Changing Racial Segregation in the New South Africa

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Abstract

We examine the degree to which racial residential segregation has changed since the end of apartheid in South Africa. We use reallocated census enumeration data from 1996 through 2011 to measure the level of racial segregation across major population groups, and we chart changes in those levels of segregation. We make use of both the pairwise index of dissimilarity and the (multigroup) entropy index. Our calculations for segregation—by either index—point to very high levels of spatial separation among population (race) groups. At the same time, we observe declines in residential segregation: lower values of pairwise dissimilarity and entropy are found in all provinces in the more recent period, but with important variations in for specific pairings. We argue that such analyses help point the way to expanding the study of residential patterns out from the conventional limitation to the Global North. We suggest that in future work it will quite valuable to probe this patterns further with greater geographic detail and with a more dynamic analysis of residential moves themselves.
**Introduction**

In this paper we examine the degree to which racial residential segregation has changed since the end of apartheid in South Africa. We use census enumeration data from 1996 through 2011 (geographically reallocated for optimum comparability) to measure the level of racial segregation across major population groups, and we chart changes in those levels of segregation. We imbed our study in the long tradition of looking at residential segregation as a window of social inequality in society generally.

While residential segregation has been measured extensively by social scientists and discussions of the importance of residential segregation permeate twentieth-century writing in urban sociology, most segregation research has been conducted in the United States and other countries of the Global North. These studies have demonstrated that residential patterns—who shares neighborhoods and urban space with whom—provide particularly valuable insights into societal inequality and dynamics.

A literature on residential segregation in South Africa has demonstrated the sharp degree of residential separation across groups (Christopher 2001; StatsSA, 2016b). At the same time, there has been some indication of decline in residential segregation, at least beginning to appear, in the post-apartheid era (Christopher, 2005, Hamann and Horn, 2015). It remains to be seen is how the residential pattern for the more recent time (as seen in the 2011 census) will be manifest. Also of interest is the overall trend in residential proximity across pairs of population groups.

The research corpus on residential segregation provides a robust conceptual and evidentiary base from which our analysis proceeds. In this paper we offer an initial descriptive view of South African residential segregation. We concentrate on the residential patterns manifest in Gauteng province, the geographically smallest yet most urbanized and populous province in the nation. Gauteng is also been an economic engine for South Africa, accounting for a third of the national GDP (GCRO, 2016) and drawing migrants from elsewhere in the country as well as from international origins. We also present calculations at the provincial level for all South African provinces. In making these calculations, we draw on that conventional framework and apply the same techniques to similar data. Our analysis is designed to shed light on the present state of racial residential unevenness (a window on inequality) today, and the changes that have ensued with the end of apartheid and the arrival of the New South Africa.

**Approach**

There are nowadays a host of different residential segregation indices available to the analyst (Iceland and Weinberg 2002; White 1986) and much methodological work continues to advance in this subject. At the same time a straightforward examination of residential unevenness, using one or two of the most well-known conventional measures, has plenty to offer (White 2005). In our analysis, we make use of two conventional measures of spatial segregation: the Index of Dissimilarity and the Entropy statistic. Both of these fall into the dimensional classification of measuring population unevenness (Massey and Denton, 1988; Massey, White, and Phua, 1996). We apply these statistics to enumerated census data collected by Statistics South Africa (the South African governmental census agency) for the years 1996, 2001, 2006, and 2011. Furthermore, we make use of boundary-allocated versions of these geographic
datafiles, as prepared by the Quantec Corporation and provided to the Guateng City Region Observatory (GCRO). These reallocations aim to improve on geographical comparability of the spatial units.

**Index of Dissimilarity (D).** The index of dissimilarity is the workhorse of the residential segregation literature. It is the most widely used index for comparing the levels of residential segregation of racial and ethnic groups within and across urban areas. We define the dissimilarity index D to be:

\[
D = \frac{1}{2} \sum_{i=1}^{l} \left| \frac{n_{ij}}{N_j} - \frac{n_{ik}}{N_k} \right|
\]

where:

- j, k reference distinct groups
- \( n_{ij} \) = number of persons in the jth group in the ith parcel (geographic area)
- \( N_k \) = number of persons in the jth group in population

(White and Kim, 2005)

The dissimilarity index is bounded from 0 to 1. Evenness is achieved when the composition of each parcel reflects the total urban composition. One can see readily from the formula that if each parcel i has the same share of each group’s population the calculation of D reverts to zero. Since the dissimilarity index has been in use since the early 20th century and across a number of societies, it has some advantage in a comparative context. The index possesses several desirable properties. It is normed with 0 indicating a proportionate distribution of each group (no segregation) in each parcel. It is not sensitive to group size; that is, doubling the number of persons of group A in each parcel (and thus increasing the fraction in the city) leaves the index unchanged. The dissimilarity index also benefits from an intuitive verbal interpretation: it represents the fraction of one group that would have to relocate to produce an “even” (unsegregated) distribution. All indices based on geographic parcels (blocks, tracts, wards) are sensitive to the size of the geographic unit, something we discuss below.

**Entropy Index (H).** The Entropy index was most extensively developed by Theil (1972) originally, and it is also known as the information index. It is computed as the weighted average deviation of each category’s diversity from the total diversity, standardized by the total diversity.

\[
H = \frac{(E^* - \bar{E})}{E^*},
\]

\[
E^* = (-1) \sum_{k=1}^{K} P_k(\ln(P_k)),
\]

\[
\bar{E} = (-1) \sum_{i=1}^{l} \frac{n_i}{N} \sum_{k=1}^{K} P_{ik}(\ln(P_{ik}))
\]
where \( P_k \) is the proportion of group \( k \) in the population; \( P_{ik} \) is the proportion of group \( k \) in parcel \( i \); \( n_i \) is the total population in parcel \( i \); \( N \) is the total population (White and Kim, 2005). Note also that we define \( P_{ik}\ln P_{ik}=0 \) for \( P_{ik}=0 \).

As for the index of dissimilarity, the entropy index is bounded from 0 to 1. The entropy index does not have a convenient intuitive interpretation to match that of the dissimilarity index. It does have the virtue, however, of returning a single index value to polytomies, whereas the dissimilarity index can only handle dichotomies. In addition, \( H \) is a proportional reduction of error (PRE) measure, and it has been used to summarize the amount of variance explained in a nominal-level outcome variable. As a practical matter, entropy (\( H \)) tends to run a bit smaller then \( D \) when calculated for identical distribution of dichotomies.

**Data.** We produce these entropy (\( H \)) and dissimilarity (\( D \)) calculations for areal data from the 1996, 2001, and 2011 censuses of South Africa. The small-area geographic unit of interest is the *ward*. Wards average around 20,000 persons in Gauteng metropolitan territory, and so are about four times the size of census tracts in the US and Canada. In general smaller geographic units are more homogeneous, while conversely, larger geographic units are more likely to span local communities or neighborhoods (Reardon et al 2009). (Of course the issue of what constitutes a neighborhood has itself been subject of extensive study and debate.) Suffice to say that South African ward data would be expected to exhibit less residential segregation than would smaller geographic parcels. At the same time, the use of wards as geo-ecological units across successive censuses (while boundaries are not always strictly kept the same) allows us some confidence in looking at time trends in residential patterns.

Even more important for the case of the South Africa is the apartheid-era conscious division of residential space, especially the designation and maintenance of Group Areas and Homelands. We would expect this to leave not only a legacy of intergroup relations with regard to residential mixing, but also administrative boundaries that would help determine the units on which segregation would be measured. Group Areas, for example, have been divided into wards which do not include sections of other Group Areas. In the context of the high population concentrations that were found in Group Areas, it is expected that high level of ethnic group separation (concentration) would be found in these wards, thus contributing to increased values of any calculated index.

When using the index of dissimilarity, we measure “pairwise” dissimilarity for the major racial groups identified in the census. Since the index of dissimilarity can only be calculated for dichotomies (sometimes seen as a methodological weakness), only such pairwise calculations are possible. Often, however, observers prefer such calculations, because they reveal the patterns of segregation between specific groups of interest (Kim and White, 2010). That is likely to be the case for South Africa.

**Results**

We first present results for Gauteng Province (12.3 million persons presently), the highly developed and urbanized territory that includes Johannesburg and Pretoria (StatsSA, 2016b). Within Gauteng Province, we carry out selected calculations for Johannesburg (4.4 million persons) and Tshwane (2.9 million persons), two major municipal subdivisions, individually (StatsSA, 2016b). We also present calculations at the provincial level for all South African provinces. While this last calculation is somewhat unconventional, the 1996-2001-2011 time trend for these calculations allows us to see what social
sifting and sorting has been underway—and among what groups—in South Africa in the 15 year span following the final dismantling of apartheid.

**Figure 1** presents the 2011 pairwise dissimilarity levels for Gauteng Province. We observe that almost all segregation levels are fairly high by conventional standards. When one considers that these are Ward data (population size larger and thus expecting more heterogeneity on that basis), the figures confirm the very sharply differentiated South African population.

One also observes that Black/African-vs-White [DBlkWhi] segregation attains the highest value. This of course does not surprise given the legacy of group relations in South Africa (Seekings, 2008). Further examination of Figure 1 points to particularly high levels in all pairings, save the residual “other” in which the black population appears. Calculations for Johannesburg and Tshwane individually replicate Figure 1. The two municipalities constitute a substantial share of the province, and the segregation values are similar for most of the population group pairs. For a few pairings—Coloured-vs-Indian/Asian; Coloured-vs-White; Coloured-vs-Other—Tshwane records very modestly lower levels of segregation amidst a broad overall parallel pattern.

**Figure 2** presents the 1996-2001-2011 time trend of segregation across specific pairings of major population groups—Black/African; Indian/Asian; Coloured; White—as recognized in the South African census. We have eliminated the “Other” category here. (We note also that in the Quantec data for 2001, the “Other category does not appear; also “Other” is denoted as “Unspecified” in the 1996 South African census.) Figure 2 we see that there has been noticeable and steady desegregation from 1996 to 2011 in all pairwise dissimilarity values. While overall segregation values themselves remain high, the steady progression toward intermingling among all groups is readily
visible. While the absolute change may seem modest, we note that Black/African-vs-White dissimilarity [DBlkWhi] declines by 7.5%. More notable perhaps, Black/African-vs-Coloured [DBlkCol] and Black/African-vs-Indian/Asian [DBlkInd] segregation declined by over 12% during this time. Indian/Asian-vs-White [DIndWhi] Segregation declined by 26.5%. Considered from another perspective, while there has been widespread decline in residential segregation, that decline is manifest quite differently among the racial groups.

**Figure 3a-d** presents a summary of 1996-2011 (two points-in-time only) change in residential segregation for selected pairings for all 9 Provinces in South Africa.

**[Figure 3 at end of ms]**

We use the complete complement of census data; thus, within each Province all territory is represented. While this pools rural villages, towns, and large urban aggregations into the same calculation, the approach also allows us to gain an overview of settlement patterns and their change in the 15-year span. These figures exclude statistics from 2001 statistics, due to the lack of availability (as discussed above) of the “other” or unspecified” category in the Quantec allocated data.

Figures 3a-d point to appreciable differences by province in the level of segregation for these selected pairs and also highlight some sharp differences in trend by region. Figure 3a confirms that Black/African -vs-White [DBlkWhi] segregation (as indicated by the dissimilarity index) is quite high throughout the country. In all provinces upwards of three quarters of Whites (or, equivalently, Black/Africans) would have to relocate across wards (within their province) to produce an even distribution, that is, a distribution in which each ward had the same share of both the provincial Black/African and White populations. We also see that Black/African-vs-White spatial unevenness [DBlkWhi] is highest in the Eastern Cape; lower values are found in Free State and Northern Cape. Declines in Black/African-vs-White segregation during the 1996-2011 interval are modest (less than other pairings). Proportionate decline was 10% or less in all Provinces.

Residential Segregation measured for Black/African-vs-Coloured [DBlkCol] (Figure 3b) and Black/African-Indian/Asian [DBlkInd] pairings (Figure 3c) was generally no more than Black/African-vs-White segregation across all provinces in 1996. Declines for Black/African-vs-Indian/Asian segregation in a few provinces—Free State, Northwest—were particularly pronounced in the 15-year interval. (We are checking into whether census or Quantec reallocation procedures could be partly responsible for this.) Figure 3d examines Indian/Asian-vs-White [DIndWhi] segregation. Initial circumstances were more diverse, with dissimilarity ranging from 0.5 (Free State) to over 0.8 (KwaZulu-Natal). But here again, declines in dissimilarity were universal across all provinces. In the Western Cape and in Gauteng segregation fell over 25%.
Making use of the Entropy statistic, we can summarize the differential ethnic distribution (across the several groups) with a single index value. Figure 4 presents such a calculation for 1996 and 2011 for all 9 provinces. Provinces vary appreciably in the overall level of segregation they manifest. The Eastern Cape, KwaZulu-Natal and Gauteng are the most segregated by this measure in 1996, and they remain at the top (with Mpumalanga about the same as Gauteng in 3rd place) in 2011. Overall residential segregation has declined measurably in each province. We must be mindful that 1996 and 2011 comparisons are made without perfectly comparably geography, so some of the change could be due to boundary changes or to the reallocation process.

Discussion

Our results show the value of taking concepts and measures for residential segregation and employing them on settings outside of the Global North. A more complete understanding of residential patterns in particularly pertinent for South Africa, given the legacy of controlled residence during the apartheid era. Our calculations for segregation—whether via pairwise dissimilarity or multigroup entropy—point to very high level of spatial separation among population (race) groups. The severity of residential separation among group is further underscored when one considers that the geographic parcels on which our calculations are made are coarser than those often employed in other settings and thus reported in the literature. Ward here are several time the size of census tracts or other such units. It is highly probably that residential segregation statistics calculated on conventional, smaller “neighborhood” units would be appreciably higher.

At the same time, we also observe declines in residential segregation. Lower values of pairwise dissimilarity and entropy (summary across all groups) are found in all provinces. Despite some concerns about strict geographic comparability, this points to measurable desegregation in the last 15 years. But our results (from the pairwise dissimilarity analysis) also point to variation in desegregation patterns, that is, who is becoming more intermingled with whom. Our results point to noticeable desegregation of blacks with respect to Coloured and Indian/Asian populations. We also observe desegregation of Whites and Asians, with much variability across the experiences of individual provinces. Black-White segregation has been observed to decline, but much more modestly.
In further work it will be crucial to understand how any integration is coming about: which groups are moving out of and into which neighborhoods? Indeed, in a study of Tshwane, there was evidence of “considerable desegregation” in some areas, mostly inner city and outlying (Hamann and Horn, 2015). One can examine whether, as might be hypothesized, Group Areas and other such areas of enforced segregation, have remained segregated, while integration, albeit modest, may become discernable in White areas. Dynamic analysis at the neighborhood (ward) level can provide insight.

Perhaps of further interest is the prospect of stepping back from these analyses to place such results in a broader international context. We can ask what features of our findings are unique to South Africa and its distinctive history, and what features find parallels with segregation and inequality findings for other locations and times around the world.
REFERENCES


Figure 3 a-d Change in Residential Segregation 1996-2011 for Selected Group Pairings, all Province