksburg	7
Lichtenburg	712	Inanda	7
Aliwal North	707	Harrismith	6
Albany	704	Winburg	6
Oudtshoorn	701	Waterberg	6
Somerset East	692	Lower Tugela	6
Middelburg	635	Queenstown	5
Boksburg	621	Simonstown	5
Ladybrand	614	Boshof	4
Paarl	603	Rustenburg	4

Table 3: Regression results

| Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	13.318	.091		146.767	.000
	ln(rank1911)	-.783	.020	-.937	-38.338	.000
2	(Constant)	17.280	.171		100.971	.000
	ln(rank2011)	-1.356	.039	-.927	-35.214	.000

Table 4: Spearman's rho for vehicles per person per place, 1911 and 2011

	Vehicles per person per place in 1911	Motorised vehicles per person per place in 1911	Vehicles per person per place in 2011
Vehicles per person per place in 1911	1.000	.308**	.377**
Motorised vehicles per person per place in 1911	.308**	1.000	.465**
Vehicles per person per place in 2011	.377**	.465**	1.000

Figure 1: Population density in 1911
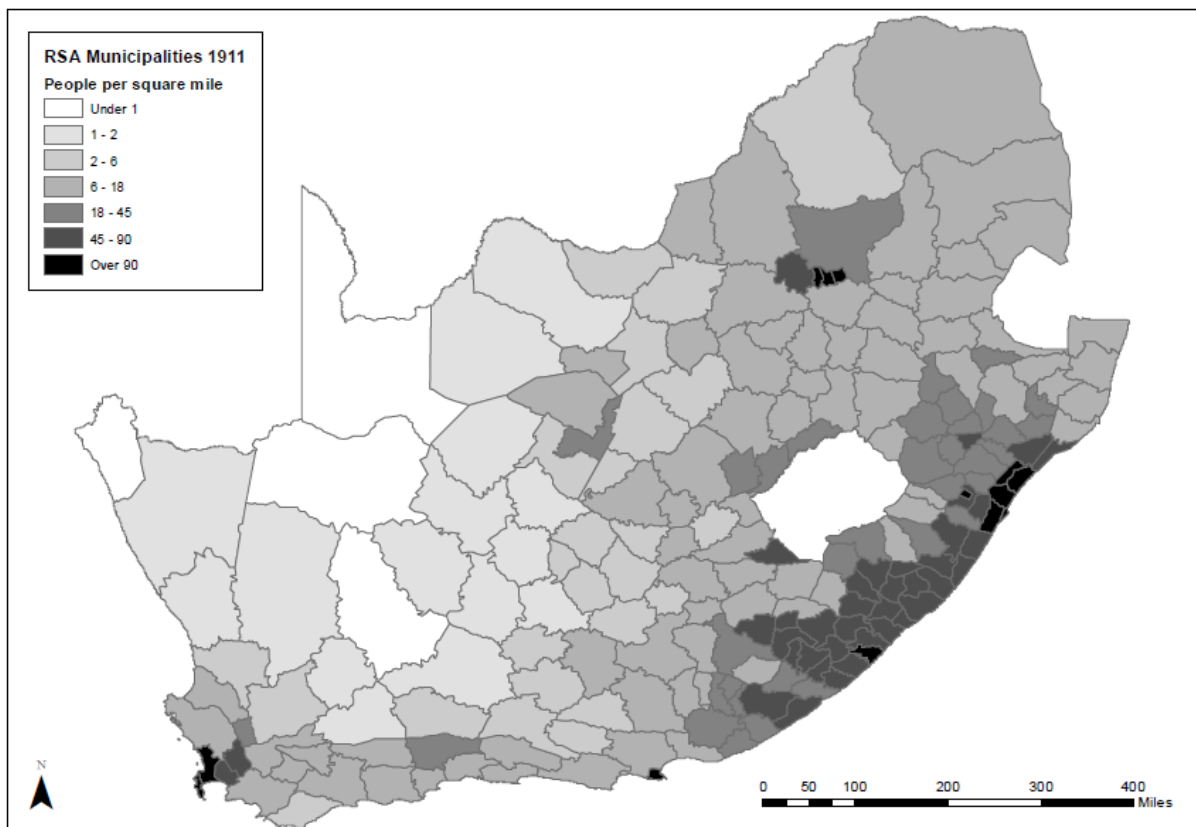
Figure 2: People per place in 1911 and 2011
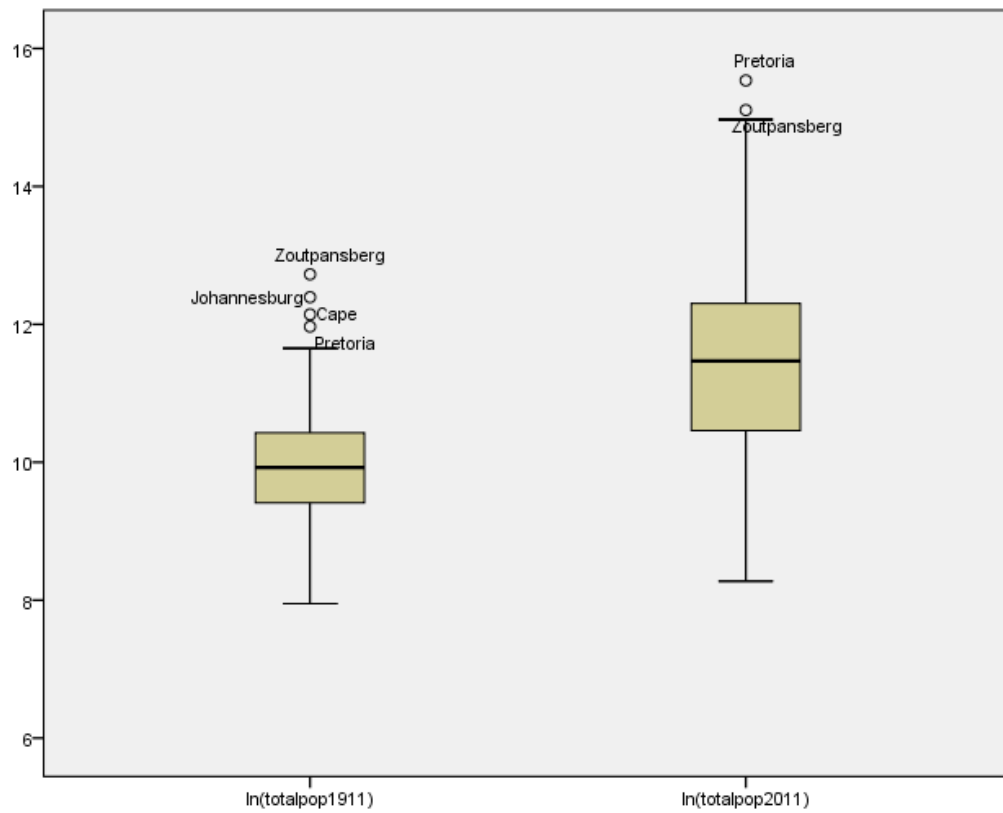
Figure 4: The rank-size relationship in 1911 and 2011