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## **Occupational segregation by race in South Africa after apartheid**

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**Abstract:** This paper investigates progress in reducing the high level of racial stratification of occupations after apartheid in South Africa. Empirical analysis, using census microdata and Labour Force Surveys, does not provide strong evidence of sustained or significant desegregation. Occupations remain highly segmented by race, with blacks disproportionately holding low-paying jobs (compared with whites). Less than a third of segregation and about half of racial stratification in occupational distribution are related to blacks' characteristics, especially their lower educational achievement, a gap that has been reduced over time. Segregation and stratification, however, remain when blacks and whites with similar characteristics are compared.

**Keywords:** occupational segregation, stratification, low-paying, apartheid, South Africa, race  
**JEL classification:** J15, J42, J71, J82, O15, O55

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## 1 Introduction

The lives of South Africans have been dominated by racial segregation since the first Europeans arrived at the Cape in 1652, beginning the largest European settlement on the continent. The segregation of blacks, along with that of coloured and Asians, was intensified during apartheid, the political and social regime enforced by the National Party after it took office in 1948 until the first general democratic elections in 1994.

The ultimate aim of white rulers was to force non-whites to provide seasonal, cheap, and abundant labour for farms, mines, and other sectors, while keeping economic and political power in their own hands. Segregation in South Africa stood out for the range and extent of its discriminatory legislation, which affected every possible sphere of life (e.g. work, education, health, transport, recreation, politics, sexual relationships).<sup>1</sup> Among this legislation, the ‘colour bar’ resulted in job reservation for whites that excluded blacks from skilled and semi-skilled jobs, also depriving them of an adequate education (e.g. 1953 Bantu Education Act). Segregation was also an ideology and set of practices seeking to legitimize social difference and economic inequality (Beinart and Dubow 1995). Core elements of this segregation, such as the exclusion of blacks from skilled work (especially if it involved supervisory functions over whites), or the system of large-scale oscillating labour migration, were determined by custom as well as legislative bars.

The construction of a new deracialized South Africa started after the end of the apartheid regime under the rule of the African National Congress. This involved the formal dismantlement of all the remaining segregative legislation, along with the introduction of anti-discriminatory and affirmative policies to reverse its effects (i.e. Labour Relations Act, Employment Equity Act, Promotion of Equality and Prevention of Unfair Discrimination Act). Deeply rooted inequalities along racial lines, however, proved more difficult to remove, especially in the context of a sluggish economy, the result of the shrinkage of the non-mineral tradable sector from the early 1990s on (Rodrik 2008), with a chronically high level of unemployment.

The aim of this paper is to investigate the extent to which the end of apartheid produced a sustained process of racial desegregation in the distribution of occupations, thus dismantling one of the core elements of racial inequality in South Africa. This has strong implications for the degree of inclusion of blacks as citizens, as well as for improving their material living conditions.

We document the extent and nature of the segregation of black and white workers across occupations based on post-apartheid census and labour force data. For that, we first use the conventional framework based on segregation curves and indices such as Gini and Dissimilarity (Jahn et al. 1947; Duncan and Duncan 1955).<sup>2</sup> We also analyse the vertical or

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<sup>1</sup> This included the disenfranchisement of blacks (e.g. 1936 Representation of Natives Act), restrictions on their geographical mobility (e.g. pass laws), the seizure of most productive lands (e.g. 1913 Native Land Act), the imposition of hut or poll taxes, urban segregation (1923 Natives Act), etc. Feinstein (2005) provides a detailed historical account of racial segregation in South Africa.

<sup>2</sup> We are aware, however, of the complexity of South African demographic groups due to the presence of other racial categories (coloured and Asians), and the high level of heterogeneity within racial groups by other dimensions, such as ethnicity, gender, or area of residence, that need to be analysed in more detail.

ordinal dimension of segregation, measuring the extent to which the labour market is stratified by race, with blacks being systematically segregated into low-paying occupations, using concentration curves and indices when occupations are sorted by average earnings (Gradín 2013a, 2017). Additionally, we attempt to identify the driving factors of this segregation at each moment in time by measuring the level conditional on workers' characteristics using a counterfactual distribution in which blacks are given the characteristics of whites (Gradín 2013a). More precisely, we analyse if segregation is driven by workers' endowments, such as the lower level of education of blacks or their over-representation in rural areas and the poorest provinces of the country. Alternatively, segregation might result from the labour market being intrinsically segregative among workers with similar characteristics on the basis of their race. Both sources of segregation might be the result of discrimination (actual or anticipated), but their distinction helps us to better understand its nature.

In what follows, the next section briefly reviews the relevant literature. The third and fourth sections describe the methodology and data. The fifth section discusses the empirical results, which are summarized in the last section.

## **2 Race and labour market outcomes in South Africa**

As a legacy of colonialism and apartheid, the labour market in South Africa is largely stratified by race. Some of these racial inequalities have been extensively addressed in the previous literature, trying to measure how much progress, if any, was accomplished after the first democratic elections.<sup>3</sup> Most of the research has focused so far on the magnitude of racial gaps in labour market outcomes and the extent to which they can be explained by differences in workers' productivity, especially the large differential in attained education (a gap that is analysed in detail in van der Berg 2007).

A primary source of racial inequality in the labour market occurs in the access to employment. Unemployment rapidly increased in South Africa, especially among blacks, during the 1990s and 2000s, when the economy was unable to absorb the growing supply of semi-skilled labour (e.g. Kingdon and Knight 2007; Banerjee et al. 2008). This occurred in a context characterized by labour market inflexibility and a small informal sector compared with other developing countries (e.g. Kingdon and Knight 2007), and was exacerbated by skill-biased technical change (e.g. Banerjee et al. 2008). This large employment gap by race was largely (but not entirely) explained by the characteristics of workers from each group. For example, Kingdon and Knight (2004) found that one fifth (8 out of 34 percentage points) of the unemployment gap between blacks and whites could not be explained by their attributes in 1994. A higher unexplained term was found by Rospabé (2002) for 1993–99 and by Brookes and Hinks (2004) for 1995–2002. Paradoxically, changes in the characteristics of black South African men after apartheid have made them more employable over time, but at the same time their propensity to be employed has declined (Wittenberg 2007).

Once workers enter the labour market, they face another source of racial inequality: the occupational distribution. This was an essential element of the segregation through job reservation policies and discriminatory practices that excluded blacks from accessing any

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<sup>3</sup> Leibbrandt et al. (2010) provide a thorough description of the situation (trends, institutions, policies) of the labour market in post-apartheid South Africa.

skilled or semi-skilled job. Some sort of desegregation started before the end of apartheid (Mariotti 2012) with the increasing access of blacks to semi-skilled occupations which had previously been reserved for whites between 1970 and 1980, the year of the formal abolition of job reservation, although this was prompted by the scarcity of white workers (who were increasingly better educated). However, racial segregation continued to be strong, since whites were mostly employed in skilled jobs.

Treiman et al. (1996) estimated that the gap in occupational status in 1980 and 1991 (measured by the scale from the International Socioeconomic Index of Occupations) could be largely explained by the different characteristics of each group. Rospabé (2002) reported a gap between blacks and whites in occupational attainment (the probability of getting a high-ranking job such as manager, professional, semi-professional, or technician) of about 40 percentage points in 1993, of which 32 per cent remained unexplained after controlling for productivity characteristics. In 1999, that gap was similar, but the unexplained part had increased to 37 per cent. Similarly, using a multinomial logit model, Treiman (2007) found a large racial penalty in occupational attainment in 1996 that vanished for the very few blacks with tertiary education. As for the reasons for continuing segregation, Keswell et al. (2013) highlighted the importance of education, showing that black female children who inherited the same level of educational opportunity as their parents were 6 to 10 per cent more likely to be at the bottom of the occupational distribution than if they were exposed to better educational opportunities. Regarding the consequences, Gradín (2013b) has recently shown that the higher presence of blacks in more skilled occupations (along with their improved education) has contributed to reducing the racial poverty gap after apartheid (which was to a large extent explained by the cumulative disadvantaged characteristics of blacks, i.e. education, labour, demographic structure, area of residence, and family background).

We have found, however, very little research attempting to directly measure the extent and nature of occupational segregation, the main purpose of this paper. Among the exceptions, Campbell (1987) reported a steady Dissimilarity index of about 0.540 during apartheid years (1970, 1980, and 1985), a time of rapid industrialization that increased the access of blacks to professional and technical occupations.<sup>4</sup> More recently, in the context of an analysis of sex segregation, Parashar (2008) reported a Dissimilarity index of white–black segregation (two-digit classification of occupations) of 0.572 in 2001 using census data. She also reported that this segregation was greater among women (0.580 vs. 0.512 for men), and in Free State and Western Cape (compared with Gauteng). She highlighted the fact that South Africa, unlike the US, stands out for displaying higher segregation by race than by gender.

More attention has focused on the huge earnings gap found between black and white South Africans. For example, Allanson et al. (2000) reported that one third of that gap in 1994 remained unexplained after controlling for differences in productivity, and Allanson et al. (2002) found no immediate improvement after that date. Keswell (2010), however, reported a modest decline in the white–black wage differential between 1993 and 2002, with an increasing importance of differences in the returns to education, which accounted for virtually none of the differential in 1993 but about 40 per cent of it by 2002. This finding points to the increasing importance of differences in the quality of the education received by each population group, while the gap in the number of years of education was reduced.

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<sup>4</sup> He cited an unpublished report from the US Bureau of the Census and the Commission on Civil Rights, and it is not clear how detailed the occupational classification was.

Consistently, Rospabé (2002) also reported an increase in the unexplained part of a shrinking gap between 1993 and 1999.

### 3 Methodology

The conventional framework for measuring segregation of two groups across occupations uses the segregation curve and indices such as Dissimilarity or Gini (Jahn et al. 1947; Duncan and Duncan 1955). Gradín (2017) expanded this framework to take into account the extent to which the segregation of one group (blacks) involves their workers holding the lowest-paying jobs using the concentration curve and indices derived from it. We also follow Gradín's (2013a) approach to identify the level of segregation that can be explained by differences in the attributes of workers of each race, and the level of segregation that remains unexplained when both groups have the same characteristics, in line with previous research on the employment, earnings, and occupational attainment gaps.

#### 3.1 Measuring segregation

We compare the employment distribution across  $J$  occupations of workers from a target or comparison group (i.e. blacks, labelled as  $i = c$ ) and another group, the reference distribution (i.e. whites, denoted by  $i = r$ ). The vector of relative frequencies is  $f^i = (f_1^i, \dots, f_J^i)$ , where  $f_j^i$  is the proportion of workers from group  $i$  in occupation  $j$ , when occupations are sorted by the ascending values of the relative share of members of the reference group (i.e.,  $f_j^r / f_j^c$ ).  $F_j^i = \sum_{s=1}^j f_s^i$  indicates the corresponding cumulative distribution value. The objective is to assess the extent to which each population group tends to be concentrated in a different subset of occupations, and how this changes over time. For that, we first compare each year's segregation curve, and then quantify the amount of segregation at each moment using specific segregation indices.

The segregation curve  $F^r(p)$ ,  $p \in [0,1]$  plots the cumulative proportions of workers for the comparison ( $F_j^c$ ) and reference ( $F_j^r$ ) groups for the  $j$ th occupation with largest under-representation of the reference group, connected with linear segments. The 45° line indicates the case of no segregation (both groups have the same employment distribution across occupations). The segregation curve goes along the abscissa and then shifts to 1 at  $p = 1$  in the case of maximum segregation (both groups working in different occupations). If the segregation curves of two distributions (i.e. years) do not intersect, the one with the curve falling below exhibits higher segregation (upon agreement on only four basic properties; Hutchens 2004).<sup>5</sup> A large set of segregation indices (including Gini, and Generalized Entropy and Atkinson families) will rank them consistently. However, if the curves do intersect, we cannot rank them without agreeing on additional properties, and those measures can produce different rankings, depending on the degree of sensitivity of the index to disequalizing movements at different points of the distribution. For the sake of simplicity, our results will rely on the computation of two indices of segregation.

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<sup>5</sup> A measure of segregation should verify Homogeneity, Symmetry, Principle of (disequalizing) movements between occupations, and Insensitivity to proportional divisions.

The *Dissimilarity* index,  $D$ , can be defined as half the sum of discrepancies in the population shares of each group by occupation:

$$D(f^c, f^r) = \frac{1}{2} \sum_{j=1}^J |f_j^c - f_j^r| = \max_{j \in [1, J]} \{F_j^c - F_j^r\}, \quad (1)$$

Geometrically,  $D$  is the maximum vertical distance between the diagonal and the segregation curve. This occurs at the critical occupation  $q$ , defined so that the comparison group is over-represented below and under-represented above:  $D(f^c, f^r) = F_q^c - F_q^r$ , where  $q = \max_{j \in [1, J]} \{j \mid f_j^c \geq f_j^r\}$ .  $D$  can be interpreted as the proportion of workers of any group that should change occupations (from those in which their group is over-represented to those in which it is under-represented) to achieve full integration.

The *Gini* index can be defined as the area between the segregation curve and the diagonal (divided by its maximum,  $1/2$ ) and thus written as the weighted sum of these vertical distances computed at the midpoints between adjacent occupations:

$$Gini(f^c, f^r) = 2 \sum_{j=1}^J (\hat{F}_j^c - \hat{F}_j^r) f_j^c, \quad (2)$$

$$\text{where } \hat{F}_j^i = \frac{1}{2}(F_{j-1}^i + F_j^i) = F_{j-1}^i + \frac{1}{2}f_j^i, \text{ and } F_0^i = 0.$$

Gini ranks distributions consistently with non-intersecting segregation curves. However,  $D$  is consistent only in a weak sense (it will never rank two distributions in the reverse order), because it is insensitive to any disequalizing movement that occurs between occupations above or below  $q$ .  $D$  is the Gini between two sets of occupations (those dominated by each race). The main contribution of Gini is that it also takes into account segregation within these two large sets of occupations. Both indices vary between 0 (no segregation) and 1 (full segregation) and are symmetric in population groups (it is irrelevant which group is the comparison and which the reference).

### 3.2 Segregation into low-paying occupations

Gradín (2017) adapted the previous approach to measure the extent to which one group, blacks, tends to be systematically over-represented in low-paying jobs. This low-pay segregation implies stratification in occupations (also referred to as vertical or ordinal segregation). The approach basically consists in re-ranking the distribution of occupations by a measure of their quality (e.g. the average earnings  $w_j$ ). We call  $g_j^i$  and  $G_j^i$  the relative frequency and cumulative frequency of workers from group  $i$  in occupation  $j$  in this re-ranked distribution.

The concentration curve  $G^r(p)$ ,  $p \in [0, 1]$  plots the cumulative proportion of workers from both groups (with occupations sorted by  $w_j$ ):  $G_j^c$  in the horizontal axis and  $G_j^r$  in the vertical axis (connected by linear segments). The target group  $c$  is segregated into low-paying occupations (compared with group  $r$ ) if the proportion of workers from this group is larger (or equal) below any reasonable low-pay threshold. This means that the concentration curve falls below the diagonal ( $G_j^c \geq G_j^r$ ) over the target range, and that there is first-order

stochastic dominance of  $r$  over  $c$ .<sup>6</sup> If there is no segregation or if the labour market is segmented but with both groups in occupations providing similar pay, the labour market is not stratified. The labour market is stratified when workers from one group are segregated into occupations that systematically tend to pay less.

The values of the concentration curve are bounded from below by the segregation curve when all segregation is into low-paying jobs, and from above by its mirror image above the diagonal when the segregation of the comparison group is into high-paying occupations. The actual values of the curve depend on the correlation between the employment distribution using the two alternative ranks of occupations (sorted by earnings and by racial ratios). If segregation is pay neutral, the concentration curve will go along the diagonal. Whenever the concentration curves of two distributions (i.e. years) do not overlap, we can say that the one with the curve falling above the comparison group exhibits less segregation into low-paying occupations.

We use the concentration versions of the Gini and Dissimilarity indices, obtained by using  $g$  instead of  $f$  in the geometrical interpretations, to quantify low-pay segregation and to rank distributions accordingly when the concentration curves overlap. The Gini concentration index,

$$Gini(g^c, g^r) = 2 \sum_{j=1}^J (\hat{G}_j^c - \hat{G}_j^r) g_j^c, \quad (3)$$

is twice the area (positive or negative) between the diagonal and the concentration curve, and corresponds to the index of vertical segregation proposed by Blackburn and Jarman (1997) based on Somers' (1962) measure of statistical association.

The Dissimilarity concentration index,

$$D(g^c, g^r) = G_s^c - G_s^r; \text{ where } |G_s^c - G_s^r| = \max_{j \in [1, J]} \{|G_j^c - G_j^r|\}, \quad (4)$$

is the maximum vertical distance (positive or negative) between the diagonal and the concentration curve, and measures the proportion of workers of each group that should change occupation in order to eliminate segregation into low-paying (high-paying) occupations for any possible low-pay threshold.

Each concentration index is bounded between the corresponding segregation index (when all segregation of the comparison group is into low-paying jobs) and its negative value (when all segregation is into high-paying jobs). Thus, the index falls in the range between  $-1$  and  $1$ , with the extremes requiring full segregation. A positive (negative) sign indicates predominant segregation of the comparison group into low-paying (high-paying) occupations. If the distribution is pay neutral, the concentration indices will be zero. We will compute standard errors for segregation and concentration indices using bootstraps.

We can also define concentration ratios as the proportion of observed segregation of the comparison group that is low-paying (or high-paying), by normalizing each concentration index by its maximum value (the segregation index), with the sign still indicating whether the comparison group tends to be segregated into low- or high-paying occupations,  $r_S = \frac{S(g^c, g^r)}{S(f^c, f^r)}$

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<sup>6</sup> By replacing  $\geq$  by  $\leq$  or with  $=$  we similarly define segregation into high-paying occupations and neutral-pay segregation.

$S = Gini, D$ . In particular,  $r_{Gini}$  is the *Gini correlation coefficient* between groups' ratio and average earnings across occupations, computed among members of group  $c$ .<sup>7</sup> These concentration indices (and ratios) are symmetric in their absolute values. Exchanging group labels (which is the reference and which is the comparison group) will just change their sign.

### 3.3 Measuring conditional segregation

The observed level of segregation might be the result of the distribution of relevant characteristics differing across population groups. We follow here Gradín (2013a, 2014), who adapted DiNardo et al.'s (1996) procedure for the decomposition of the interdistributional wage differentials to the measurement of segregation. To disentangle what part is driven by differences in observable characteristics (explained or compositional effect) and what part is conditional segregation of workers with similar characteristics on the basis of race, we construct a counterfactual distribution  $F_Y^c$ . In this counterfactual, individual observations of the comparison group (blacks) are reweighted to reproduce the same distribution of characteristics of the reference (whites). The reweighting factor is the odds of being white conditional on characteristics using a logit regression.<sup>8</sup> In this counterfactual, both races will exhibit the same distribution of types (workers with any given combination of characteristics, such as holding a university degree, living in urban Western Cape, etc.), but each race keeps its own distribution across occupations conditional on type.<sup>9</sup>

This flexible semi-parametric approach allows us to obtain the aggregate decomposition of any unconditional segregation index  $S(f^c, f^r)$  into explained and unexplained terms:

$$S(f^c, f^r) = S^E + S^U = [S(f^c, f^r) - S(f^v, f^r)] + S(f^v, f^r), \quad (5)$$

where  $S^E = [S(f^c, f^r) - S(f^v, f^r)]$  is the level of segregation explained by both population groups having different distributions of characteristics (types of workers).  $S^U = S(f^v, f^r)$  is the unexplained or conditional segregation that remains after equalizing the distribution of types in both groups, depending on how much the labour market segregates (on the basis of race) people with similar observed characteristics. The identification of the unexplained term with discrimination in the labour market, however, has to be cautious, as in the analysis of wage or employment discrimination, because it may also reflect racial differences in unobserved characteristics (e.g. job preferences, quality of education, unobservable skills). Similarly, the explained part could also reflect discrimination in the

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<sup>7</sup> This is a measure of association that uses the Gini covariance as a measure of variability (instead of the conventional covariance), whose properties are a mixture of Pearson's and Spearman's correlations (see Schechtman and Yitzhaki 1987, 1999; Yitzhaki and Olkin 1991).

<sup>8</sup> That is, the reweighting factor is  $\Psi_X = \frac{f^r(x)}{f^c(x)} = \frac{N^c Pr(r|x)}{N^r Pr(c|x)}$ , where  $Pr(r|x) = \frac{\exp(x\beta)}{1+\exp(x\beta)}$  and  $Pr(c|x) = 1 - Pr(r|x)$ ; while  $x$  is the vector of characteristics and  $\beta$  the estimated coefficients.  $\frac{N^c}{N^r}$  is a constant indicating the groups' population ratio. The  $Pr(r|x)$  is obtained by estimating the probability of being a member of  $r$  (as opposed to  $c$ ) on a set of workers' characteristics, using a logit model.

<sup>9</sup> Another counterfactual is possible in which blacks keep their own distribution of characteristics, but are given the conditional employment distribution of whites (obtained by reweighting the reference distribution instead). However, given that blacks exhibit characteristics (such as lower educational attainment) that constrain their occupational opportunities, the other counterfactual seems to be more reasonable as one expects blacks to eventually converge with whites in education and other attributes (and not otherwise).

labour market anticipated by the disadvantaged group (leading, for instance, to lower investment in human capital or influencing their migration patterns), apart from reflecting pre-labour market discrimination (such as in the access to education).

A detailed decomposition of the explained segregation term will allow us to identify the main determinant factors.<sup>10</sup> Given the non-linear nature of the approach, this is not straightforward, however. Starting with the case in which all estimated coefficients in the logit regression are set to zero, we produce a sequence of reweighting factors, consecutively switching the coefficients of each set of characteristics to its estimated value, finishing when all coefficients are changed. The contribution of each set of characteristics would be the change in segregation after their associated coefficients were switched on, but this procedure has a path-dependency problem. To avoid that, we obtain the contribution of each factor after averaging over all possible sequences (Gradín 2014, using a Shapley decomposition: Chantreuil and Trannoy 2013; Shorrocks 2013).

The same exercise is done with segregation into low-paying occupations, after replacing  $f$  with  $g$  in (5).

## 4 Data

Censuses have been conducted in South Africa since 1911, but those prior to the 1994 democratic elections (the last one in 1991) are problematic, especially regarding the black population. The 1996 Census was the first one covering the entire country and treating all populations groups equally (e.g. StatsSA 2007). Our main empirical analysis uses microdata samples from the post-apartheid 1996 and 2001 Censuses, and the 2007 Community Survey from Statistics South Africa, harmonized by the Minnesota Population Center in its Integrated Public Use Microdata Series (IPUMS-I, Minnesota Population Center 2015). Unfortunately, the most recent 2011 Census did not code the information about occupation. The use of census data guarantees larger samples from which to analyse segregation across a more detailed classification of occupations, while providing the required information related to workers' characteristics.

Race is considered using the classification that comes from apartheid. Whites are those with European ancestry (mostly Dutch and British), making up 9 per cent of the population in 2007 (16 per cent of workers). Blacks (or Africans) are the largest population group (80 per cent of the population and 69 per cent of workers in 2007) and are mostly the descendants of Bantu farmers who have migrated from the Great Lakes region in East Africa into eastern areas of South Africa since the third century. This racial category comprises different ethnicities from the Nguni (e.g. Xhosa, Zulu), Sotho-Tswana, and other minor linguistic branches. The other non-white categories (coloured and Asians) are not analysed here.

For the sake of inter-temporal comparability, the final sample is composed of white and black individuals not living in group quarters,<sup>11</sup> 15–65 years old, who are employed, not in

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<sup>10</sup> With this methodology it is not possible to obtain a detailed decomposition of the unexplained effect (which in any case would be subject to a serious identification problem).

<sup>11</sup> We included in the sample those with group quarter status unknown in 1996. IPUMS-I reports that 17 districts in Easter Cape were not organized into households in that census.

the Armed Forces.<sup>12</sup> This implies a total of 1,414,812 individual observations with the following distribution by year and race: 630,350 (166,560 whites, 463,790 blacks) in 1996; 590,227 (139,085 whites, 451,142 blacks) in 2001; and 194,235 (33,268 whites, 160,967 blacks) in 2007.

Our main results use the IPUMS harmonized three-digit International Standard Classification of Occupations (ISCO-1988),<sup>13</sup> with 125 categories, including one for those with occupation not classified elsewhere or unknown, which is problematic given its large importance, especially in 2007 (16 per cent compared with around 7 per cent in the previous years). For robustness, we also produced results for IPUMS one- and two-digit harmonized classifications (with 10 and 37 categories respectively), and for all three classifications with those reporting unknown occupation removed from the sample.

Earnings for each occupation will be approximated using contemporary average income, using a person's annual income in rands for the twelve months prior to the census.<sup>14</sup> Given the strong stratification of the South African labour market, it is not straightforward whose income we should consider in order to rank occupations. We present our main results using the average calculated over the entire population, although we also estimated the alternative using the black population only.<sup>15</sup>

Workers' characteristics used to estimate conditional segregation were defined as follows. Location includes area (urban or rural) and province (Western Cape, Eastern Cape, Northern Cape, Free State, KwaZulu-Natal, North West, Gauteng, Mpumalanga, and Limpopo). Educational attainment distinguishes no schooling, some primary, primary (6 years), lower secondary, secondary, university, other education, and unknown education. Immigration is measured by immigrant status (no immigrant, national immigrant, immigrant from abroad) and years residing in current dwelling. Other demographic variables include: age intervals (15–24, 25–34, 35–44, 45–54, and 55–64 years old), gender, marital status (single, never married, or unknown; married or in consensual union; separated, divorced, or spouse absent; widowed), household head, spouse, and disabled statuses.

The empirical analysis is also based on the South Africa – Post-Apartheid Labour Market Series (PALMS v3.1, Kerr et al. 2016) 1994–2015, from the DataFirst portal at University of Cape Town, in order to have more detailed information over time and for the sake of robustness. PALMS combines different Statistics South Africa surveys: the annual October Household Surveys (OHS 1994–99), the biannual Labour Force Surveys (LFS 2000–07), and the Quarterly Labour Force Surveys (QLFS 2008–15). The sample consists of 1,017,093 observations (855,882 blacks, 161,211 whites), with 46,232 observations per year on average

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<sup>12</sup> The universe for occupational variables is employed persons at least 15 years old in private households in 1996, employed or economically active persons at least ten years old in 2001, and persons aged 15 to 74 years old with a job last week, not in institutions, in 2007. Employment status is defined for 15–65-year-old people in 2001 and 2007 (15 or older in 1996) and refers to the time of the census (1996) or the reference week (2001 and 2007). For comparability issues across these three datasets, see Yu (2009).

<sup>13</sup> This differs from the original unharmonized classification (161 categories) because some small occupations have been aggregated by IPUMS into one single category within the same group.

<sup>14</sup> Values recoded by IPUMS to the midpoints of the broad intervals given in the original data, with the top interval coded to its lowest possible value. The average was preferred to the median in this case due to the high probability of ties when income is reported in intervals.

<sup>15</sup> The Spearman (rank) correlation between black and white average incomes across occupations was 46 per cent in 1996, 59 per cent in 2001, and 46 per cent in 2007.

(38,904 blacks and 7,328 whites), but with great variability across years: from a minimum of 11,040 in 1996 (8,891 blacks and 2,149 whites) to a maximum of 83,227 in 2008 (71,036 blacks and 12,191 whites).<sup>16</sup> We also used ISCO-1988 occupations at one-, two-, and three-digit classifications, even if the smaller sample sizes, compared with census data, impose some cautions about the more detailed results. PALMS also has an estimation of real earnings that will be used to rank occupations, after some adjustments.<sup>17</sup>

## 5 Segregation and stratification trends after apartheid

### 5.1 Trends in unconditional occupational segregation

We start the analysis using the segregation curves to check if it is possible to identify a clear and robust trend in occupational segregation by race with census data (Figures 1a and 1b). The 2007 curve entirely falls above the corresponding curve in 1996, which means that upon agreement on only four basic principles, one can say that there was a unambiguous decline in segregation that will be confirmed by most indices of segregation. However, the story is different by sub-periods.

The 2001 segregation curve generally falls below that of 1996, except at the top decile of occupations with the largest over-representation of whites. This means that segregation increased around occupations already disproportionately filled by blacks between 1996 and 2001, although there was some desegregation in occupations with larger shares of whites. These intersecting curves imply that segregation increased by all consistent indices unless they put a larger weight on predominantly white occupations. We, however, find a robust reduction in segregation between 2001 and 2007, no matter what index we use, because the 2007 curve entirely falls above that of 2001.

The use of indices allows us to quantify the intensity of segregation in each year (Figures 2a and 2b; Tables 2 and 3). The increase in segregation between 1996 and 2001 was about 2 per cent (Gini) or 6 per cent ( $D$ ), while the decrease in segregation between 2001 and 2007 was about 13 or 16 per cent, respectively. The net reduction for the entire 1996–2007 period was of nearly 11 per cent with both indices, but the remaining level of segregation in 2007 was still large, with a Gini of 0.599, 74 per cent of which was between occupations dominated by each race ( $D = 0.442$ ). This trend in segregation is similar with the one- and two-digit classifications. If we remove observations with occupation unknown or not classified elsewhere (instead of considering this group as an independent category), then the reduction

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<sup>16</sup> For inter-temporal consistency, we deleted 2,090 observations with unknown occupation (most from 1996 and 1997). Observations are weighted using the cross Entropy weight derived by DataFirst from the Actuarial Society of South Africa (ASSA) 2008 demographic model. For details of these data, see Kerr and Wittenberg (2016).

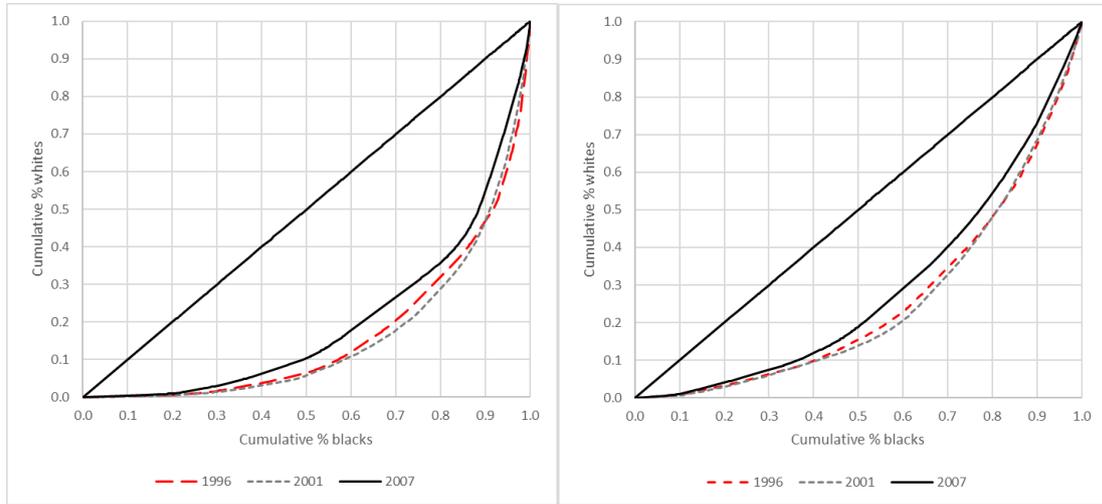
<sup>17</sup> PALMS constructed an inflation-adjusted labour earnings variable. There are some outliers and a large number of observations with missing earnings. The latter affects all occupations in various years (1996, 2008–09, and 2015), and some occupations using detailed classifications in others. For that, we used the median (instead of the mean) and imputed it for occupations lacking such information using earnings in the previous available year. The series may be affected by changes over time, especially from OHS to LFS in 1999–2000 (see Wittenberg 2014).

in segregation (three-digit) is smaller: about 8 per cent between 2001 and 2007, 3–7 per cent for the overall period.

Figure 1: Racial occupational segregation curves

a: Observed

b: Unexplained

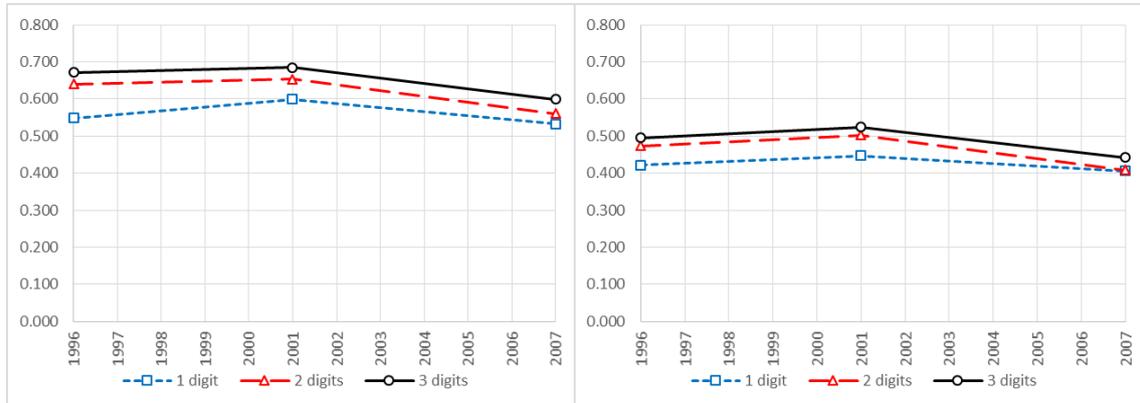


Source: Own construction based on IPUMS-International (three-digit classification).

Figure 2: Racial occupational segregation indices

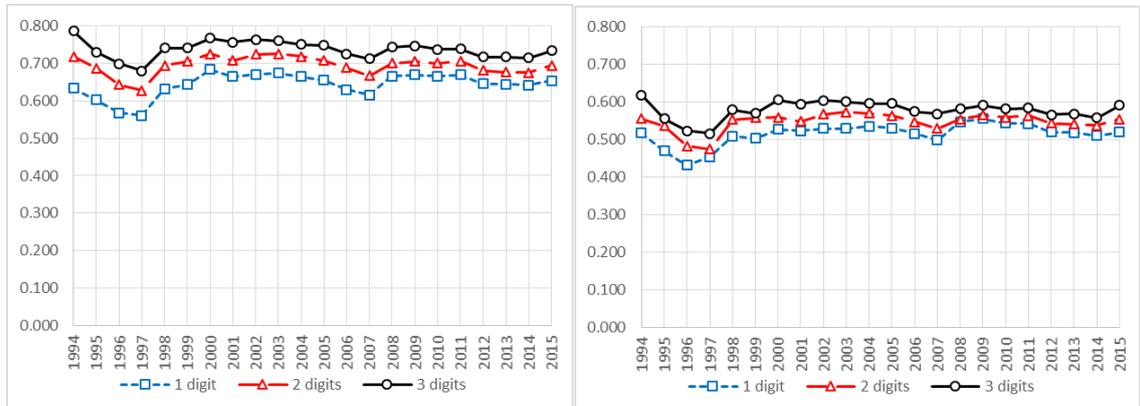
a: Census (Gini)

b: Census (Dissimilarity)



c: LFS (Gini)

d: LFS (Dissimilarity)



Source: Own construction based on IPUMS-International (census) and PALMS (LFS).

The LFS data reflect an even more pessimistic trend in segregation for 1994–2015 (Figures 2c and 2d). We can distinguish an initial intense decline in segregation between 1994 and 1997, right after the end of apartheid. This decline was followed by various oscillations according to the business cycle.<sup>18</sup> It is, however, discouraging to find out that the level of segregation in 2015 was still similar to or only slightly below that achieved right at the end of apartheid, and substantially above that in 1997 (at least 8 per cent and 15 per cent with Gini and *D*).<sup>19</sup>

## 5.2 The segregation of blacks into lower-paying occupations

We now address the issue of the quality of occupations held by blacks, by looking at the concentration curves and indices. Using census data, Figure 3a (cf. Figure 3b) shows that blacks are disproportionately over-represented in lower-paying jobs because each year's curve falls below the diagonal (implying first-order stochastic dominance along the entire occupational distribution). Between 1996 and 2001 there was an increase in the segregation of blacks into low-paying occupations for almost the entire range of earnings, although the concentration curves cross at the 97th percentile of black workers (this implies small improvement for blacks in high-paying occupations). The situation improved between 2001 and 2007 (the latter curve is always above the former). For the entire period, 1996–2007 the curves cross twice (at the 83rd and 90th percentiles), showing a general improvement in the situation of blacks at the bottom and top of the distribution, but with some deterioration in the middle.

From Figures 4a–4c, we can infer that almost all segregation of blacks with respect to whites is into low-paying occupations, because the concentration curve lies very close to the corresponding segregation curve every year. This strong racial stratification is confirmed by the corresponding Gini and *D* concentration ratios, close to 100 per cent. Thus, the proportion of blacks in an occupation is a very good predictor of how low it pays on average.<sup>20</sup> This correlation intensifies over time, from 90 per cent (92.5 per cent) in 1996 to 95 per cent (96 per cent) with Gini (*D*), because between 1996 and 2001 concentration indices increased more intensely than their segregation counterparts, and between 2001 and 2007 they decreased at a similar rate (Figures 5a and 5b). Blacks faced less segregation in 2007 than in 1996, but with a higher fraction of it being into low-paying occupations. The unnormalized concentration indices increased by 6 per cent (Gini) and 10 per cent (*D*) between 1996 and 2001, and decreased by 11 per cent and 15 per cent respectively between

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<sup>18</sup> The correlation between unemployment rates and segregation (three digits) after 1997 is 67–72 per cent (Gini and Dissimilarity).

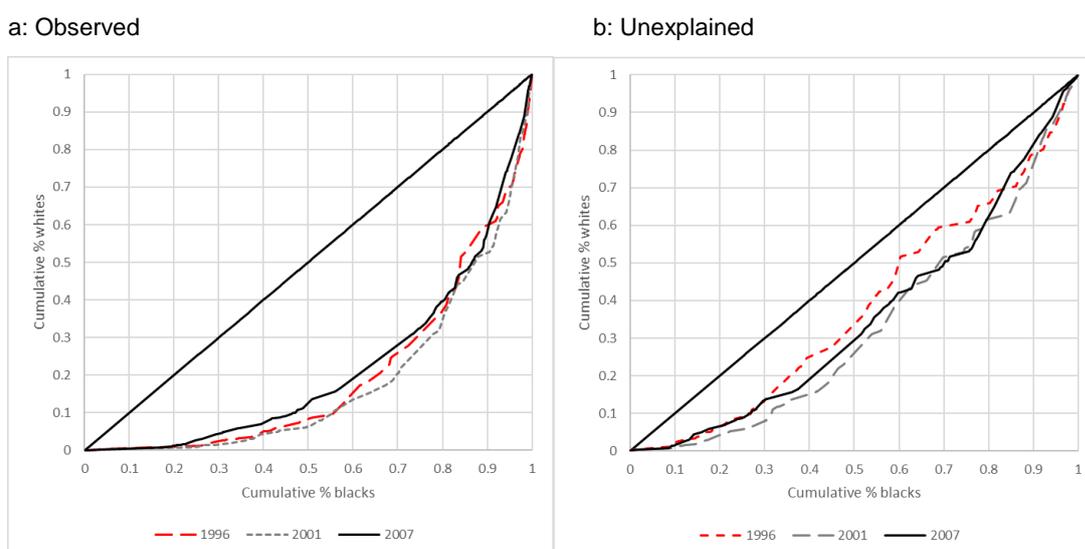
<sup>19</sup> The results with Labour Force Surveys corroborate the 1996–2001 increase and the 2001–07 decrease found using census data, but with different intensities, such that the 1996–2007 period shows a net increase (2–8 per cent with Gini, 9–15 per cent with *D*, depending on the classification used). When workers with unknown occupation in Labour Force Surveys are included, segregation is higher in 1996–97 than reported here.

<sup>20</sup> This may be influenced by the fact that the presence of blacks in an occupation in itself pushes down the average income. The use of blacks' income structure (instead of that of the entire population) to measure how much an occupation pays maintains the qualitative results, even if the share of segregation into low-paying occupations that can be considered is smaller: 79 per cent, 84 per cent, and 84 per cent (Gini), and 80 per cent, 84 per cent, and 94 per cent (*D*), in 1996, 2001, and 2007, respectively.

2001 and 2007. The reductions for the entire period were of only 6 per cent and 7 per cent, respectively.<sup>21</sup>

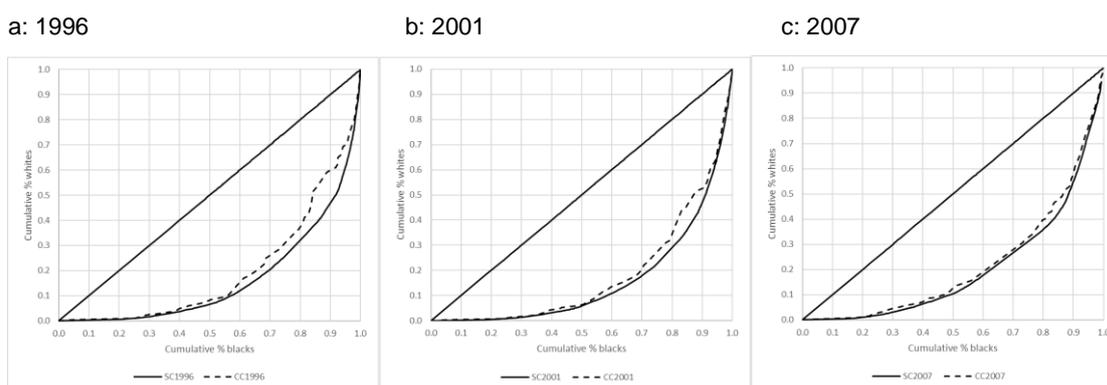
The results using labour force data (Figure 6 for three-digits) show that unnormalized levels of segregation into low-paying occupations follow a similar trend to the one described for segregation. However, the degree of stratification is even higher in 2015 than right after the end of apartheid, and about 23–29 per cent higher than its minimum, achieved in 1996, with oscillations along the business cycle in between.<sup>22</sup> These results also confirm that most segregation of blacks is into low-paying occupations, with the fraction tending to increase over time (from 81 per cent in 1994 to 89–95 per cent in 2015). A similar picture is obtained with the two-digit classification (reported in Table A1 in the Appendix).

Figure 3: Racial occupational concentration curves



Source: Own construction based on IPUMS-International (three-digit classification).

Figure 4. Racial occupational segregation and concentration curves



Source: Own construction based on IPUMS-International (three-digit classification).

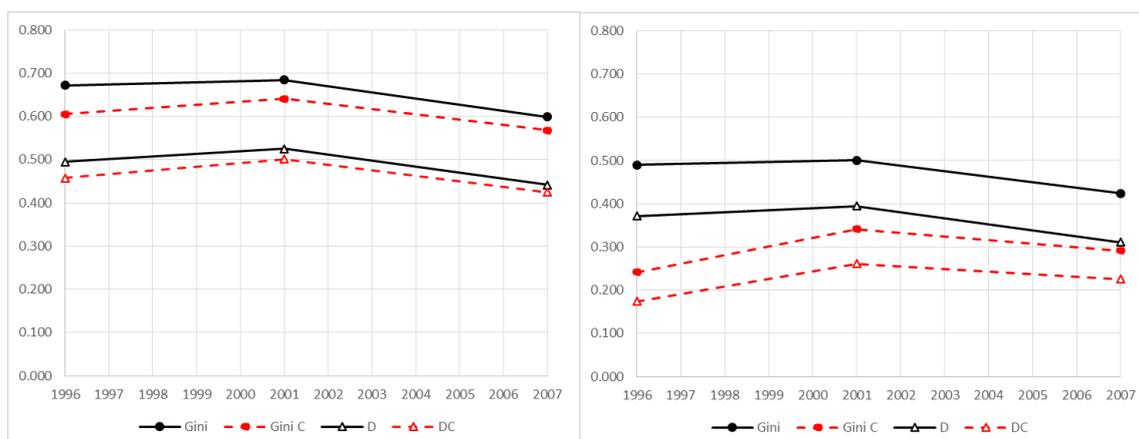
<sup>21</sup> As in the case of segregation, the improvement for blacks is smaller if we remove workers with unknown occupation, resulting in no improvement between 1996 and 2007 with  $D$ , and a small 3 per cent reduction with Gini.

<sup>22</sup> The correlation between stratification and unemployment rates was 74–76 per cent (three-digit Gini and  $D$ ) between 1994 and 2015. When workers with unknown occupation in Labour Force Surveys are included, low-pay segregation is slightly higher in 1996–97 than reported here.

Figure 5: Segregation of blacks into low-paying occupations

a: Observed

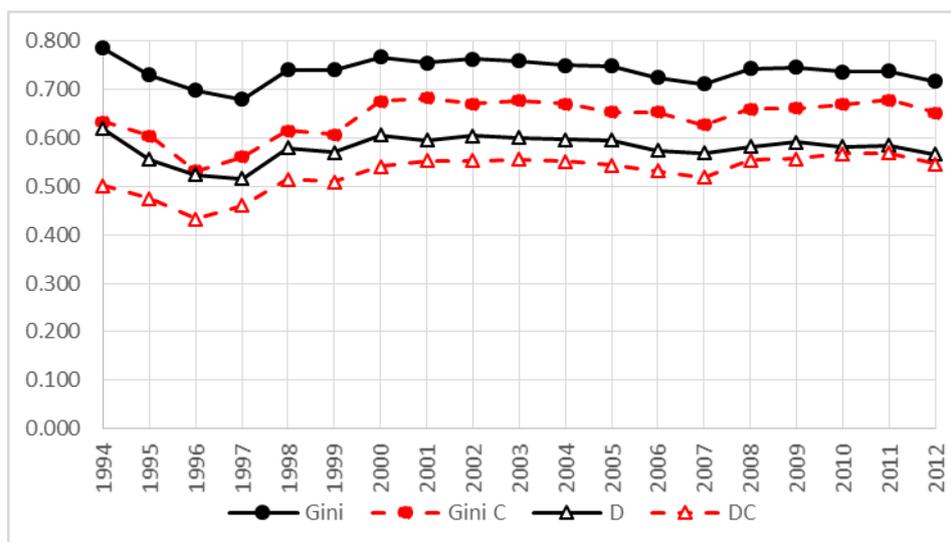
b: Unexplained



Note: Gini and Dissimilarity segregation and concentration (C) indices.

Source: Own construction based on IPUMS-International (three-digit classification).

Figure 6: Segregation and low-paying segregation



Note: Gini and Dissimilarity segregation and concentration (C) indices.

Source: Own construction based on PALMS (three-digit classification).

### 5.3 Conditional racial segregation and stratification

The segregation of black African workers across occupations, and their over-representation in low-paying occupations, could be to some extent the result of inequalities of other kinds (geographical, demographic, educational, etc.) that occurred previous to the entrance into the labour market, whether the result of previous or anticipated discrimination or not. As reported in Table 1, blacks, compared with whites, are under-represented in urban areas, in the richest provinces such as Gauteng (which includes Johannesburg and Pretoria) or Western Cape (including Cape Town). They are also under-represented among high-skilled workers (with secondary or higher education completed) and immigrants, and they tend to be younger and unmarried in larger proportions (black spouses are less likely to be employed). To see how much segregation is due to the different distribution of characteristics across races, we compare observed segregation and segregation in the counterfactual

situation in which blacks are given the same distribution of characteristics as whites (Tables 2 and 3 using census data).

Table 1: Workers' characteristics by race

|                                  | Blacks |      |      | Whites |      |      |
|----------------------------------|--------|------|------|--------|------|------|
|                                  | 1996   | 2001 | 2007 | 1996   | 2001 | 2007 |
| Rural                            | 35.5   | 32.9 | 32.7 | 8.6    | 8.0  | 7.8  |
| Urban                            | 64.5   | 67.1 | 67.3 | 91.4   | 92.0 | 92.2 |
| Western Cape                     | 4.6    | 5.3  | 6.4  | 18.2   | 18.7 | 20.6 |
| Eastern Cape                     | 10.0   | 8.7  | 11.3 | 7.2    | 6.7  | 6.3  |
| Northern Cape                    | 1.2    | 1.1  | 1.1  | 2.4    | 2.2  | 1.8  |
| Free State                       | 8.8    | 8.0  | 6.4  | 6.6    | 4.9  | 5.6  |
| KwaZulu-Natal                    | 18.0   | 17.7 | 17.7 | 13.0   | 11.0 | 9.8  |
| North West                       | 10.8   | 10.3 | 9.3  | 4.5    | 5.0  | 4.2  |
| Gauteng                          | 28.5   | 31.1 | 30.5 | 40.4   | 44.2 | 43.5 |
| Mpumalanga                       | 9.0    | 8.6  | 8.8  | 5.5    | 4.4  | 5.9  |
| Limpopo                          | 9.1    | 9.3  | 8.5  | 2.5    | 2.9  | 2.3  |
| No schooling                     | 16.3   | 14.0 | 7.2  | 0.6    | 0.6  | 0.2  |
| Some primary                     | 12.5   | 12.4 | 11.8 | 0.2    | 0.3  | 0.2  |
| Primary (6 years)                | 25.6   | 20.7 | 18.4 | 1.5    | 2.4  | 2.3  |
| Lower secondary                  | 21.0   | 21.1 | 23.1 | 15.5   | 15.0 | 11.0 |
| Secondary                        | 19.4   | 28.7 | 33.8 | 58.5   | 64.3 | 62.1 |
| University                       | 1.5    | 3.1  | 4.6  | 12.6   | 17.4 | 23.6 |
| Other education                  | 3.1    | 0.0  | 1.2  | 7.1    | 0.0  | 0.6  |
| Unknown education                | 0.6    | 0.0  | 0.0  | 4.0    | 0.0  | 0.0  |
| 15–24 years old                  | 10.1   | 10.0 | 12.8 | 14.3   | 11.8 | 10.9 |
| 25–34 years old                  | 35.8   | 33.8 | 31.3 | 29.7   | 28.3 | 23.3 |
| 35–44 years old                  | 31.0   | 31.7 | 28.8 | 27.4   | 28.4 | 27.4 |
| 45–54 years old                  | 16.4   | 18.3 | 19.6 | 20.1   | 21.4 | 23.8 |
| 55–65 years old                  | 6.6    | 6.2  | 7.5  | 8.6    | 10.2 | 14.6 |
| Female                           | 41.0   | 42.0 | 43.6 | 42.8   | 44.2 | 45.5 |
| Single/never married/unknown     | 37.4   | 36.3 | 42.1 | 20.4   | 19.3 | 21.1 |
| Married/in union                 | 56.0   | 56.9 | 51.1 | 70.4   | 72.0 | 71.4 |
| Separated/divorced/spouse absent | 3.7    | 3.6  | 3.0  | 7.4    | 7.0  | 5.7  |
| Widowed                          | 2.9    | 3.2  | 3.8  | 1.8    | 1.7  | 1.7  |
| Household head                   | 57.8   | 58.8 | 57.2 | 55.1   | 52.1 | 51.1 |
| Spouse                           | 16.2   | 16.4 | 15.0 | 28.4   | 28.9 | 29.8 |
| Disabled                         | 7.3    | 3.3  | 2.0  | 2.5    | 1.9  | 1.5  |

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|                       |      |      |      |      |      |      |
|-----------------------|------|------|------|------|------|------|
| Native                | 88.8 | 93.6 | 93.6 | 87.2 | 89.8 | 90.8 |
| National immigrant    | 9.5  | 5.6  | 5.4  | 11.4 | 9.1  | 7.7  |
| Immigrant from abroad | 1.7  | 0.7  | 1.0  | 1.3  | 1.0  | 1.5  |

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Source: Own construction based on IPUMS-International.

Table 2: Racial occupational segregation/concentration (Gini) with standard errors (se)

| 1996              | Segregation | se    | % observed | Concentration | se    | % observed | Ratio  | % observed |
|-------------------|-------------|-------|------------|---------------|-------|------------|--------|------------|
| Observed          | 0.672       | 0.001 | 100        | 0.606         | 0.001 |            | 0.901  | 100        |
| Unexplained       | 0.490       | 0.003 | 72.9       | 0.242         | 0.003 | 39.9       | 0.493  | 54.7       |
| Explained (total) | 0.182       | 0.002 | 27.1       | 0.364         | 0.003 | 60.1       | 0.408  | 45.3       |
| Location          | 0.015       | 0.001 | 2.2        | -0.014        | 0.001 | -2.3       | -0.040 | -4.4       |
| Education         | 0.169       | 0.002 | 25.2       | 0.373         | 0.002 | 61.6       | 0.432  | 47.9       |
| Demographics      | -0.001      | 0.001 | -0.2       | 0.005         | 0.001 | 0.9        | 0.017  | 1.8        |
| Immigration       | 0.000       | 0.000 | 0.0        | 0.000         | 0.000 | -0.1       | -0.001 | -0.1       |
| 2001              |             |       |            |               |       |            |        |            |
| Observed          | 0.685       | 0.001 | 100        | 0.641         | 0.001 |            | 0.936  | 100        |
| Unexplained       | 0.501       | 0.002 | 73.1       | 0.342         | 0.003 | 53.3       | 0.683  | 72.9       |
| Explained (total) | 0.184       | 0.002 | 26.9       | 0.299         | 0.002 | 46.7       | 0.253  | 27.1       |
| Location          | 0.019       | 0.001 | 2.8        | -0.006        | 0.001 | -1.0       | -0.038 | -4.1       |
| Education         | 0.168       | 0.001 | 24.5       | 0.293         | 0.001 | 45.7       | 0.260  | 27.8       |
| Demographics      | -0.003      | 0.001 | -0.5       | 0.013         | 0.001 | 2.0        | 0.032  | 3.4        |
| Immigration       | 0.001       | 0.000 | 0.1        | 0.000         | 0.000 | 0.0        | -0.001 | -0.1       |
| 2007              |             |       |            |               |       |            |        |            |
| Observed          | 0.599       | 0.003 | 100        | 0.567         | 0.003 |            | 0.948  | 100        |
| Unexplained       | 0.424       | 0.005 | 70.8       | 0.292         | 0.006 | 51.4       | 0.688  | 72.6       |
| Explained (total) | 0.175       | 0.004 | 29.2       | 0.276         | 0.005 | 48.6       | 0.260  | 27.4       |
| Location          | 0.021       | 0.002 | 3.6        | 0.005         | 0.002 | 0.9        | -0.026 | -2.7       |

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|              |        |       |      |       |       |      |        |      |
|--------------|--------|-------|------|-------|-------|------|--------|------|
| Education    | 0.155  | 0.003 | 25.9 | 0.247 | 0.003 | 43.5 | 0.228  | 24   |
| Demographics | -0.003 | 0.002 | -0.6 | 0.023 | 0.002 | 4.0  | 0.059  | 6.2  |
| Immigration  | 0.002  | 0.000 | 0.3  | 0.001 | 0.000 | 0.1  | -0.001 | -0.1 |

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Note: Bootstrap standard errors (200 replications).

Source: Own construction based on IPUMS-International (three-digit classification).

Table 3: Racial occupational segregation/concentration (*D*) with standard errors (se)

| 1996              | Segregation | se    | % observed | Concentration | se    | % observed | Ratio  | % observed |
|-------------------|-------------|-------|------------|---------------|-------|------------|--------|------------|
| Observed          | 0.495       | 0.001 | 100        | 0.458         | 0.001 | 100        | 0.925  | 100        |
| Unexplained       | 0.371       | 0.002 | 75.0       | 0.174         | 0.002 | 38.0       | 0.468  | 50.7       |
| Explained (total) | 0.124       | 0.002 | 25.0       | 0.284         | 0.002 | 62.0       | 0.456  | 49.3       |
| Location          | 0.009       | 0.001 | 1.9        | -0.010        | 0.001 | -2.1       | -0.033 | -3.5       |
| Education         | 0.117       | 0.002 | 23.6       | 0.293         | 0.001 | 64.0       | 0.476  | 51.5       |
| Demographics      | -0.002      | 0.001 | -0.4       | 0.001         | 0.001 | 0.2        | 0.014  | 1.5        |
| Immigration       | 0.000       | 0.000 | 0.0        | 0.000         | 0.000 | -0.1       | -0.001 | -0.1       |
| 2001              |             |       |            |               |       |            |        |            |
| Observed          | 0.525       | 0.001 | 100        | 0.502         | 0.001 | 100        | 0.956  | 103        |
| Unexplained       | 0.395       | 0.002 | 75.2       | 0.261         | 0.002 | 52.0       | 0.661  | 71.5       |
| Explained (total) | 0.130       | 0.002 | 24.8       | 0.241         | 0.002 | 48.0       | 0.295  | 31.9       |
| Location          | 0.015       | 0.001 | 3.0        | -0.008        | 0.001 | -1.7       | -0.047 | -5.1       |
| Education         | 0.117       | 0.001 | 22.3       | 0.240         | 0.001 | 47.9       | 0.312  | 33.7       |
| Demographics      | -0.003      | 0.001 | -0.6       | 0.009         | 0.001 | 1.9        | 0.033  | 3.5        |
| Immigration       | 0.001       | 0.000 | 0.1        | -0.001        | 0.000 | -0.1       | -0.002 | -0.2       |
| 2007              |             |       |            |               |       |            |        |            |
| Observed          | 0.442       | 0.003 | 100        | 0.424         | 0.003 | 100        | 0.961  | 104        |
| Unexplained       | 0.311       | 0.004 | 70.5       | 0.225         | 0.005 | 53.1       | 0.724  | 78.3       |
| Explained (total) | 0.130       | 0.004 | 29.5       | 0.199         | 0.005 | 46.9       | 0.237  | 25.6       |
| Location          | 0.018       | 0.001 | 4.0        | 0.011         | 0.001 | 2.6        | -0.008 | -0.9       |

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|              |        |       |      |       |       |      |       |      |
|--------------|--------|-------|------|-------|-------|------|-------|------|
| Education    | 0.115  | 0.003 | 26.0 | 0.176 | 0.003 | 41.6 | 0.204 | 22.1 |
| Demographics | -0.003 | 0.002 | -0.8 | 0.011 | 0.002 | 2.6  | 0.042 | 4.5  |
| Immigration  | 0.001  | 0.000 | 0.3  | 0.001 | 0.000 | 0.2  | 0.000 | 0.0  |

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Note: Bootstrap standard errors (200 replications).

Source: Own construction based on IPUMS-International (three-digit classification).

Only 29 per cent of segregation in 2007 is directly associated with differences in observed characteristics between blacks and whites (i.e. 0.175 with Gini, and 0.130 with  $D$ ).<sup>23</sup> More precisely, about 26 per cent of segregation is explained by differences in attained education, and another 4 per cent by the different geographical distribution of workers of each race. There is virtually no effect associated with differences across demographic variables or immigration profiles. This means that a large 71 per cent of segregation—i.e. Gini = 0.424 and  $D = 0.311$ —remains after equalizing the distribution of characteristics for black and white workers (73 per cent with Gini, 75 per cent with  $D$ , in 1996 and 2001).

Racial inequality in the distribution of characteristics helps to better explain the segregation of blacks into low-paying occupations, nearly one half in 2007 (49 per cent Gini; 47 per cent  $D$ ), with education playing the most fundamental role (44 per cent Gini; 42 per cent  $D$ ), the rest being associated with differences in demographic variables and location.<sup>24</sup>

These large unexplained terms in segregation and stratification are the result of differences in the conditional occupational distributions, with similar workers working in different occupations based on their race. This may be the result of differences across unobservables, such as the lower quality of education received by blacks, of differences in preferences, or of direct discrimination by race in hiring or promotion practices. It is also interesting to note the differential roles that the explained and unexplained terms played in the trends described above.

There is some overlapping between the 1996 and 2001 unexplained segregation curves (Figure 1b), while the level of the unexplained segregation indices increased, accounting for most (79–85 per cent) of the overall increase in segregation during this period. The 2007 curve of unexplained segregation falls always above that of 2001, which implies a large decline in unexplained segregation indices, accounting for the decrease in segregation with  $D$ . It also accounts for nearly 90 per cent of the decrease with Gini, although in this case there was also a substantial reduction associated with the relative improvement in education of blacks (which must have reduced segregation within white- or black-dominated occupations and for that reason did not affect  $D$ ). For the entire period, the observed reduction in segregation was mostly driven by the unexplained part (with non-overlapping curves).

In the case of unexplained stratification, concentration curves are less informative because they overlap in all periods. The indices, however, produce clear results. The increase in the level of low-pay segregation between 1996 and 2001 was also entirely driven by large increases in the unexplained term, only partially compensated by reductions in the explained term (mostly due to education upgrading among blacks). Between 2001 and 2007, both components (explained and unexplained) were reduced, but the reduction in this type of segregation was mostly driven by the unexplained part (70 per cent) in the case of Gini, and the explained part (56 per cent) in the case of  $D$ . As a result, we do find evidence that the improvement in the level of education of blacks helped to push down racial stratification of occupations in both periods: a total reduction of about 34–40 per cent was explained by this

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<sup>23</sup> Auxiliary logit regressions are reported in Table A3 in the Appendix.

<sup>24</sup> The explained terms are smaller if we use the alternative counterfactual and give blacks the conditional employment distribution of whites (by reweighting whites' distribution to reproduce the characteristics of blacks): 16–18 per cent (segregation) and 24–26 per cent (segregation into low-paying jobs).

characteristic. While during the first period this was partially offset by a higher unexplained term, this was reversed in the second period.

## 6 Concluding remarks

Discriminatory legislation and social practices in pre-democratic South Africa led to a labour market strongly stratified by race, with whites holding the most-skilled and best-paying jobs. Lessons from other societies, such as the US or Latin American countries, indicate that removing all discriminatory legislation is not, in itself, enough to eradicate racial discrimination and segregation. Discrimination may persist before entrance into the labour market in the form of a lower amount and quality of education for non-whites or the negative influence of ghettos or family background, compromising non-whites' economic opportunities. This may later be aggravated by direct or subtler discriminatory practices in hiring or promotion, whether based on prejudices or on information problems (statistical discrimination).

With all the necessary cautions that data limitations impose, we have not found strong evidence to supporting the idea that the distribution of occupations has been effectively either desegregated or de-stratified in post-apartheid South Africa. There is limited evidence of some improvement only over short periods, during the first years of democracy in the mid-1990s or during the early 2000s, but not of the required sustained path over time. It seems, in fact, that the current situation is not better than it was in mid-1990s. Not only has segregation remained high, but the nature of that segregation still implies a strong racial stratification, with an over-representation of blacks in the lowest-paying jobs.

Inequality in the distribution of workers' characteristics, especially in attained education, explains less than a third of segregation and about a half of stratification. The improvement in the characteristics of blacks over time has had a positive impact on segregation and stratification trends, but has not been effective enough to reverse the inherited situation. A large unexplained term remains. Blacks tend to work in different and lower-paying occupations to whites with similar observed characteristics. Changes over time in this unexplained part generally drove the segregation and stratification trends, which are strongly connected with the business cycle.

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## Appendix: Additional tables

Table A1: Occupational segregation by race

| Digits | Segregation indices |       |       |               |       |       | Concentration indices and ratios |           |       |           |       |           |               |           |       |           |       |           |
|--------|---------------------|-------|-------|---------------|-------|-------|----------------------------------|-----------|-------|-----------|-------|-----------|---------------|-----------|-------|-----------|-------|-----------|
|        | Gini                |       |       | Dissimilarity |       |       | Gini                             |           |       |           |       |           | Dissimilarity |           |       |           |       |           |
|        | 1                   | 2     | 3     | 1             | 2     | 3     | 1                                | ratio (%) | 2     | ratio (%) | 3     | ratio (%) | 1             | ratio (%) | 2     | ratio (%) | 3     | ratio (%) |
| 1994   | 0.634               | 0.718 | 0.785 | 0.517         | 0.556 | 0.620 | 0.590                            | 93.2      | 0.614 | 85.5      | 0.633 | 80.7      | 0.499         | 96.5      | 0.504 | 90.6      | 0.501 | 80.9      |
| 1995   | 0.603               | 0.687 | 0.730 | 0.470         | 0.537 | 0.556 | 0.578                            | 95.8      | 0.588 | 85.5      | 0.604 | 82.8      | 0.466         | 99.3      | 0.447 | 83.3      | 0.475 | 85.5      |
| 1996   | 0.567               | 0.643 | 0.699 | 0.432         | 0.483 | 0.524 | 0.552                            | 97.4      | 0.547 | 85.0      | 0.532 | 76.2      | 0.428         | 99.0      | 0.420 | 86.8      | 0.432 | 82.6      |
| 1997   | 0.560               | 0.627 | 0.679 | 0.454         | 0.475 | 0.516 | 0.525                            | 93.7      | 0.553 | 88.3      | 0.561 | 82.6      | 0.454         | 100.0     | 0.446 | 94.0      | 0.461 | 89.3      |
| 1998   | 0.631               | 0.694 | 0.740 | 0.510         | 0.553 | 0.579 | 0.576                            | 91.3      | 0.623 | 89.8      | 0.615 | 83.1      | 0.510         | 100.0     | 0.541 | 97.8      | 0.515 | 88.9      |
| 1999   | 0.643               | 0.704 | 0.741 | 0.503         | 0.558 | 0.570 | 0.604                            | 94.0      | 0.590 | 83.7      | 0.607 | 81.9      | 0.503         | 100.0     | 0.498 | 89.2      | 0.510 | 89.4      |
| 2000   | 0.683               | 0.725 | 0.767 | 0.527         | 0.560 | 0.606 | 0.620                            | 90.8      | 0.655 | 90.3      | 0.676 | 88.1      | 0.527         | 100.0     | 0.553 | 98.8      | 0.541 | 89.2      |
| 2001   | 0.665               | 0.707 | 0.756 | 0.524         | 0.548 | 0.595 | 0.617                            | 92.9      | 0.641 | 90.7      | 0.683 | 90.4      | 0.524         | 100.0     | 0.545 | 99.4      | 0.553 | 93.0      |
| 2002   | 0.670               | 0.724 | 0.763 | 0.529         | 0.568 | 0.605 | 0.604                            | 90.2      | 0.642 | 88.7      | 0.670 | 87.7      | 0.529         | 100.0     | 0.555 | 97.8      | 0.553 | 91.4      |
| 2003   | 0.673               | 0.725 | 0.759 | 0.530         | 0.574 | 0.601 | 0.628                            | 93.3      | 0.653 | 90.0      | 0.677 | 89.2      | 0.530         | 100.0     | 0.547 | 95.3      | 0.556 | 92.5      |
| 2004   | 0.664               | 0.717 | 0.750 | 0.536         | 0.570 | 0.596 | 0.627                            | 94.4      | 0.645 | 89.9      | 0.671 | 89.5      | 0.536         | 100.0     | 0.547 | 96.0      | 0.551 | 92.4      |
| 2005   | 0.655               | 0.707 | 0.748 | 0.531         | 0.564 | 0.596 | 0.611                            | 93.3      | 0.632 | 89.5      | 0.653 | 87.3      | 0.531         | 100.0     | 0.528 | 93.6      | 0.544 | 91.3      |
| 2006   | 0.630               | 0.688 | 0.725 | 0.516         | 0.547 | 0.574 | 0.603                            | 95.7      | 0.639 | 92.8      | 0.654 | 90.2      | 0.516         | 100.0     | 0.523 | 95.6      | 0.532 | 92.6      |
| 2007   | 0.615               | 0.666 | 0.712 | 0.499         | 0.530 | 0.569 | 0.589                            | 95.7      | 0.607 | 91.1      | 0.627 | 88.1      | 0.499         | 100.0     | 0.506 | 95.5      | 0.518 | 91.1      |
| 2008   | 0.665               | 0.700 | 0.743 | 0.547         | 0.554 | 0.582 | 0.636                            | 95.7      | 0.646 | 92.3      | 0.660 | 88.9      | 0.538         | 98.4      | 0.530 | 95.7      | 0.555 | 95.3      |

|      |       |       |       |       |       |       |       |      |       |      |       |      |       |       |       |      |       |      |
|------|-------|-------|-------|-------|-------|-------|-------|------|-------|------|-------|------|-------|-------|-------|------|-------|------|
| 2009 | 0.669 | 0.705 | 0.746 | 0.555 | 0.565 | 0.592 | 0.632 | 94.5 | 0.645 | 91.6 | 0.661 | 88.6 | 0.542 | 97.6  | 0.536 | 94.8 | 0.558 | 94.3 |
| 2010 | 0.665 | 0.699 | 0.737 | 0.544 | 0.559 | 0.582 | 0.635 | 95.5 | 0.656 | 93.7 | 0.670 | 90.9 | 0.544 | 100.0 | 0.553 | 98.9 | 0.567 | 97.4 |
| 2011 | 0.669 | 0.706 | 0.738 | 0.543 | 0.564 | 0.585 | 0.644 | 96.3 | 0.664 | 94.1 | 0.678 | 92.0 | 0.535 | 98.6  | 0.550 | 97.4 | 0.569 | 97.3 |
| 2012 | 0.646 | 0.681 | 0.717 | 0.520 | 0.544 | 0.566 | 0.628 | 97.4 | 0.625 | 91.8 | 0.652 | 90.9 | 0.513 | 98.8  | 0.537 | 98.8 | 0.547 | 96.6 |
| 2013 | 0.644 | 0.676 | 0.717 | 0.519 | 0.542 | 0.569 | 0.615 | 95.5 | 0.625 | 92.5 | 0.641 | 89.5 | 0.512 | 98.8  | 0.529 | 97.6 | 0.534 | 93.8 |
| 2014 | 0.641 | 0.675 | 0.714 | 0.511 | 0.538 | 0.558 | 0.609 | 95.0 | 0.628 | 93.0 | 0.636 | 89.0 | 0.504 | 98.6  | 0.526 | 97.7 | 0.532 | 95.3 |
| 2015 | 0.653 | 0.694 | 0.734 | 0.520 | 0.555 | 0.591 | 0.618 | 94.7 | 0.642 | 92.5 | 0.655 | 89.2 | 0.515 | 98.9  | 0.540 | 97.2 | 0.559 | 94.6 |

Source: Own construction based on PALMS.

Table A2: Occupational segregation by race (standard errors)

|        | Segregation |       |       |               |       |       | Concentration |       |       |               |       |       |
|--------|-------------|-------|-------|---------------|-------|-------|---------------|-------|-------|---------------|-------|-------|
|        | Gini        |       |       | Dissimilarity |       |       | Gini          |       |       | Dissimilarity |       |       |
| Digits | 1           | 2     | 3     | 1             | 2     | 3     | 1             | 2     | 3     | 1             | 2     | 3     |
| 1994   | 0.007       | 0.006 | 0.005 | 0.007         | 0.007 | 0.006 | 0.007         | 0.007 | 0.007 | 0.007         | 0.007 | 0.007 |
| 1995   | 0.007       | 0.007 | 0.006 | 0.007         | 0.008 | 0.007 | 0.007         | 0.007 | 0.007 | 0.007         | 0.007 | 0.007 |
| 1996   | 0.011       | 0.010 | 0.009 | 0.011         | 0.010 | 0.010 | 0.011         | 0.012 | 0.013 | 0.011         | 0.012 | 0.012 |
| 1997   | 0.008       | 0.008 | 0.007 | 0.009         | 0.008 | 0.008 | 0.009         | 0.009 | 0.009 | 0.009         | 0.009 | 0.008 |
| 1998   | 0.010       | 0.009 | 0.008 | 0.011         | 0.010 | 0.009 | 0.011         | 0.010 | 0.011 | 0.011         | 0.010 | 0.010 |
| 1999   | 0.009       | 0.008 | 0.008 | 0.010         | 0.009 | 0.009 | 0.009         | 0.009 | 0.009 | 0.010         | 0.010 | 0.010 |
| 2000   | 0.007       | 0.007 | 0.006 | 0.008         | 0.007 | 0.007 | 0.008         | 0.007 | 0.007 | 0.009         | 0.009 | 0.009 |
| 2001   | 0.006       | 0.006 | 0.005 | 0.007         | 0.007 | 0.006 | 0.006         | 0.006 | 0.006 | 0.007         | 0.006 | 0.006 |
| 2002   | 0.005       | 0.005 | 0.005 | 0.006         | 0.006 | 0.005 | 0.006         | 0.006 | 0.005 | 0.006         | 0.006 | 0.006 |
| 2003   | 0.006       | 0.005 | 0.005 | 0.006         | 0.006 | 0.005 | 0.006         | 0.006 | 0.005 | 0.006         | 0.006 | 0.006 |

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|      |       |       |       |       |       |       |       |       |       |       |       |       |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 2004 | 0.006 | 0.006 | 0.006 | 0.007 | 0.007 | 0.006 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 |
| 2005 | 0.008 | 0.007 | 0.006 | 0.008 | 0.008 | 0.007 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 |
| 2006 | 0.008 | 0.008 | 0.007 | 0.009 | 0.008 | 0.008 | 0.009 | 0.008 | 0.008 | 0.009 | 0.009 | 0.008 |
| 2007 | 0.010 | 0.010 | 0.008 | 0.013 | 0.010 | 0.009 | 0.012 | 0.012 | 0.011 | 0.013 | 0.012 | 0.012 |
| 2008 | 0.004 | 0.004 | 0.004 | 0.005 | 0.004 | 0.004 | 0.005 | 0.004 | 0.004 | 0.005 | 0.005 | 0.005 |
| 2009 | 0.005 | 0.004 | 0.004 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |
| 2010 | 0.005 | 0.004 | 0.004 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |
| 2011 | 0.004 | 0.004 | 0.004 | 0.005 | 0.005 | 0.005 | 0.004 | 0.004 | 0.004 | 0.005 | 0.005 | 0.005 |
| 2012 | 0.005 | 0.005 | 0.004 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |
| 2013 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.006 | 0.005 |
| 2014 | 0.005 | 0.005 | 0.005 | 0.006 | 0.005 | 0.006 | 0.006 | 0.005 | 0.005 | 0.006 | 0.005 | 0.005 |
| 2015 | 0.005 | 0.005 | 0.004 | 0.006 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.006 | 0.006 | 0.005 |

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Source: Own construction based on PALMS.

Table A3: Logit regressions (probability of being white vs. black)

|                                    | 1996    |           | 2001    |           | 2007    |           |
|------------------------------------|---------|-----------|---------|-----------|---------|-----------|
| Number of obs.                     | 630,350 |           | 590,227 |           | 194,235 |           |
| Wald chi2(28)                      | 118,613 |           | 97,458  |           | 25,124  |           |
| Prob. > chi2                       | 0       |           | 0       |           | 0       |           |
| Pseudo R2                          | 0.423   |           | 0.341   |           | 0.321   |           |
| Dependent variable                 |         |           |         |           |         |           |
| White                              |         |           |         |           |         |           |
| Explanatory variables              | Coef.   | Std. Err. | Coef.   | Std. Err. | Coef.   | Std. Err. |
| Urban                              | 0.918   | 0.012     | 0.915   | 0.014     | 0.937   | 0.025     |
| Eastern Cape                       | -1.703  | 0.018     | -1.458  | 0.017     | -1.451  | 0.036     |
| Northern Cape                      | -0.158  | 0.033     | -0.080  | 0.031     | -0.395  | 0.050     |
| Free State                         | -1.399  | 0.018     | -1.446  | 0.019     | -1.143  | 0.036     |
| KwaZulu-Natal                      | -1.619  | 0.016     | -1.560  | 0.015     | -1.460  | 0.030     |
| North West                         | -1.983  | 0.020     | -1.648  | 0.020     | -1.588  | 0.041     |
| Gauteng                            | -1.299  | 0.013     | -1.111  | 0.012     | -0.969  | 0.024     |
| Mpumalanga                         | -1.497  | 0.020     | -1.490  | 0.019     | -1.202  | 0.036     |
| Limpopo                            | -2.533  | 0.025     | -2.026  | 0.025     | -2.102  | 0.049     |
| Some primary completed             | -1.188  | 0.070     | -0.637  | 0.060     | -0.334  | 0.181     |
| Primary (6 years) completed        | 0.197   | 0.039     | 0.737   | 0.041     | 1.546   | 0.141     |
| Lower secondary general completed  | 2.910   | 0.034     | 2.745   | 0.038     | 3.145   | 0.137     |
| Secondary, general track completed | 4.450   | 0.033     | 4.012   | 0.037     | 4.595   | 0.137     |
| University completed               | 5.388   | 0.037     | 4.841   | 0.039     | 5.435   | 0.138     |
| Unknown/missing                    | 4.153   | 0.036     | -       | -         | 3.010   | 0.161     |
| Other education                    | 5.180   | 0.042     | -       | -         | -       | -         |
| Aged 25-34                         | -1.313  | 0.014     | -0.969  | 0.014     | -0.729  | 0.028     |
| Aged 35-44                         | -1.143  | 0.015     | -0.779  | 0.015     | -0.404  | 0.030     |
| Aged 45-54                         | -0.386  | 0.017     | -0.071  | 0.017     | 0.264   | 0.033     |
| Aged 55-65                         | 0.031   | 0.021     | 0.687   | 0.021     | 1.211   | 0.039     |
| Female                             | -0.312  | 0.010     | -0.177  | 0.009     | -0.242  | 0.020     |
| Married/in union                   | 1.013   | 0.011     | 1.124   | 0.012     | 1.037   | 0.025     |
| Separated/divorced/spouse absent   | 1.780   | 0.020     | 1.713   | 0.020     | 1.461   | 0.043     |
| Widowed                            | 0.802   | 0.031     | 0.546   | 0.030     | 0.368   | 0.059     |
| Household head                     | 0.138   | 0.012     | -0.285  | 0.012     | -0.440  | 0.025     |
| Spouse                             | 0.729   | 0.015     | 0.203   | 0.015     | 0.164   | 0.033     |
| Disable                            | 1.019   | 0.021     | 0.172   | 0.028     | -0.250  | 0.068     |
| Immigrant within South Africa      | 0.085   | 0.013     | 0.181   | 0.015     | 0.278   | 0.031     |

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|                       |        |       |        |       |        |       |
|-----------------------|--------|-------|--------|-------|--------|-------|
| Immigrant from abroad | -0.052 | 0.034 | 0.210  | 0.044 | 0.353  | 0.077 |
| Intercept             | -4.693 | 0.043 | -4.136 | 0.049 | -5.057 | 0.158 |

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Note: Omitted categories: Rural, Western Cape, No schooling, Aged 16–24, Non-immigrant, Male, No disability, other than spouse or household head.

Source: Own construction based on IPIMUS-International.