Income Stratification and Polarization in Post-Apartheid South Africa

by

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Declaration

I declare that this thesis entitled "Income Stratification and Polarization in Post-Apartheid South Africa" is the result of my own research except as cited in the references. This thesis has not been submitted for any degree at any other university.

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Date: 23 May 2019

Abstract

The thesis explores the patterns and evolution of income polarization, income stratification, and social polarization in post-Apartheid South Africa. It uses data from a survey conducted at the end of Apartheid, and data from two post-Apartheid surveys to understand the socio-economic transformation the country has undergone since the end of Apartheid.

At the dawn of democracy in 1994, South Africa implemented many reforms to redress the effects of Apartheid. Two decades after the fall of Apartheid, the country is still battling against the social and economic hierarchies bestowed during the period of Apartheid. Black/African people, for example, still constitute at least 90% of the poor, unemployment hovers around 25% (with Blacks/African having 32% unemployment rate), and inequality is unchanged. There are also concerns of increasing intolerance to diversity as well as plummeting levels of social cohesion in the country. Therefore, if these disparities are not properly understood and addressed, disintegration could emerge as the future threat. Thus, our goal in this thesis is to examine the impact of political transition, which was followed by the enactment of a number of reforms, on the appearance (or disappearance) of economic distances and differences across population groups. This investigation is carried out through the perspective of income polarization and income stratification literature.

Chapter 2 presents the analysis of the concepts of bi-polarization and polarization on the distribution of income in South Africa between 1993 and 2014-2015. Applying the non-parametric relative distribution approach and the summary measures of bi-polarization and polarization, the chapter finds that, from 1993 to 2008, as inequality rises, both notions of polarization also increase, but at a much higher rate such that the distribution becomes perfectly bi-polar. During the period between 2008 to 2014, the level of bi-polarization falls below its 1993 level. Given the axiomatised link between bi-polarization and the size of the middle class, the results point to an increase in the size of the middle class in South African since the fall of apartheid. Lastly, the chapter finds that the distribution of government transfers and that of remittances have a depolarizing effect, while the distribution of labour income and of capital income have a tendency to erect poles on the national income distribution.

Chapter 3 attempts, on the basis of Analysis of Gini, to provide the extent to which the income distributions of racial groups are hierarchically ordered along the national income distribution. Hierarchically ordering of income distributions assumes convergence, or lack of it, of incomes and of education across the racial groups. Therefore, first the chapter presents the rate of convergence of education and of income across the racial groups to serve as a backdrop in the analysis of overlapping of distribution of income across the racial group. The chapter finds that the income distribution of Whites overlaps less with that of the overall population and that of other racial groups, and changes in the distribution of labour income, and of capital income are likely to increase the degree of income stratification (or reduce degree overlapping of income distributions).

Chapter 4 tries to demonstrate how social gaps across racial groups have evolved in post-Apartheid South Africa. To operationalize a measure of social gaps, we use the degree to which one feels identified and thus defends the interest of his racial group. This is referred to as a degree of radicalism. Through a series of regressions, the chapter shows how the degree of radicalism decreases with household wealth, level of education, employment, and satisfaction with life. Using the distribution of radicalism to quantify alienation, the chapter shows a fall in the scores of social polarization, which is largely driven by a fall in between-group polarization. Given that within-group polarization rises concurrently with a fall in between-group polarization, this implies a trade-off between internal heterogeneity and external homogeneity.

In short, the thesis advances our understanding of the normatively undesirable issue of distances and differences across groups and highlights the often neglected, yet indispensable, dimensions of an income distribution.

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I would like to express my profound gratitude to my supervisors Murray Leibbrandt and Ingrid Woolard for their tremendous support, patience, and guidance throughout my studies and thesis research. Murray and Ingrid spent many laborious hours reading different versions of this thesis. They also encouraged me to teach and tutor so as to grow as an academician and researcher. I am forever thankful for their valuable feedback. Needless to say, any errors that remain are my own. I am also hugely appreciative of Prof. Hiroyiko Hino who has provided insightful discussions and suggestions that were instrumental in helping me frame policy-related questions. I would also like to thank colleagues in the School of Economics PhD programme for their comments at different stages of this thesis. This PhD project would not have been possible without financial support from the AERC. I am also grateful for funding from SALDRU and from my supervisors. Finally, I thank my wife 'Maleseloa Machema and our daughters Neo Imelda Machema and Leseloa Mary Machema for the uncounted hours they had to endure without me. They have been a great source of encouragement, and I would not have made it without them.

Ratjomose P. Machema
Cape Town, South Africa
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Dedication

To my mother 'Malinkeng Machema, my wife 'Maleseloa Machema and my daughters Neo Imelda Machema and Leseloa Mary Machema.

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Chapter 1

Introduction

1.1 Overview of the thesis

This thesis investigates whether South Africa's ascendancy to democracy has been accompanied by a reduction in economic and social distances across groups. The formation of groups and existence of distances among groups in a society create perceptions of socio-economic exclusion, which hamper the effectiveness of public policies. Thus, differences across groups may be linked to socio-economic mobility and may also be a cause of social conflicts. More specifically, marked distances among groups in an income distribution is a matter of social concern, independent of their effects on other variables. The implication of such income distances is that income is acquired unevenly in the society. Thus an understanding of these social and economic distances is instrumental in reaching other social objectives, and in making a society more egalitarian.

Despite the instrumental role that a reduction of the distances across groups plays, few studies focus on the factors that underlie the formation of groups. While the literature on inequality (an indicator of differences in a society) is abundant, empirical studies that systematically investigate other dimensions, like polarization and stratification, are currently lacking, and therefore little is known about these concepts. We postulate that a thorough analysis of the income distribution in developing countries must include a measurement of differences across groups and how different components of total income interact to change the distances across the groups. This thesis makes a contribution in this regard by advancing our understanding of the concepts of polarization and stratification. That is, it evaluates the evolution of the extent of polarization (formation of economic and social groups), and the extent of income stratification (integration of groups into the mainstream economy). In doing so, it also focuses on the moderating influence of socio-economic transformation policies on polarization and stratification. More precisely, it investigates how the distribution of different components of total income (like labour earnings, capital income, and government transfers)

impact the clustering of incomes and the overlapping of income distributions of different groups.

The thesis uses survey data from the 1993 survey, Project for Statistics on Living Standards and Development (PSLSD), and data from the 2008, 2012 and 2014-2015 waves of the National Income Dynamics Study (NIDS), in South Africa to investigate income polarization, income stratification, and social polarization. Existing research in South Africa has largely been on poverty and inequality, thus little is known about either the relative fortunes or economic assimilation of different groups in South Africa in the post-Apartheid era. Two decades after the fall of Apartheid, the social and economic inequalities stemming from Apartheid are still so endemic that some scholars ponder the role of post-Apartheid policies in perpetuating them. That is, some individuals from previously disadvantaged groups have benefited economically from the post-Apartheid South African economy. An issue that emerges, therefore, is whether members of all groups undergo the same integration process. Researchers also debate the notions of equity that should guide public policy in the country. Our study provides an in-depth discussion of polarization and stratification to provide new perspectives on these debates.

1.2 Background and Motivation

Apartheid in South Africa divided people into four racial groups (Africans/Blacks, Coloureds, Whites, and Indians) and kept them apart by law. During Apartheid, education of Africans/Blacks (hereafter referred to as Blacks) was governed by the Bantu Education Act and was inferior to education provided to Whites. Similarly, education opportunities for Coloureds and Indians were poor, compared to that of Whites. Also during the period of Apartheid, certain occupations were reserved for Whites, and non-whites' wages and job opportunities were limited. The numerous laws of Apartheid called for separate development by segregating jobs, forcing different racial groups to live separately, and be educated separately. In short, Apartheid was geared towards channelling wealth, opportunity, and prosperity towards the White minority by creating a racially stratified system in terms of education, incomes, and residential places. These and many other Apartheid laws segmented the labour market and together acted to bring about labour market earnings differentials (Sherer, 2000).

At the end of Apartheid, South Africa introduced policies and enacted a number of laws to abolish racial discrimination and segregation. The emphasis of these policies

was to even out opportunities among racial groups. The primary focus was to create an African elite, cultivate a sense of national unity, and enhance overlapping of social identities (Seekings, 2008). For example, policies were introduced to level education funding and increase access to educational opportunities for all. The policy of affirmative action and the promotion of people from previously disadvantaged groups was also introduced. These policies and reforms could reduce earnings differences caused by the inferior Bantu education system and labour market practices that meant blacks (Africans, Coloureds, and Indians) earned much less than Whites. Other equalisation policies targeted the expansion of the non-white entrepreneurial base and thetransfer of share equity to be representative of the racial demographics of the country. The expansion of black entrepreneurial and business-owning classes increased economic integration by promoting and expanding their share of productive property. Other policies included improving access to basic services, such as water and electricity, and an increase in the coverage of state grants.

These policies, in parallel with other development goals, such as fostering tolerance for diversity, are likely to narrow the social and economic distances across racial groups in the country. From this backdrop, we ask whether the distances across groups have narrowed in the post-Apartheid era. That is, given the societal changes, economic growth, and changes in inter-race relations, has the clustering of incomes reduced, in both absolute and relative terms. Thus, this thesis presents the analysis of the effects of the post-Apartheid initiatives on the evolution of relative fortunes across racial groups.

There is a large and growing body of literature on the effects of these de-racialisation policies (see, among others, Leibbrandt, Finn and Woolard (2012); Leibbrandt and Levinsohn (2014); Leibbrandt, Wegner and Finn (2011)). While no attempt is made to offer a detailed review of the numerous and intriguing issues these studies raise, a quick glimpse highlights the puzzling formation and persistence of inequities, even as individuals in these groups and social environments evolve. In a nutshell, two decades after the end of Apartheid, South Africa is still battling against the social and economic hierarchies created by Apartheid. For instance, Black people still constitute 90% of the poor and aggregate inequality has remained unchanged, though it now reflects higher intra-racial and lesser inter-racial components (Leibbrandt et al., 2011). While the general consensus is that the increase in state grants has succeeded in moving Black people out of poverty into the middle income classes, the persistent income inequality is usually credited to labour market earnings differentials (Leibbrandt et al., 2012; Schiel, Leibbrandt & Lam, 2014).

For some scholars, these de-racialisation policies only reformed the Apartheid era dis-

tributional regime, and only a select few benefited, while the rest remained confined to poverty (Seekings & Nattrass, 2008). More precisely, Seekings and Nattrass (2008) point out that some black South Africans have benefited from the changes and gained social and economic mobility, while the majority of formerly disadvantaged people still face poverty, unemployment, and social exclusion. As a consequence, there is rising within-group inequality and somewhat stagnant between-group inequality. Using data from the Quarterly Labour Force Survey (QLFS) to explore the evolution skills within the South African workforce over the last 20 years (from 1994 to 2014), Statistics South Africa (StatsSA) reports that less skills development of Blacks takes place relative to that of Whites. This means the process of economic integration in South Africa is quite slow. The proposition, in this case, is that affirmative action policies marginally changed the racial composition of higher paying occupations.

Most of the studies focus on poverty and inequality. This has left unexplained the extent to which people in previously disadvantaged groups have been assimilated into the mainstream economy. Economic assimilation, which is the rate of convergence in incomes between the groups, can be an important indicator of economic mobility. This is especially true in countries undergoing socio-economic transformations like South Africa. And social assimilation, which is defined as the commonality of values, commitments, and social relations among groups and individuals, has the potential to strengthen social cohesion.

To get a clearer picture of the economic integration of blacks (Africans, Coloureds, and Indians), this thesis argues that the focus should be on polarization of income, stratification of racial groups' income distribution, and social polarization. A study of these three concepts will offer insight into the transformation the country has undergone, and determine whether social and economic distances across groups narrowed or widened in the post-Apartheid era. Our argument is that reversing the imbalances of Apartheid requires a thorough understanding of the formation of economic and social groups, economic assimilation of racial groups, and the evolution of social distance across race groups.

1.3 Objectives and Hypothesis

The question that forms the basis of this thesis is: Has the country's transition to a more democratic state been accompanied by a significant reduction in the economic and social distances across racial groups? The thesis has the following objectives:

Firstly, this study investigates the extent of income polarization and bi-polarization in South Africa. Polarization is the formation of either two income groups with the median as the divide (bi-polarization) or an arbitrary number of income groups (multi-polar income polarization). These two notions have in common that the society is divided into groups, which may be antagonistic. This investigation, therefore, is relevant for governments aiming to reduce class warfare and social unrest. It also examines the relative contribution of the distribution of different income sources to the overall level of polarization in the country. Our hypotheses are that the expansion of government transfers is expected to lessen clustering of incomes, while changes in the distribution of labour earnings and of capital income should create poles in the income distribution. The hypotheses are premised on the fact that government transfers and remittances are usually received by people from lower income groups, and tend to move them into the lower-middle income group. In contrast, labour earnings and capital dividends mostly accrue to a select few at the top end of the income distribution. This will most likely bring incomes below and above the median closer together, such that there is a larger spread around the mean. As the incomes bunch, the distance between the rich and poor might widen, and there might be local poles such that there are multiple groups of incomes.

Secondly, the thesis will examine the extent of income stratification (or economic integration) of racial groups. Stratification is the hierarchical ordering of the income distributions of different groups. This ordering of incomes of groups is the first step to understanding the economic (dis)advantages of (low) high-income groups. For instance, if Whites continue to dominate the high-income group, then the post-Apartheid policies have not addressed the economic disadvantages of non-whites. An increase in the degree of overlapping (the inverse of stratification), requires the incomes of blacks (Blacks, Coloureds, and Indians) to catch up to that of their White counterparts. Thus, investigating stratification is necessary for addressing socially embedded inequalities in the country.

In pursuit of this second objective, this thesis also presents an analysis of convergence with respect to educational attainment and income across the racial groups. The convergence of educational attainment and incomes of non-whites towards those of their white counterparts is a precondition for economic assimilation. In a complementary way, it also assesses the effect of changes in the distribution of different income sources on the extent of stratification of income distributions of racial groups. We conjecture that changes in government transfers and remittances ought to expand overlapping of the incomes of Black people, and changes in labour earnings and capital income should explain overlapping of the incomes of Whites.

Thirdly, we examine the evolution of social distances among racial groups in South Africa between 2003 and 2012. From this perspective, income is not the only relevant factor that underpins identity and differences across individuals (Duclos & Taptue, 2015). Clustering is driven by social factors like race, religion, language, and education. We use the extent to which respondents express involvement with their racial group to measure social distance between individuals in different groups (that is, alienation). Assuming an increase in the convergence of educational attainment and income among Whites and Blacks, we expect social distance across race and the salience of race to diminish in the post-Apartheid era.

1.4 Motivation for and Contribution of the Thesis

The thesis is composed of three empirical chapters, which differ in terms of questions, hypothesis and the empirical tools used. The aim of the three chapters is to address the problem of a divided society. Easterly (2001) finds that homogeneous societies are more likely to have better socio-economic indicators and less social unrest. Existing evidence suggests that inequality of opportunities and racial divisions affect socio-economic mobility, economic integration, and other development outcomes. That is, when groups have access to substantially different opportunity sets and different living standards, their society is more susceptible to social disintegration, as social tensions are likely to emerge.

As a supplement to the measurement of polarization and stratification of incomes, we also study how the distribution of different components of total income impact on the changes in these concepts. We argue that this investigation is tantamount to evaluating the impact of the economic reforms enacted at the dawn of democracy on the economic distances across groups. To put this into perspective, consider the expansion of state grants, whose immediate result is to move the recipients into higher income brackets. This can either increase polarization by creating local poles in the distribution or reduce it by enlarging the size and composition of the middle class. From the stratification perspective, it can increase the number of Blacks (or recipients) intersecting in the range of Whites incomes, thereby lowering (increasing) stratification (overlapping) of incomes of Whites (by Blacks).

Therefore, a better understanding and effective measurement of these phenomena can enable the design of public policies which in turn can provide efficiency gains for the society as a whole.

There is an abundance of studies focusing on other dimensions of welfare (such as income inequality and poverty), and much can be learned about the welfare of different groups from these studies. Despite this, the literature on the patterns of polarization and stratification in sub-Saharan Africa is scant. There is, therefore, a lack of information on the formation of poles and ordering of groups in the income distribution. Moreover, studies on the stratification of incomes of salient groups may not be generalizable to different settings. More specifically, identity groups are dynamic and usually context-specific, which means an uneven distribution of circumstances. The thesis contributes by adding new empirical evidence from South Africa to the literature.

The thesis makes a further contribution by adding to the literature on the middle-class in the country. Increased income bi-polarization, or clustering of incomes at the extreme ends, such that the rich are getting richer and the poor becoming poorer is linked to a declining middle-class. The existence of a large middle class is associated with improved and intensified anti-corruption efforts, and it mitigates class warfare and helps democracy to flourish (Easterly, 2001; Pressman, 2007). For example, a taxonomy of economic classes in a society can include three wealth categories: the rich (or affluent), the middle-class, and the poor. A society with few middle-class members will have wider distances (or larger average income gaps) between the rich and the poor. Therefore, a poor person is more likely to revolt against the society when the size of the middle-class is smaller. The reason being, if there is a sizeable middle class, such a poor person may not be rich, but may expect to achieve a middle-class position. In order to reduce such risks of social instability, it is therefore essential to better understand bi-polarization.

Equally important to the size of the middle-class is the composition of the middle-class. One of the goals of the post-Apartheid policies was to create a black African middle class to ensure diversity within the middle-class. This thesis therefore adds something of value to the debate in the form of a robust measure of the size of the middle class. By extension, it will provide evidence of the effectiveness of the post-Apartheid policies.

Our study makes its third contribution to literature by documenting proximate causes of economic distances across groups. Analyses of clustering of incomes from both polarization and stratification perspectives usually involve computing and contrasting summary measures. Therefore, by incorporating the effects of the distribution of different income sources, our study allows for a thorough empirical analysis of the clustering of incomes. That is, we attempt to model the drivers of clustering, which should advance our understanding of the factors behind the formation of groups.

While there is nascent research aiming to assess the formation of local poles in an income distribution, there are not many studies focusing on formation and disappearance of social groups. The few available studies, most of which are illustrative examples of proposed indices, are not generalizable because the partitioning identities, and the factors used to measure alienation, are context specific in these studies (Apouey, 2007; Fusco & Silber, 2014; Permanyer, 2012; Permanyer & D'ambrosio, 2015). Therefore, the fourth contribution of this thesis lies in its development of a measure of social distance across racial groups. We partition the population by race, then measure the degree of alienation by the strength with which someone in a racial group compares themselves with those in other racial groups, and their sense of identity with others in their racial group. Our measure of alienation across racial groups is drawn from the literature on the economics of identity (Akerlof & Kranton, 2000, 2005), the political economy of hate (Glaeser, 2005), and social identities in social psychology Klandermans (2014). By examining the possible determinants of alienation across racial groups, the thesis extends our understanding of convergence in social identities.

Lastly, the measurement of social distances across racial groups provides information about the extent of de-racialisation in South Africa. To put it into perspective, one of Apartheid's broad objectives was to maintain *racial purity* by preventing and limiting inter-racial interactions through racial segregation in residential areas, schools, universities, and on public transport (Seekings, 2008). The post-Apartheid policies, therefore, sought to promote social interactions across race and increase tolerance for diversity. Our study can therefore be seen as an attempt to understand how public policies have impacted the social and economic positions of individuals. The literature on South Africa has overlooked these issues, and this is another research gap that this thesis seeks to fill.

1.5 Summary of the Chapters

Chapter 2 is the first substantive chapter in this thesis and it explores the extent of income polarization and bi-polarization in post-Apartheid South Africa. First, we show that, from 1993 to 2008, people moved from lower and upper-middle income groups into lower-middle and high-income groups. These movements increased income bi-polarization and multi-polar income polarization in the 19 years between 1993 and 2008. Between 2008 and 2014-2015, the majority of South Africans moved from the lower income group into the middle-income group, such that polarization of incomes decreased. Lastly, we show that the distribution of incomes for Blacks has diverged

the most, which makes Black South Africans highly clustered around local poles in the national distribution. A similar conclusion is reached with regard to the distribution of incomes in urban areas, which makes urban residents more susceptible to conflict. We also find that the distribution of labour earnings and that of capital income have a tendency to cluster incomes. The distribution of government transfers, in contrast, is more likely to attenuate the clustering of incomes.

Chapter 3 addresses the question of income convergence, income stratification, and how the distribution of different income sources affect the degree of income stratification. First, we demonstrate that educational attainment only converges at primary and high school levels, and the average income of all other races has converged to match that of their White counterparts. These convergence patterns, which are statistically significant, may increase the extent of overlapping of incomes. The ANOGI approach confirms that the incomes of Whites are indeed less stratified (or overlap more). A shift-share micro-simulation shows that changes in labour earnings and in capital incomes are behind the reduced income stratification of Whites' income, while changes in government transfers largely influence the overlapping of incomes of Blacks.

Chapter 4 focuses on an analysis of social polarization, in order to evaluate the salience of racial identities in social interactions. We incorporate recent developments in the measurement of alienation or hostility across groups to argue that there is convergence in racial identities. Analysing the South African Social Attitudes Survey (SASAS) data for the period 2003 to 2012, we measure *racial radicalism* as the degree to which an individual feels identified with a racial group. We find that the degree of *racial radicalism* is influenced by household wealth, level of education, labour market status, and life satisfaction. Using the *racial radicalism* variable in the analysis of social polarization reveals that, with lower between-group polarization, within-group polarization becomes more salient. This could mean a new identity or classifying stratum emerges alongside race, or replaces race as the defining stratum. On the whole, the degree of social polarization shows a downward trend, meaning some degree of convergence in racial identities. This conclusion is robust to using the distribution of racial groups in different categories of self-reported health status to measure alienation.

We conclude the thesis in chapter 5 with is a brief summary of findings, a discussion of the implications of these results, and some ideas for future research. On the whole, the results imply that the de-racialisation policies, through their partial effects on the different components of total income, have succeeded in redressing some of the socio-economic imbalances of the Apartheid. Nonetheless, our research also shows that incomes of Blacks are the most polarized and the incomes of Whites are highly

stratified. Thus, we conclude that economic assimilation of race groups has not been uniform. The increase of social distance or alienation within-groups amid declining social polarization suggests a reduction in the social distances across race groups.

From a policy perspective, these results imply that an increase in the share of labour earnings and capital income in total income of previously disadvantaged groups may reduce the extent of income polarization and stratification.

Chapter 2

Analysis of Income Polarization in Post-Apartheid South Africa

2.1 Introduction

It is a well-established fact that during the last 20 years, income inequality in South Africa, as captured by the traditional indices such as the Gini Coefficient, has not decreased. More specifically, recent studies suggest that income inequality has an intra-race rather than an inter-race character in the post-Apartheid era. At the same time, Blacks still make up more than 90% of the poor. Are these income disparities indicating incomes clustering around local poles in the income distribution of a population? This chapter attempts to answer this question by making use of techniques for measuring polarization.

There is an expanding body of literature focusing on the understanding and measurement of polarization of incomes. This literature starts from the seminal work by Esteban and Ray (1994); Foster and Wolfson (2010/1992); Wolfson (1997). Even though the measurement of polarization has received a fair amount of attention in developed nations, little is known about its evolution in developing countries. One reason for the lacuna in polarization studies in Sub-Saharan Africa is poor (or lack of quality) data. We therefore expand this literature by investigating patterns and evolution of income bi-polarization, and (multi-polar) income polarization in the context of South Africa.

The basic idea of polarization is to capture a divided society that is a threat to social cohesion and social justice. Polarization also has implications for the equality of opportunity and the ability of individuals to move up in a society (Gochoco-Bautista, Bautista, Maligalig & Sotocinal, 2013). Bi-polarization of incomes corresponds to the absence of a middle class (Chakravarty, 2015; Duclos & Taptue, 2015). A well established middle class contributes to the well-being of society (Deutsch, Silber &

Yalonetzky, 2014). Recent studies have also brought to light the detrimental effects of (multi-polar) income polarization on health, growth rates, and convergence levels, and prospects of social mobility (Azzimonti, 2011; Brzezinski, 2013; Esteban & Ray, 2011; Perez & Ramos, 2010). A polarized income distribution may lead to the emergence of social conflict, social unrest, and tension. Therefore, a proper understanding of the structure and profile of polarization in the distribution of income in a population is the first step towards the achievement of social equity and cohesion in the society.

South Africa presents an obvious case because notions of inequity are socially embedded in the country's history. For instance, Adato, Carter and May (2006) argue that apartheid-era racial segregation policies have created ineffective avenues for upward social mobility. These are evidenced by the poverty traps identified in Woolard and Klasen (2005), and the inequality traps suggested in Pellicer, Ranchhod, Sarr and Wegner (2011). Therefore the country is susceptible to social disintegration. Moreover, the spreading levels of social and township[1] unrest reflect the slow pace of economic mobility. This escalation of protests is an attribute of a polarized society. This situation gives further prominence to the need for effective measurement and continuous monitoring of the extent of income polarization.

The research in this chapter has a two-fold purpose. Firstly, we investigate the extent of *bi-polarization* and *multi-polar income polarization* in the South African income distribution. The racial segregation policies of Apartheid clearly polarized the country, and we aim to see how the government's de-racialisation policies and the transformation the country has undergone in the post-Apartheid era has changed the South African income distribution. Secondly, we decompose the polarization patterns by factor components and population subgroups. The idea is to figure out whether various income components (like labour market earnings, government transfers, remittances, etc) tend to create local means (or clusters) in the overall distribution. It has been pointed out that labour market income is the main component of total income and the largest driver of income inequality (Leibbrandt et al., 2012), thus it is important to know if its distribution also leads to the polarization of household income. We further assess how the income differences between and within groups defined by region (rural vs urban) and by race contribute to overall income polarization in the country.

The chapter proceeds first by applying a non-parametric relative distribution analysis to demonstrate that people in the bottom income classes moved into the middle-income classes, and those in the middle-income category moved to the top end of the distribu-

[1] Township "is a suburb or city of predominantly black occupation, formerly officially designated for black occupation by apartheid legislation" (Adapted from Oxford Dictionaries)

tion. The summary measures (of polarization and bi-polarization) indicate that these two movements have narrowed income distances among individuals below and above the middle. The bunching of incomes (i.e., narrower income distances) signify a country divided into two income groups that are internally homogeneous. More precisely, the level of polarization increased between 1993 and 2008 such that there is near perfect bi-polarity. This lends support to the view of the former president, Thabo Mbeki, that the country consists of "Two Nations". Between 2008 and 2014, there is a decline in the degree of income polarization in the post Apartheid era, which suggests a growth in the size and composition of the middle class.

The decompositions reveal an increase in the contribution of the income differences within the groups and the decline of between-group polarization. Moreover, the income distribution of Black South Africans is the largest contributor to income differences within racial groups. The distribution of labour earnings and that of capital income are found to increase the extent of clustering of incomes, while the distribution of government transfers and that of remittances are the depolarizing income components.

Considering the results in a Bayesian sense, that is, whether they change our prior understanding of distributional dynamics of per capita income in South Africa, we can argue that the country is highly polarised. The clustering of incomes around local means has, however, declined in the post-Apartheid era, which suggests the de-racialisation policies have a positive effect.

The remainder of the chapter is organized as follows: Section 2.2 gives a brief review of standard concepts and a literature review on income bi-polarization and income polarization. In subsection 2.2.3 we discuss the Araar (2008) decomposition techniques. Section 2.3 discusses the data, clarifies some of the limitations of the study, presents summary and descriptive statistics, and discusses the relative distribution results. The main results of the research are presented in Section 2.4 while Section 2.5 summarizes the findings, concludes the chapter, and offers directions for future research.

2.2 Concepts and Brief Review of the Literature

Polarization refers to the formation (or disappearance) of groups in a society. Polarization may be derived from properties of traditional inequality measures (see Rodríguez and Salas (2000); Silber, Deutsch and Hanoka (2007); Zhang and Kanbur (2001)), but

it is a distinct concept from inequality (Duclos, Esteban & Ray, 2004), or at least it adds another dimension to the notion of inequality (Yitzhaki, 2010). The primary distinction, axiomatically at least, between them, rests on the Pigou-Dalton transfer principle, an elementary property of all inequality measures. According to this principle, income transfer from the non-poor to the poor must result in a less unequal income distribution, but one which is more polarized, especially when both individuals are on the same side of the median.

As an illustration, consider a society divided uniformly into four income levels - y_1, y_3, y_4, y_6. Then assume a redistribution between y_1 and y_3 and between y_4 and y_6 which leads to two income levels - y_2 and y_5 with large population shares. Although inequality has decreased, society is now clustered at income extremes, and is thus more polarized. Polarization and inequality do not always move in opposite directions. By way of an example, assume a society divided evenly across only two income levels - y_2 and y_5. Suppose y_2 moves to the left to y_1, while y_5 moves to the right to, say, y_6, then income disparity (or inequality) has increased. Similarly, the two groups have moved further apart, and therefore polarization has also increased.

The last couple of decades have witnessed substantial theoretical developments in the measurement of polarization. The literature identifies five different types of polarization, namely, (multi-polar) income polarization, income bi-polarization, social polarization, socio-economic polarization, and multidimensional polarization. These polarization types mainly differ by how groups are formed or defined, and by the measurement of distances between the groups. Chakravarty (2015); Duclos and Taptue (2015) provide a thorough description of these polarization categories. In this chapter, we focus on (multi-polar) income polarization and income bi-polarization, and in chapter 4 we focus on social polarization and socio-economic polarization.

There are at least four approaches to the measurement of polarization of income. The most common approach computes summary measures of polarization and inequality and compares the qualitative and quantitative effects of polarization and inequality indices to see how similar their conclusions are. Alternate approaches make use of kernel density estimation (as in Jenkins (1995, 1996); Pittau and Zelli (2001, 2006)), and finite mixture models within countries (as in Flachaire and Nunez (2007); García-Fernández, Gottlieb and Palacios-González (2013); Massari, Pittau and Zelli (2009)), and mixture models across countries (see Bianchi (1997); Pittau, Zelli and Johnson (2010)). Another approach uses the non-parametric relative distribution approach to measure the degree of income polarization (as in Borraz, González and Rossi (2013); Clementi, Dabalen, Molini and Schettino (2014); Clementi and Schettino (2013)). The

relative distribution approach is considered a variant of the kernel densities literature since it compares densities of two groups.

The present chapter adopts the first approach, which estimates the summary measures of polarization. In a manner similar to inequality studies, we also consider polarization by looking at the polarization of income among population sub-groups, and polarization in the distribution of main components of total income.

This section presents a brief description of income polarization and bi-polarization[2]. We begin by exploring the concept of bi-polarization and highlighting notable empirical papers. Second, we explain income polarization and highlight some notable contributions. We end by synthesizing the literature on these two concepts.

2.2.1 Income Bi-polarization

Income bi-polarization refers to the dispersion of the distribution of income from the central value towards the extreme points. A bi-polarized income distribution is, thus, one in which there is a significant number of people who are exceptionally poor but also a non-negligible class of extremely rich individuals, such that there are fewer individuals with middle-level incomes. Bi-polarization is thus associated with a tendency toward bi-modality, or the clustering of formerly middle-level incomes at either the bottom or top end of the distribution (Wolfson, 1997). An increase in bi-polarization can further signal a reduction inequality above or below the median income. This implies that the two groups are becoming internally homogeneous (lesser within-group inequality), or the distance between the average incomes of the two groups has increased (higher between-group inequality).

2.2.1.1 Definition and Measurement of Middle Class

A direct implication of increased bi-polarization is that there is no sizeable middle-income class.Low levels of bi-polarization correspond to a distribution that is very concentrated around the median, that is, it shows a large middle class (Duclos & Taptue, 2015). Looking at bi-polarization from this perspective forewarns about the problem of the "disappearing middle class" in a society. The importance of the middle

[2]For a detailed review of the literature on polarization, an interested reader should consult Chakravarty (2010, 2015); Duclos and Taptue (2015)

class is a well-documented fact (Easterly, 2001; Pressman, 2007). Empirical evidence suggests that socio-economic reforms cannot be sustained over long periods if the middle-income class does not grow and if those in the middle perceive themselves as losing as a result of reforms (Birdsall, 2007).

More importantly, measuring the middle class within the ambit of bi-polarization bypasses the debates surrounding the definition and measurement of middle class. Foster and Wolfson (2010/1992) explain that measuring the extent of the middle class in a country involves four steps. First, specifying the space (such as income or population space) for splitting the distribution. In the income space, an income range is chosen such that all people whose incomes fall within this range are regarded as middle class. For instance, we could define the middle class as the population share with incomes within some interval that includes the median. These intervals, often set in diverse and ad hoc ways, include 75% to 125%, 60% to 225% and 85% to 115% of the median income (Foster & Wolfson, 2010/1992; Wolfson, 1997). The population space rather looks at the income range covered by a given percentage of the population (Chakravarty, 2015). In the second step, we could define the middle (which would be the mean or median). The third step sets the boundaries of the middle class. Finally, the fourth step aggregates the chosen middle-class characteristics.

Most studies use an income space to quantify the size of the middle class. For instance, in a cross-country analysis, Milanovic and Yitzhaki (2002) define the middle class as those living between the mean incomes of Brazil and Italy, whereas Banerjee and Duflo (2008) define the middle class as those living on between $2 and $10 per day at 1993 PPP. In the context of South Africa, Visagie and Posel (2013) outline the "affluent middle class" as those with a per capita monthly income of between $R1400$ to $R10000$ in 2008 prices. While informative, these definitions and measurement strategies are incompatible, and often give confusing and misleading results (Foster & Wolfson, 2010/1992). The resultant middle-class groupings then depend on the definition of the middle, and these studies may measure something other than the extent of the middle class.

Burger, Steenekamp, Van der Berg and Zoch (2014) provide convincing evidence of the inconsistencies in these different approaches in the South African context. For their measure, they use occupation and skills level, vulnerability to poverty, the income polarization index of Esteban and Ray (1994), and self-identification into the middle class. Mindful of the limitations of the income space approach to measurement of the extent of the middle class, Burger and McAravey (2014) characterise an "empowered middle class" based on several dimensions, such as having at least 7 years of school-

ing, access to public services and information, living in a household with a working adult and living in a household with a stove and refrigerator. Using the vulnerability approach, Zizzamia, Schotte, Leibbrandt and Ranchhod (2016) show that the South African middle class has grown, and the share of Black middle-class South Africans has also increased.

One limitation of these studies is that they have to assume a certain cut-off point to define the middle class. As a consequence, it is unclear whether the reported increase is actually a middle class. The bi-polarization approach circumvents the arbitrary cut-offs by looking at the dispersion of the distribution from the central value. And the hollowing out of the distribution is interpreted as the decline in the middle class. Nonetheless, the bi-polarization approach only says that the middle class either increases or declines, it does not provide the size or the composition of those in the middle class.

2.2.1.2 Measures of Bi-polarization

The literature on bi-polarization has its roots from the seminal work by Foster and Wolfson (2010/1992) and Wolfson (1994). Foster and Wolfson (2010/1992) define two innate properties that distinguish bi-polarization from inequality. These are "*increasing spread*" and "*increasing bipolarity*". Increasing spread means an unambiguous movement of incomes on any side of the median income away from the median. This not only means the poor are getting poorer and the rich richer, but the two subgroups are also becoming more distant from one another such that heterogeneity between them increases. For example[3], in a given distribution, a median preserving income transformation that makes the rich richer and the poor poorer, will move people away from the middle, and increase bi-polarization. Alternatively, income transfer from the poor to the rich will pull both the poor and the rich further from the middle, thereby increasing bi-polarization.

Increased bi-polarity, in contrast, means clustering of incomes such that individuals close to the middle move further from it, whereas individuals farther from the median move towards it. That is, narrowing distances among those below or above the middle, and increasing homogeneity among the subgroups. The movement of the first group (those nearer to the middle) increases the spread from the middle, while the movement of the second group (those further from the middle) reduces those spread. The first movement is assumed to carry more weight than the second movement, which is why

[3]This example is adapted from Motiram and Sarma (2014)

bi-polarization increases. It is important to note that this clustering of incomes would decrease any inequality measure satisfying the Pigou-Dalton transfer principle, which deems progressive transfers to be equalizing. Most studies that investigate the extent of bi-polarization take these properties as given (see, among others, Amiel, Cowell and Ramos (2010); Chakravarty and Majumder (2001); Deutsch et al. (2014); Duclos and Échevin (2005); Foster and Wolfson (2010/1992); Prieto-Rodríguez, Salas and Rodríguez (2003); Wang and Tsui (2000); Wolfson (1994)).

Foster and Wolfson (2010/1992) and Wolfson (1994) propose an index of bi-polarization as twice the area between the Lorenz curve and the tangent to the Lorenz curve at median income. Formally, the Foster and Wolfson (2010/1992) index, (FW index hereinafter), is defined as:

$$P^{FW} = \frac{4\mu}{m}\left[\frac{1}{2} - L(0.5) - \frac{G}{2}\right] \tag{2.2.1}$$

where μ is the mean; m is the median; $L(0.5)$ is the ordinate of the Lorenz curve at the 50^{th} percentile (that is, the share of income held by the poor half of the population); G is the Gini coefficient. The larger the term in brackets, the fewer individuals there are with mid-level incomes and, the greater the bi-polarization. Maximum bi-polarization occurs when half the population has zero income and the other half has twice the mean. A convenient feature of the FW index is that it does not need to assume arbitrary cut-offs to define the middle class.

The bi-polarization literature agrees that zero bi-polarization coincides with the absence of inequality. There is, however, no consensus over the maximum value of the bi-polarization. Foster and Wolfson (2010/1992) and Wang and Tsui (2000) argue that bi-polarization indices are unbounded from above, while Silber et al. (2007) claims that a maximum (of 1) is achieved when the bottom half has zero income, and the top half has evenly distributed positive income. Nonetheless, there is an implicit acceptance that the score of FW index of 0 implies no polarity and the score of 1 implies bi-polarity.

There are a variety of extensions on the FW index (see, among others, Deutsch et al. (2014); Prieto-Rodríguez et al. (2003); Wang and Tsui (2000). For instance, Prieto-Rodríguez et al. (2003) restates the FW index in terms of incomes below and above the median, as follows: $P_{RS}^{FW} = (G^B - G^W)S$, where G^B is inter-group inequality, G^W is intra-group inequality and S is a measure of income skewness (i.e $2\mu/m$). From

this formulation, we clearly see that bi-polarization increases with greater distance between those with income below the median and those with income above the median (i.e higher G^B). It also increases when people above and below the median income are more alike (lower G^W). Lastly, polarization may increase when top incomes are further away from the middle of the distribution (higher S). Thus, income polarization and inequality may or may not have the same direction, depending on the source of the inequality.

2.2.2 Income polarization

Income polarization looks at the extent of clustering of incomes around a small number of arbitrary and distant poles in the distribution of income, wherever the poles may be. Measurement of multi-polar income polarization can be traced back to Esteban and Ray (1994). Esteban and Ray (1994) define a polarized society as one characterized by a small number of considerably sized groups, a high degree of homogeneity within each group (internal homogeneity) and a strong degree of heterogeneity between groups (external heterogeneity). This conceptualization is based on an alienation/identification behavioural framework. Alienation is the degree of hostility felt by individuals from one group toward individuals belonging to other groups. Alienation increases with income distances between individuals in those groups. Identification, on the other hand, refers to income homogeneity within each group. It is usually measured by group sizes such that a society with many small-sized groups is less homogeneous than a society with a few big-sized groups. In other words, an alienation/identification framework postulates that individuals identify with those with similar income levels, and feel more alienated from an individual the greater the income distance between their incomes. This means that income polarization increases with both alienation and identification. The interaction between these two concepts yields hostility between groups which may, in turn, generate social tensions or sabotage social cohesion.

Based on this framework, Esteban and Ray (1994) develop an index to characterize the degree of income polarization in a society. Assume that the income distribution is split into the pre-defined number of income classes - K, each with income equal to y_i. Identification is then an increasing function of the number of individuals in an income class. And an individual feels more alienated from others as the income distance between them increases. By imposing some axioms, the Esteban and Ray

(1994) (ER) indicator takes the following form:

$$P^{ER} = A \sum_{i=1}^{K} \sum_{j=1}^{K} \pi_i^{1+\alpha} \pi_j |y_i - y_j| \tag{2.2.2}$$

where π^{α} and $|y_i - y_j|$ are respectively identification and alienation components; y_i is the income level, π_i is the size of group i in total population, $A > 0$ is a normalization constant that has no effect on ordering of distributions and $\alpha \in (0, 1.6)$. For $\alpha = 0$ the ER index corresponds to the Gini index. The greater the value of α, the greater the divergence from inequality, thus α is the polarization sensitivity parameter. That is, the higher α gives more weight to homogeneity within the groups.

One of the major limitations of the ER indicator is that the number of income class - K, is set arbitrarily by the researcher. To overcome this and other drawbacks, several alternatives and modifications of the ER index are proposed in the literature (see Duclos et al. (2004); Esteban, Gradin and Ray (2007); Gradín (2000)). Particularly relevant for this chapter is the extension developed by Duclos et al. (2004). They extend the ER index for continuous distributions by using kernel density functions so that the number of groups is endogenous. The advantage of this extension of Duclos et al. (2004) is that it does not assume knowledge of pre-existing groups. This property is most relevant when the population of one group is also regarded as the population of other groups.

Following the presentation in Duclos and Taptue (2015), the effective antagonism of an individual with income x towards an individual with income y is a function of the identification - $I = f(x)$ - and of the alienation - $a = |x - y|$. The antagonism function $T(I, a)$ is continuous and increases in a, and is such that $T(I, 0) = T(0, a) = 0$. Polarization is proportional to the sum of all effective antagonisms. The normalized Duclos et al. (2004) (DER) index is defined as

$$P^{DER} = A \int \int f(x)^{1+\alpha} f(y) |x - y| dx dy \tag{2.2.3}$$

Where $A = 0.5\mu^{\alpha-1}$, a factor that makes the index invariant to proportional changes in all income; $f(x)$ is the density function which captures identification; μ is the mean; $0.25 \leq \alpha \leq 1$ is the identification effect weight, such that if $\alpha = 0$, the index reduces to Gini coefficient. Similarly, the higher α is, the stronger the homogeneity individuals feel with other members of the same groups. A standard approach in the literature is to assume $\alpha = 0.5$.

Duclos et al. (2004) show that the DER can be decomposed as follows:

$$P^{DER} = \bar{\iota}_{\alpha}\bar{a}_{\alpha}[1+\rho_{i,a}] \tag{2.2.4}$$

where $\bar{\iota}_{\alpha} = \int f(y)^{1+\alpha}dy$ - is the average identification effect; $\bar{a} = \int a(y)dF(y)$ - is overall average alienation (which equals two times the Gini coefficient) and $\rho_{i,a} = {}^{cov[f(y)^{\alpha},a(y)]}/_{\bar{\iota}_{\alpha},\bar{a}}$ - is the normalized covariance between identification and alienation.

For empirical purposes, the DER index is stated as follows:

$$P^{\hat{DER}} = \frac{1}{n}\sum_{i=1}^{n}\left[\hat{f}(y_i)\right]^{\alpha}\bar{a}(y_i)$$

where $\hat{f}(y_i)$ is the Gaussian kernel density and $a(\bar{y}_i) = \mu + \frac{2(i-1)-n}{n}\hat{y}_i - \frac{2}{n}\sum_{j=1}^{i-1} y_i$ and $\hat{\mu}$ is the sample mean.

The DER index is conceptualized to satisfy a set of desirable axioms. The axioms are grouped into those that are common for most distributive indices and those that are specific to polarization measures. The generic axioms include 1) Anonymity (independence from individual characteristics except for income), 2) Population-independence (invariance to population size replication), and 3) Scale-invariant (invariance to uniform proportional changes in income). The polarization specific axioms include 4) Alienation-sensitivity, which states that squeezing the global distribution around its mean does not increase polarization, 5) Identification-sensitivity, which states that squeezing the local uni-modal distribution around its mean does not decrease polarization and 6) Interaction-sensitivity, which states that increasing the distance, by the same level, between incomes which form the local distributions and average incomes does not decrease polarization.

Both the DER and ER indicators are widely used in the literature. Most empirical studies were conducted to illustrate and motivate the study of polarization. Nonetheless, all the empirical studies can be grouped into four categories. The first category includes studies that assess the link between polarization and inequality (as in Chakravarty and Majumder (2001); Deutsch, Fusco and Silber (2013)). The second category is those on robust polarization comparisons or stochastic dominance in polarization (as in Chakravarty and D'Ambrosio (2010); Duclos and Taptue (2015). The third category is those on polarization and growth (Azzimonti (2011); Brzezinski (2013); Ezcurra, Pascual and Rapún (2006)) and the final category is studies on the linkages between polarization and conflict (Esteban & Ray, 2011; Montalvo & Reynal-Querol, 2005b).

In this chapter, we follow the first category of studies, which assesses the link between polarization and inequality by computing and comparing their respective indices. Zhang and Kanbur (2001) are among the first to reject the hypothesis of the empirical difference between the two concepts. They find that, in the context of China, income polarization and inequality have similar trends and relative ranking of subgroups. However, when they use a new indicator of polarization they develop, their results lead them to conclude that the two are different. Using information from the Luxembourg Income Study, Duclos et al. (2004) also find cross-country evidence in support of polarization. Chakravarty and Majumder (2001) in the case of India discovered that polarization and inequality move in opposite directions. Also in India, Motiram and Sarma (2012) find that inequality and polarization have similar trends at the national level, but the magnitudes of changes and the disaggregated trends are different. Therefore, the empirical difference between polarization and inequality is context specific and depends on the indices used to measure polarization. Further research using new datasets will likely expand this literature. Thus, in the present chapter, we contribute by estimating the FW and DER indicators using South Africa as a case study.

As is common in income inequality studies, we also explain polarization of income by considering polarization of income in the sub-populations and the polarization of the main components of total income. Some notable studies in this area of research in include Araar (2008); Awoyemi and Araar (2009); Bonnefond and Clément (2012); Wan and Wang (2015). The differences in the impact of an income source on inequality and polarization could be another indication of their empirical differences. The assumption is that if polarization and inequality are indeed identical, then they ought to have similar contributors.

Furthermore, the income source and population sub-group decompositions are also the first steps in understanding the proximate causes of polarization. For instance, if between-group differences contribute more to polarization than within-group differences, it suggests that the country is divided across those groups. Alternatively, higher within-group contributions suggest decreasing internal homogeneity which indicates an emergence of new strata within the groups. Given that polarization means the existence of poles, flagging which income component is responsible for creating the poles may help policymakers to make changes which could narrow social fractures in a country.

A noteworthy study in this decomposition research is one by Deutsch et al. (2013). They use Shapley value decomposition to compare the differential impact of income components on inequality, polarization, and bi-polarization. They discover that differ-

ences in labour market income contribute considerably to the three concepts. However, varying income from transfers is the sole contributor to polarization, while differences in capital income are strongly related to both inequality and polarization. Using a variant of the Shapley Value approach common in studies on poverty and inequality, Wan and Wang (2015) show that unequal investment income is a dominant polarizing component. When they further decompose these changes into growth and redistribution effects, their results reveal different patterns across regions. However, on average, wages and transfer income redistribution affect polarization negatively. Bonnefond and Clément (2012) find that subsidies are depolarizing in urban areas while non-agricultural opportunities are polarizing in rural areas. These factor decompositions highlight that, on average, different income sources contribute differently to both polarization and inequality.

2.2.3 DER index decomposition

There are generally three approaches one can follow to decompose polarization indices. The first approach is Shorrocks (2013)'s Shapley value decomposition (see Deutsch et al. (2013)), the second is the micro-simulation approach of Bourguignon, Ferreira and Lusting (2005) (see Viollaz, Olivieri and Alejo (2009)), and the third is the analytical approach of Araar (2008). In this chapter, we follow the approach developed by Araar (2008) because of its simplicity and ease of estimation.

Borrowing ideas from the Gini coefficient decompositions, Araar (2008) develops an analytical approach to decompose the DER index by both subgroup and factor components. Let the population be composed of g exclusive groups (say rural vs urban) and assume that ϕ_g and ψ_g are, respectively, the population share and income share of group g. Suppose that the inter-group inequality represents inequality when every income in every subgroup is replaced by the relevant subgroup's mean income, then algebraic decomposition of the Gini index (G) is as follows:

$$G = \sum_g \phi_g \psi_g G_g + \bar{G} + R \tag{2.2.5}$$

where G_g is the Gini coefficient for income within subgroup g, $\bar{G}$ is the inter-group inequality and R is the residual term, which vanishes if group incomes do not overlap. Assuming that f_g is the density of group g, the contribution of an individual with income x to the DER is given as: $c(x) = \frac{a(x)f(x)^{1+\alpha}}{\mu^{1-\alpha}}$. If $\pi_g(x)$ denotes the local propor-

tion of individuals belonging to group g with income x, then the local contribution of group g with income x - $c_g(x)$ - to DER is $c_g(x) = \pi_g(x) f(x)^{\alpha} \frac{f(x)a(x)}{\mu^{1-\alpha}}$. From these local contributions, the DER index can be written as:

$$P^{DER} = \sum_g \int c_g(x)dx \tag{2.2.6}$$

Thus, the DER index can be decomposed as follows:

$$P^{DER} = \underbrace{\sum_g \phi_g^{1+\alpha} \psi_g^{1-\alpha} R_g P_g^{DER}}_{within-group} + \underbrace{\bar{P}^{DER}}_{between-group} \tag{2.2.7}$$

where $R_g = \frac{\int a_g(x)\pi_g(x)f(x)^{1+\alpha}dx}{\phi_g \int a_g(x) f_g(x)^{1+\alpha}dx}$ which is unity if groups do not overlap and depends again on the correlation between the density function of the group and that of the population; $a_g(x)$ is the alienation component and $\bar{P}^{DER} = \sum_g \phi_g^{1+\alpha} a(\dot{\mu}_g)$ is between-group or inter-group polarization which is equivalent to the DER index when within-group polarization is ignored or assuming that each individual has the average income of its group, with $\dot{\mu}_g = \mu_g/\mu$ and $a(\dot{\mu}_g) = \sum_h \phi_h |\dot{\mu}_g - \dot{\mu}_h|$.

The income source decomposition of DER follows closely the Gini decomposition approach of Rao (1969). This approach states that the contribution of each income source equals the product of its income share and the coefficient of concentration. Assuming total income is a sum of k various income sources and ψ_k is the income share of source k, then the DER index can be given as:

$$P^{DER} = \sum_k \psi_k CP_k^{DER} \tag{2.2.8}$$

where $CP_k^{DER} = \frac{\int f(x)^{1+\alpha} a_k(x)dx}{\psi_k^{\alpha} \mu_k^{\alpha}}$ is the pseudo-polarization index of source k which is similar to the concentration index. The more equally distributed income source k is, the lower its pseudo polarization index. Similar to Rao (1969), the contribution of each income source mainly depends on its income share and on its pseudo polarization index. Comparing the pseudo-polarization index (CP_k^{DER}) with the DER polarization index, one can easily judge the direction of the contribution simply by checking the sign of ($CP_k^{DER} - P^{DER}$). An income source is polarizing if its contribution to polarization is greater than its share in total income, or its pseudo-polarization index is greater than the overall DER index.

This approach has two limitations. First, in the case of subgroup decomposition, the

problem arises in the distribution created by replacing each individual income with a subgroup mean income. This makes the distribution degenerate, which is problematic, given that polarization depends on the size of the groups and their density. Second, in the case of factor decomposition, current approaches assume linearity of the underlying index, and polarization is not linear. These two drawbacks present restraint in drawing strong conclusions from the decomposition results.

2.3 Data and Descriptive Statistics

2.3.1 Data Description

This chapter uses data from the 1993 Project for Statistics on Living Standards and Development (PSLSD), the 2000 Income and Expenditure Survey (IES) and the 2008, 2012, and 2014-2015 waves of the National Income Dynamics Study (NIDS).

The PSLSD was conducted from January 1993 to April 1994, before the first democratic elections, to give a detailed picture of the welfare of South Africans at the dawn of democracy. It was designed as a self-weighting survey. But weighting became necessary after some areas could not be enumerated because of unrest, and under-representation of whites in some clusters. The PSLSD targeted 9000 households, and the final sample consists of 8802 households and 43685 individuals. IES is conducted every five years to determine the average expenditure patterns of households in different areas across the country, and to assist in the calculation of weights for the country's Consumer Price Index (CPI). The IES, like most Statistics South Africa (Stats SA) surveys, targets 30000 households, and the final sample for the 2000 IES consists of 26263 households and 104153 individuals. After the release of 2001 census, Stats SA calibrated the original design weights to align them to 2001 population totals.

NIDS is the country's first national panel survey, which started in 2008. It is conducted every two years. It is designed to capture the distributional dynamics of welfare across the nine provinces in South Africa. NIDS starts with 7305 households, then followed and re-interviewed individuals from these households in each of the subsequent survey waves. The 2014-2015 data set is the fourth and most current wave of the NIDS survey. The final samples for NIDS are 28226 individuals from 7296 households in the 2008 wave, 36279 individuals from 9252 households in the 2012 wave, and 40787 individuals from 9951 households in the 2014-2015 wave. Throughout the chapter, we

treat these waves as independent cross-sectional surveys. That is, we weight them appropriately using post-stratification weights that have been corrected for non-response and attrition. The post-stratification weights are derived from the non-response adjusted design weights by calibrating them using a cross-entropy approach. For wave 1 (2008), given that it is the original sample, we need not worry about attrition. But the representativeness of the subsequent waves (the 2012 and 2014-2015) becomes an issue because by construction they are based on the 2008 sample design, and not representative of the underlying population. Therefore, the original post-stratification weights are adjusted by an inverse of the probability of non-attrition[4]. In theory, these weights make the sample more representative of the population. We opted to use only the first, third, and fourth waves of NIDS because the quality of the 2010-2011 wave is questionable (Finn & Ranchhod, 2013).

These surveys use a two-stage sampling design. The first stage units (or primary sampling units) are a random sample of Enumeration Areas (EAs) delineated from the Population Census preceding each survey, (that is, the 1991 census for the PSLSD, 1996 census for the IES and 2001 census for NIDS). The second stage units are private households[5] or dwellings selected systematically in each EA. A PSU in each survey consists of either one or multiple EAs, depending on whether the number of dwelling units in the base EA is less than the minimum number of required dwelling units. The sampling weights in each survey reflect the selection probabilities of each individual.

We use data from these surveys because they cover a wide time span, and are therefore more likely to accurately reflect the effects of structural changes in welfare distribution such as inequality and polarization.

In this study, we use real household per capita income. Total household monthly income is derived as the sum and aggregation of individual incomes from the labour market, remittances, dividends, government transfers, and other income sources (see appendix 2.6.1 on page 55 for a list of variables used to compute each income component). To adjust for no economies of scale, each individual is assigned the total monthly income of their household, divided by the corresponding household size. The per capita income adjustment assumes that all household members get the same share of income, regardless of their individual incomes, their role in the household, and other characteristics. All incomes are in rands and inflated to 2012 values using the South African Consumer Price Index of 2012. We thus use real household income per cap-

[4]For details about calibration of the weights visit http://www.nids.uct.ac.za/images/documents/wave3/NIDS-W3UserGuide-PublicRelease20150330_v1.5.pdf

[5]Household includes a group of people (related or unrelated) living together and pooling resources for purposes of meals and lodging.

ita as our indicator of well-being. This is equivalent to performing the analysis at household level, but weighting each household by the number of members. Lastly, we remove all households and individuals with zero, missing, and negative income. This means the samples used in our analyses are slightly smaller than the actual samples, an issue that may cause bias. But the excluded cases are less than 1% of each sample's observations. The final sample (pooled) has 237644 individuals. The PSLSD 1993 accounts for 16.3% of the final sample, the IES 2000 for 43.2%, and the three waves of NIDS (i.e., 2008, 2012, and 2014) account for 11.4%, 13.5%, and 15.6%, respectively.

2.3.1.1 Data Limitations

The surveys cover a period characterized by significant changes in the structure of the economy (see Leibbrandt & Levinsohn, 2011). However, they have some methodological differences and comparability issues that need to be considered when using the data from them for income distribution analysis. First, the PSLSD and IES survey questionnaires are administered to a single individual in the household, while the NIDS interviewed all members of the household. Therefore, PSLSD and IES are more prone to measurement error, and analyses based on these surveys could produce biased results.

Moreover, we omit imputed rental income and agricultural income because their measurement differs in the NIDS and PSLSD. The IES only has an agricultural production variable and does not include requisite data to impute rental income. Another key issue is that the panel structure of NIDS means there might be high attrition of those in the top end of the distribution. This under-representation of rich individuals can lead to a downward bias in the measurement of inequality and polarization.

These limitations do not mean that data from these surveys have no bearing on the measurement of polarization and inequality, rather one should consider carefully the conclusions drawn from them. For instance, the exclusion of both imputed rental income and agricultural income may bias comparison of sub-populations across different surveys and in the same surveys. Evidence from prior studies (Leibbrandt et al., 2012; Leibbrandt & Levinsohn, 2011) shows that any biases that come from omitting imputed rental income and agricultural income are not large enough to explain away the conclusions drawn. The comparability concerns are discussed in detail by Leibbrandt et al. (2012).

2.3.2 Summary Measures and Distribution of Real Income per Capita

Before proceeding with measurement of income polarization, it is important to know the structure and profile of household income in South Africa. We do this in two ways, first we compute several typical summary measures to get an initial understanding of the evolution of incomes. Tables 2.3.1 and 2.3.2 present the summary statistics of income and of key variables in the data. Second, we apply the non-parametric kernel density curves and relative distribution approach developed by Handcock and Morris (1998) to further characterise the distribution of income. Figure 2.3.1 displays overlaid kernel densities and Figures 2.3.2, 2.3.3 and 2.3.4, and Table 2.3.3 present the results obtained from the relative distribution approach.

A general conclusion from the summary measures is that the income distribution shifted to the left between 1993 to 2008, and the distance between the rich and the poor widened. But from 2008 to 2014-2015, the incomes of the rich and the poor tend to converge as evidenced by the fall in poverty and inequality. The non-parametric analysis lends support to the results from the summary measures. That is, there is a marked upward location shift in the income distribution between 2008 and 2014-2015. There is also evidence of change in the shape of the distribution which is due to changes in higher moments like skewness. This shape effect happens to be largely influenced by movement from lower income classes to middle classes.

The detailed results are presented in Table 2.3.1. Total monthly household income is normalised by the corresponding household size while all income sources are at household level. We learn the following from this table. During the period leading up to 2008, average per capita household income increased while median per capita household income fell. This suggests that those households with high incomes have moved further away from the middle, thereby likely raising the level of polarization. Looking at the changes in the income sources, we note the following. First, the mean and median household income for all, except remittances, have increased since 1993. Second, ratio of mean to median for household labour income declined in 2008 until 2014, which suggests that mean and median labour incomes are diverging. Third, government transfers increased sharply after 2008. The first two points can partially explain the inferred increase in polarization and the latter point can explain the lower levels of polarization in 2012 and 2012.

Table 2.3.1 gives summary statistics of key variables like the proportion of rural households, household size, and the proportion of adult workers in the household. These

variables are related to the income generating capacity of the household, thus their patterns are important. There is a uniform drop in the proportion of rural households and household size. While the proportion of households in which all adults are working drops by 10.2% between 2000 and 2008, then rises gently thereafter, the proportion of households without working adults rises during the period up to 2008, and falls thereafter until 2014-2014. The proportion of employed adults increases marginally from 0.47 to0.52 in 2008, falls to 0.50 in 2012 and rises again by 9.3% in 2014-2015. The average years of schooling for adults increases throughout the 20 year period. This increase is possibly due to a drop in the proportion of households whose head has up to 7 years of schooling (i.e., unskilled), and a rise in semi-skilled household heads and skilled heads.

Table 2.3.2 gives further summary statistics of real per capita income at the individual level. Similar to household statistics, the mean is greater than the median for all sample points, indicating that the distribution of per capita income is skewed to the left. Both kurtosis and skewness fell between 1993 and 2012, which suggests that people in the middle-income classes have moved to the top end of the distribution. The Quantile ratio is about 32.5 in 1993. This means that the income per capita of the poorest person in the richest 10% is at least 32 times higher than the income per capita of the richest person in the poorest 10%. This ratio declines to 29 in 2000, rises by 18.9% to 35 in 2008, then drops by 30.1% in 2012, and by 19.5% in 2012. These changes reflect the widening of income distances between the rich and poor between 2000 and 2008, and the narrowing of the income distances in 2012 and 2014-2015. As shown by other studies, income inequality rises during the period 1993 to 2008, then declines sharply in 2012, and increases again, though slightly, in 2014-2015. Poverty, on the other hand, declines throughout the period under analysis.

Table 2.3.1: Household level summary statistics

Variable	1993		2000		2008		2012		2014-2015	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Per capita monthly income	7629	2414	25832	2583	6857	2630	7529	3211	8572	3854
Median per capita income		999		937		916		1200		1461
Capital income	706	1504	1230	2571	409	4994	434	6562	464	15326
Remittances	1538	205	10106	669	1011	1690	1138	1545	2049	1441
Labour income	6016	2282	18714	3919	4303	6020	4943	8042	6020	8980
Government income	1895	392	6632	716	4156	854	4841	1272	5287	1372
Other income	50	766	1262	1161	18	4527	35	5083	25	9526
Rural	7629	0.406	25832	0.360	6857	0.326	7529	0.301	8572	0.294
Male dummy		0.460		0.479		0.439		0.479		0.487
Household size	7629	4.33	25832	3.85	6857	3.60	7529	3.47	8572	3.21
Work rich	7629	0.308	25832	0.333	6857	0.299	7529	0.369	8572	0.442
Work poor	7629	0.190	25832	0.269	6857	0.304	7529	0.259	8572	0.222
Some work	7629	0.501	25832	0.398	6857	0.397	7529	0.372	8572	0.336
Individual level										
Employed (18<age<66)	20058	0.473	56007	0.478	11763	0.523	16693	0.503	19449	0.550
Years of Education (18<age<66)		7.76				9.29		9.77		10.05
Unskilled		0.7972				0.7046		0.6901		0.6586
Semi-skilled		0.1765				0.2503		0.2527		0.2601
Skilled		0.0263				0.0451		0.0572		0.0813

Notes: All incomes are inflated to 2012 prices, and are analysed at household level, except where stated. All the values of the income components values are conditional on receiving, that is, strictly positive non-missing values. Work rich indicates that all adults in the household are working, work poor indicates no adult works while some work indicates that at least one adult works. Unskilled refers to those with up to 7 years of education, semi-skilled to those with 7 to 12 years of education, and skilled refers to those with more than 12 years of education

Source: Own calculations from weighted PSLSD 1993, IES 2000, NIDS 2008, 2012, and 2014-2015.

The income share of the richest percentiles increases at a decreasing rate during the period from 1993 leading up to 2008, then declines by between 10% and 6% from 2008 to 2012 and rises again in 2014-2015. The income share of the poorest quantiles shows a startling decline in 2008, a situation which may explain the wider income gaps in 2008. Table 2.3.2 further shows that the proportion of households receiving capital income, remittances, and labour incomes decreases between 1993 and 2008. In contrast, the share of households receiving government transfers increases twofold during the same period. For the 6 years between 2008 and 2014-2015, the share of both labour income and remittances increases, whereas the share of government transfers falls by 8.9%. Overall, these summary measures indicate wider income distances in 2008 which suggests greater degree of polarization of incomes in South Africa during this period.

Figure 2.3.1 provides further insights into the key distributional changes in income in South Africa. The figure presents the overlaid kernel densities of the log of real per capita income. We use Epanechnikov 2 to estimate all densities and the Silverman method to select the optimal bandwidth. The growth in average income between 1993 and 2014-2015 is set out by the upward or rightward shift of the 2014-2015 income distribution. The 2014-2015 distribution is twin-peaked, which is indicative of bi-

Table 2.3.2: South African income per capita summary statistics for all individuals

	1993	2000	2008	2012	2014-2015
Mean (at individual level)	1475	1792	1808	2067	2453
Median	521	596	537	751	903
Skewness	17.6	18.3	8.1	6.3	33.3
Kurtosis	589	892	114	60	1320
Quantile ratio $(p90/p10)$	32.5	29.2	35.7	24.8	20.0
Gini Coefficient	0.675	0.686	0.709	0.665	0.675
Headcount Poverty	0.557	0.519	0.558	0.447	0.377
Income Shares					
Poorest 5%	0.001	0.002	0.001	0.003	0.002
Poorest 10%	0.005	0.006	0.004	0.007	0.007
Poorest 20%	0.015	0.016	0.013	0.019	0.019
Richest 5%	0.381	0.407	0.430	0.390	0.431
Richest 10%	0.539	0.565	0.588	0.544	0.567
Richest 20%	0.720	0.735	0.756	0.711	0.717
Prop. of households with income source					
Capital	0.103	0.056	0.083	0.076	0.086
Remittances	0.185	0.368	0.138	0.133	0.212
Labour	0.804	0.738	0.700	0.730	0.769
Government	0.229	0.231	0.499	0.486	0.458
Other	0.007	0.046	0.004	0.007	0.003

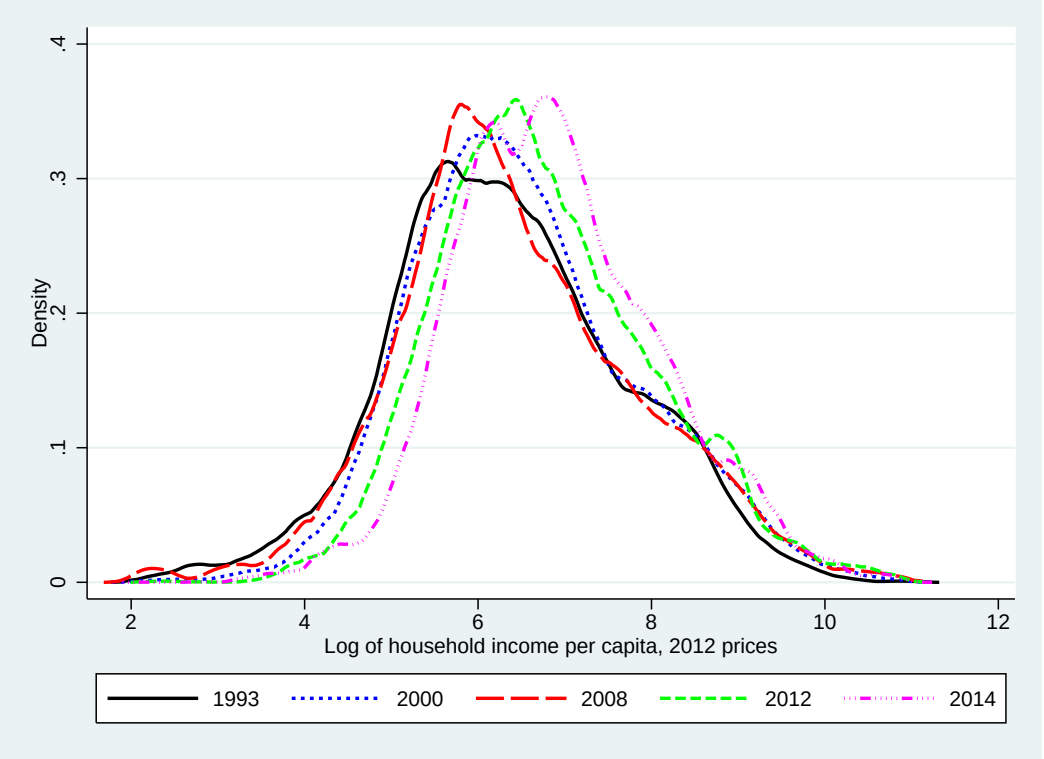
Notes: All incomes are inflated to 2012 prices, and are computed at individual level, except where stated. All the income components values are conditional on receiving (i.e positive non-missing values). The poverty headcount is based on the *R*636 poverty line of Finn and Leibbrandt (2013), which is based on a cost of basic needs approach.
Source: Own calculations from weighted PSLSD 1993, IES 2000, NIDS 2008, 2012, and 2014-2015.

modality. The existence of multiple modes suggests that there may be groups in the income distribution. The 2008 distribution is relatively leptokurtic, suggesting a small clustering around the mean or higher density at the extreme ends. While a simple visual inspection cannot determine whether one distribution is more polarized or unequal than another, the densities lend support to patterns observed in tables 2.3.1 and 2.3.2. That is, there is a clear-cut increase in all incomes in 2012 and 2014-2015.

2.3.3 Relative Distribution Analysis

The section discusses results from the relative distribution approach. A detailed description of the approach is provided in section 2.3.3 in the Appendix. The approach gives information about where and by how much an income distribution changes. Unless stated otherwise, we use the 2008 income distribution as the reference group and other years income distributions as the comparison group. The choice of 2008 distribution as the reference group is informed by the results from the summary measures.

Figure 2.3.1: Overlaid kernel density curves for South Africa



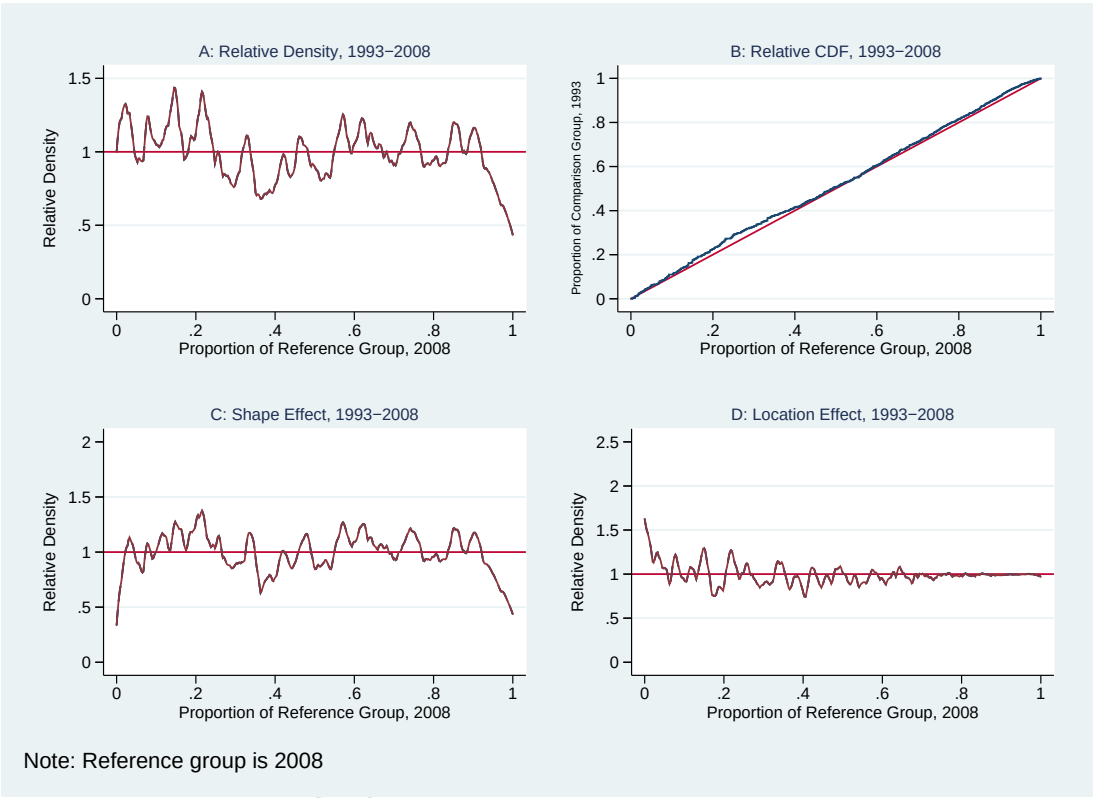
Notes: This figure shows the income distribution for South Africa. All densities are estimated by epanechnikov 2 kernel densities, using the Silverman method to select optimal bandwidth.
Source: Weighted PLSLD 1993, IES 2000, NIDS 2008, 2012, and 2014-2015.

Figures 2.3.2, 2.3.3 and 2.3.4, and Table 2.3.3 present the results derived from the approach. Panel A shows the relative density (or overall effect), panel B the relative CDF, panel C the shape effect and panel D the location effect.

A relative density greater than 1 means that the 1993 distribution (comparison group) has more density than the 2008 distribution (reference group). Panel A of Figure 2.3.2 shows that this is systematically true for $r < 0.25$ and $r > 0.81$. Therefore, the 1993 distribution has a lower proportion of individuals in the middle-income classes or lower proportion for those with incomes in any percentile between 25^{th} and 81^{st} of the 2008 distribution. Thus, defining cut-offs of the middle-class as the range of income between the 25^{th} and 81^{st} of the 2008 income distribution would likely lead to a larger size of the middle class. Another point to note is that individuals in 1993 have a higher probability (than individuals in 2008) of having income that corresponds to any percentile above 81^{st} of the 2008 distribution. There are relatively more poor people in 1993, as shown by $r < 1$ for percentiles less 25^{th}. This is another evidence of the decline in poverty between 1993 and 2008. Figure 2.6.1 (in the Appendix) provides a much clear relative density. The upshot of this figure is that the relative density is not weighted by the survey sampling weights. The density of the 1993 income distribution compared to the

2008 distribution at the 20^{th} percentile levitates at 1.2 ($g(0.2) = 1.2$). This implies that there is a 20% chance of individuals in 1993 to be at the 20^{th} percentile of the 2008 distribution. And at the 43^{rd} percentile, the relative density of 1993 is about 0.6, which means individuals in 2008 are 40% more likely to be at the 43^{rd} percentile.

Figure 2.3.2: Relative distribution of income per capita, South Africa 1993-2008



Notes: This figure shows changes in the South African income distribution using the relative distribution approach developed by Handcock and Morris (1998). The x-axis is the percentile of the reference year, 2008, while the y-axis is the ratio of share of individuals in the comparison year, 1993, to the share of individuals in the reference year, 2008. A y-value less than 1 means that the 1993 distribution has a lower share of individuals than the 2008 distribution at that percentile. All densities are estimated by epanechnikov kernel densities using the Silverman method to select optimal bandwidth.
Source: Weighted PLSLD 1993, IES 2000, NIDS 2008, 2012, and NIDS 2014-2015.

The slope of the relative income distribution gives information about the direction of the movement of people. For instance, between the 20^{th} and 43^{rd} the relative density is negatively sloped which suggests that people moved into the lower middle-income range. And the slope is positive from the 43^{rd} percentile indicative of movement away from the middle-income categories towards high-income deciles. However, the proportion of individuals in 1993 with an amount of income corresponding to the top percentiles (80^{th} and above) is higher than the analogous proportion in 2008. Even though it is by a small margin, the relative CDF (in panel B) lies above the 45° line, a result which confirms that 2008 distribution has higher frequency in the middle. The relative CDF shows the proportion of the comparison group (1993) whose incomes lie below the r^{th} percentile of the reference group (2008). One possible explanation for this is

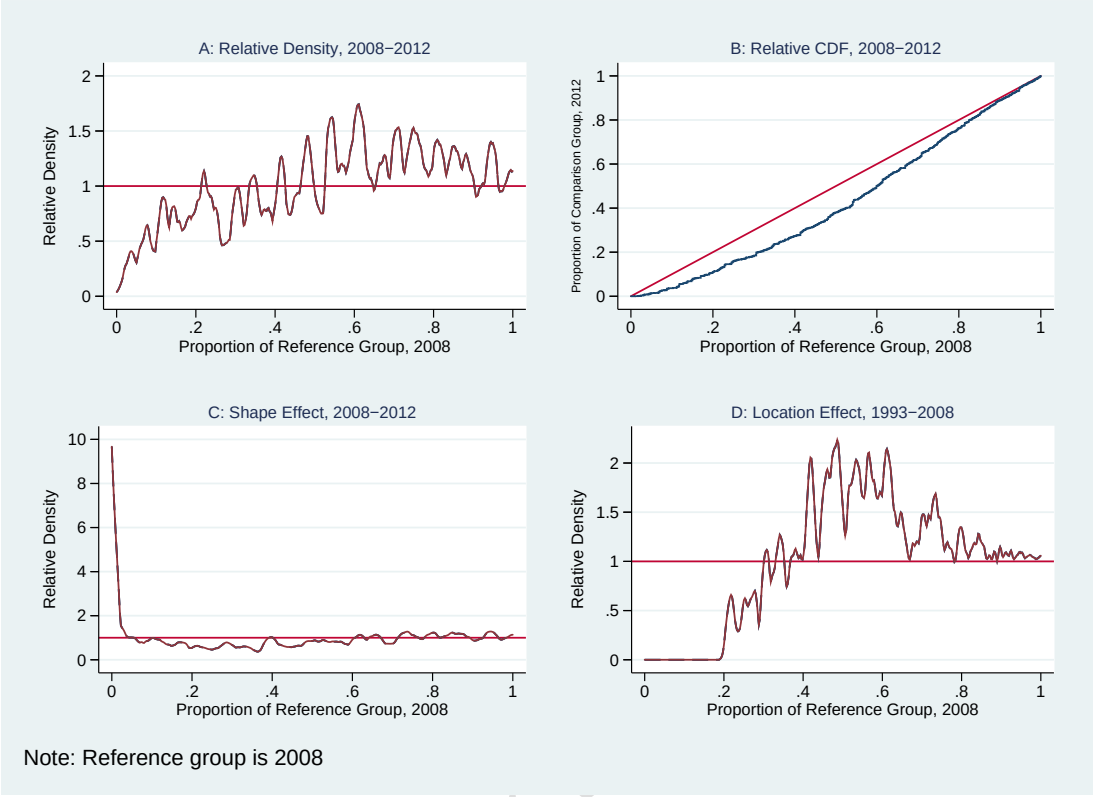
that social grants can only move people out of poverty, they can not make them rich. Therefore, during the period 1993 to 2008, there is bunching of incomes, as people move from the lower percentiles towards the middle and those in the middle move towards the top end. This movement into middle-level incomes is often interpreted as an increase in the size of the middle class.

We extend the analysis by decomposing the relative density into shape and location effects. This is analogous to growth and distributional effects in the poverty and inequality decompositions. This decomposition allows us to examine the convergence of incomes towards the middle or median. The shape effect (Panel C) and the overall effect or relative density (Panel A) are almost similar, implying that most of the income changes between 1993 and 2008 are due to changes in higher moments. An inverse U-shape of the shape effects suggests that the 2008 distribution is more spread around the median. The unweighted relative density, Figure 2.6.1 in the Appendix, gives a clearer picture of this result. The location effect is largely uniform, which means there is no significant change in the mean and median between 1993 and 2008.

Moving to income changes between 2008 and 2012, we use the 2012 income distribution as the comparison distribution and that of 2008 as the reference distribution. Figure 2.3.3 presents the results. Panel A shows that for all incomes below the median (50^{th} percentile) of the 2008 distribution, the 2012 distribution has a lower density, and for incomes corresponding to $50 < r < 95$ percentiles it has a higher density. Beyond the 95th percentile, 2008 distribution has more density. Therefore, during the four years between 2008 to 2012, incomes increased such that people moved into middle-income ranges. Panel B (relative CDF) further shows that the 2008 distribution has the lowest proportion of individuals with incomes lower than the 95th percentiles. Surprisingly though, there is a higher proportion of rich people in the 2008 distribution than that of 2012. Panels C and D reveal the incomes changes are largely due to the growth of incomes.

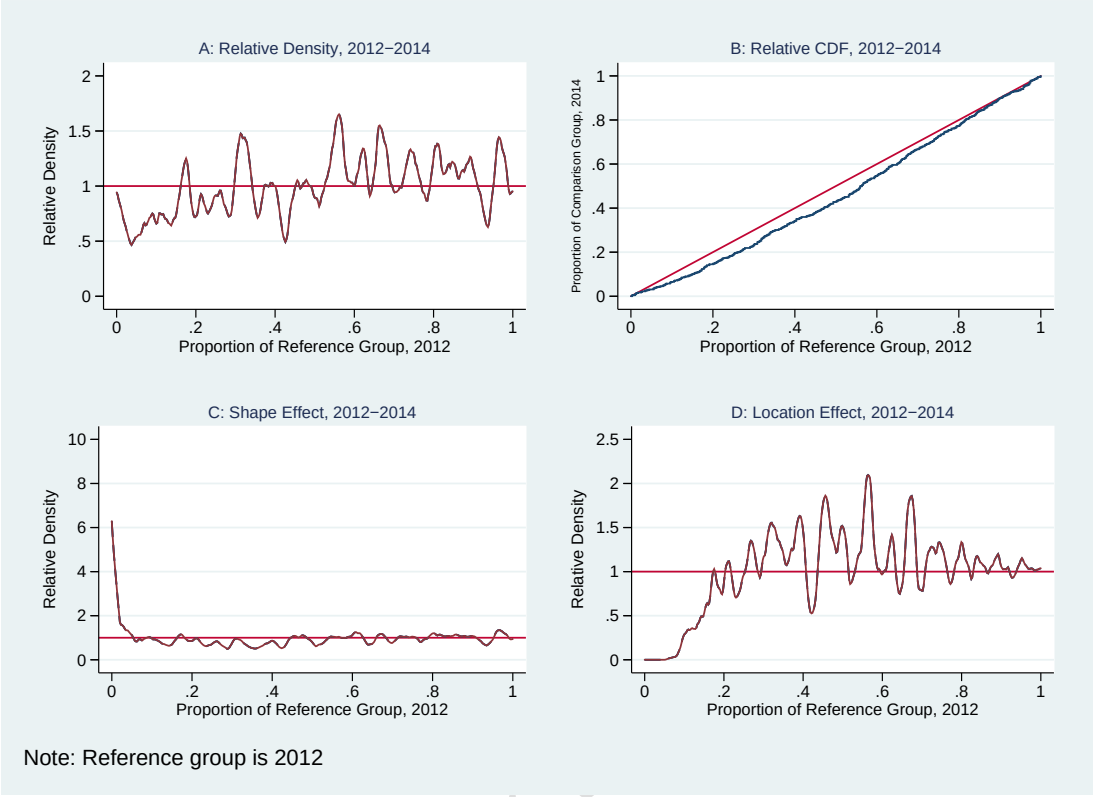
Figure 2.3.4 presents a comparison between the 2012 and 2014-2015 income distributions. The reference distribution is the 2012 income distribution and that of 2014-2015 is the comparison distribution. The share of people with incomes greater than the 42^{nd} percentile is higher in the 2012 distribution than in the 2014-2015 distribution.

Figure 2.3.3: Relative distribution of income per capita, South Africa 2008-2012



Notes: This figure shows changes in the South African income distribution using the relative distribution approach developed by Handcock and Morris (1998). The x-axis is the percentiles of the reference year, 2008, while the y-axis is the ratio of share of individuals in comparison year, 2012, to share of individuals in the reference year, 2008. A y-value less than 1 means that the 2012 distribution has a lower share of individuals than the 2008 distribution at that percentile. All densities are estimated by epanechnikov 2 kernel densities, using the Silverman method to select optimal bandwidth. All estimates are done using the *reldist* Stata code developed by Ben Jann.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012, and 2014-2015.

Figure 2.3.4: Relative distribution of income per capita, South Africa 2012-2014-2015



Notes: This figure shows changes in the South African income distribution using the relative distribution approach developed by Handcock and Morris (1998). The x-axis is the percentiles of the reference year, 2012, while the y-axis is the ratio of the share of individuals in the comparison year, 2014-2015, to the share of individuals in the reference year, 2012. A y-value of less than 1 means that the 2012 distribution has a lower share of individuals than the 2014-2015 distribution at that percentile. All densities are estimated by epanechnikov 2 kernel densities using the Silverman method to select optimal bandwidth. All estimates are done using the *reldist* Stata code developed by Ben Jann.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012, and 2014-2015.

The relative distribution also includes the median relative polarization (MRP) index that measures the direction and magnitude of these shape changes towards the median or towards one or both tails. To further understand the increases in the lower tail (downgrading) and increases in the upper tail (upgrading), the Median Relative Polarization (MRP) is decomposed into Lower Relative Polarization (LRP) and Upper Relative Polarization (URP) indices. The three indices (i.e., MRP, LRP, $\&URP$) vary between -1 and 1 such that a value of zero represents no change in the distributional shape. Positive values suggest an increase in polarization or the comparison distribution is more polarised than the median reference distribution. Negative values suggest convergence towards the median. Table 2.3.3 provides the scores of these indices to figure out if these distributional patterns suggest clustering of incomes at the local poles.

During the period from 1993 to 2008, the scores of these indices are close to zero, confirming increased bi-polarity in the 1993 distribution. That is, the distributions on

each side of the median are tightened up, such that individuals nearer to the median move away from it, while those further from the median move towards it. The score of *MRP* is negative, implying lower convergence of incomes around the mean in the 2008 distribution. Between 2008 and 2014-2015, the indices are positive which means incomes in 2008 are more polarised than incomes in 2012.

Table 2.3.3: Relative Polarization Indices, 1993-2012

	1993-2008	2008-2012	2012-2014
MRP	-0.0149	0.1820	0.1107
LRP	0.0103	0.3097	0.2003
URP	-0.0402	0.0542	0.0212

Notes: Median relative polarization index and its lower (LRP) and upper (URP) decompositions. All estimates are done using the *reldist* Stata code developed by Ben Jann.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012, and 2014-2015

2.4 Results

In this section, we discuss the results on the extent of polarization in the South African income distribution. First, we consider the patterns of polarization by employing the FW index and the DER index. Second, we move to decompose the polarization patterns by population subgroups and by income sources.

2.4.1 Extent of Polarization

Figure 2.4.1 plots polarization indices and Tables 2.4.1, 2.4.2 and 2.4.3 present changes in the scores of the indices over time and the components of the indices. The numbers in parenthesis are linearized standard errors, adjusted for the sample design. The first y-axis in Figure 2.4.1, on the left, with a larger scale, plots the estimates of the Gini coefficient or alienation component, FW index, and identification component. The second y-axis, on the right, with a lower scale, plots the estimates of the DER index.

We find that while bi-polarization decreased between 1993 and 2014-2015, thus implying a larger middle class, it increased in 2008. This is true for South Africa as a whole, and for urban income distribution. In the rural areas, bi-polarization falls during the 15 years between 1993 and 2008. Multi-polar income polarization also increased in 2008 and remains somewhat unchanged in the rural areas during the 21 years from 1993 to 2014-2015.

2.4.1.1 Bi-polarization Patterns

Taking a closer look at the extent of bi-polarization, we attempt to ascertain whether the South African distribution of income is composed of two groups, one poor, and the other rich. The score of FW index in Table 2.4.1 ranges between 0.91 in 1993 and 0.75 in 2014-2015, which indicates a high degree of bi-polarization. The score of the FW index drops marginally by 0.7% in the 7 years between 1993 and 2000, then increases by 10.37% in the 8 years leading up to 2008, and falls by 24.6% during the 6 years leading up to 2014-2015. The decline during those 6 years is statistically significant. Since the value of bi-polarization of zero means no polarity and a value of one (or higher) suggests bipolarity, then there is an 18% decline in income bi-polarization in the South African income distribution since the end of Apartheid. This decline can be due to the reduction in income spread, as indicated by the relative distribution approach. Thus the de-racialisation policies that sought to integrate previously disadvantaged groups into the mainstream economy have had a positive effect. The decrease is, however, not monotonic, as there is a huge spike in 2008.

In the urban areas (Table 2.4.2) we see a similar pattern of bi-polarization. That is, the value of the FW index declines from 0.80 in 1993 to 0.74 in 2014-2015. It however, increases by 24.8% during the period 1993 to 2008 until it reaches its local maximum. Then, during the 6 years between 2008 and 2014-2015, it declines at an annual rate of 4.2% (with the total decline equivalent to 25.5% for the period). This therefore suggests that national patterns of bi-polarization are driven by urban patterns. For rural South Africa, the story is quite different, as shown in table 2.4.3. During the period 1993 to 2008, the score of the FW index falls by an average rate of 1.2% per annum (with a total decline for the period equal to 18.3%). The recorded fall appears to be statistically significant. Between 2008 and 2012, it rises by 14.4%. The implication is that bi-polarization in the distribution of rural income decreased in 2008, and then increased in 2012 and 2014-2015. A possible explanation for the decline could be the increase in state transfers and the educational attainment of Blacks. And the increase could be due to the emergence of new strata among previously disadvantaged individuals who managed to join those in the upper-income class.

A related point to consider is that bi-polarization patterns move in opposite directions for rural and urban incomes. That is, from 1993 to 2008 the score of FW index rises in urban regions and from 2008 to 2014-2015, it falls. In the rural regions, it falls in the first period and rises in the later years. Put in a different way, as the distance between rich and poor widens (or narrows) in urban areas, it tends to narrow (or widen) in rural

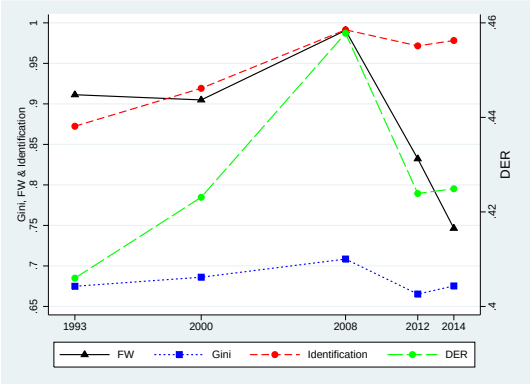
areas. Moreover, polarization and inequality also tend to give similar rankings in these regions. The similarity in the rankings between bi-polarization and inequality challenges the view that polarization and inequality can behave differently, at least in the context of South Africa. All things considered, the magnitudes suggest greater income spread between the two income groups. This has thus resulted in two groups, one extremely rich and the other exceptionally poor. In line with theory, the group below the median has very low, and unequal incomes, while the group above the median has somewhat high evenly distributed incomes.

The drop in the degree of bi-polarization between 2008 and 2014-2015 may signal a drop in wealthy individuals in the country. However, it is essential to note that bi-polarization measures are not very sensitive to incomes at the top end. This is mostly because measures of bi-polarization are concerned with the relative size of different income groups and not their incomes. In any case, during the 6 years between 2008 to 2012, all incomes increase, which means incomes of the poor might have increased faster than the those of the rich. Thus, bi-polarization has in fact fallen, though marginally. A conceivable explanation for the rise in bi-polarization in the 15 years leading up to 2008 could be the movement of the situates in the middle of the income towards the top end of the distribution.

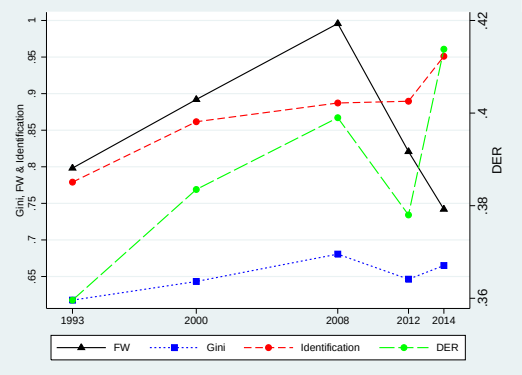
We examine the changes in the extent of bi-polarization further by disaggregating the FW index. We use the mean to median ratio, the Gini coefficient, and the share of income held by the poorest 50%. From equation 2.2.1 the increase in the mean/median ratio, ceteris paribus, prompts a rise in the FW index, though an expansion in either the Gini or the income share of the poorer half decreases the FW index.

For the national income distribution, the mean/median ratio rises by 28.2% over the period from 1993 to 2008, the share of income held by the poorer half falls by 12.4%. In other words, the incomes of those at the top moved further away from the median (higher mean/median ratio), and the incomes of those below the median moved further down. Taken together, these two components reinforce each other and lead to increasing bi-polarity and increasing spread in the South African income distribution. The increase in bi-polarization between 1993 and 2008 is therefore due to the tightening of the income distribution on either side of the median (bunching). The effects of these two components are enough to offset the downward pressure exerted by the growth in the Gini coefficient during the same period. For the 6 years between 2008 and 2014 the mean/median ratio and the share of income of the poorer half fall by 19.6% and 30.4%. The consequence is therefore a reduction in bi-polarization.

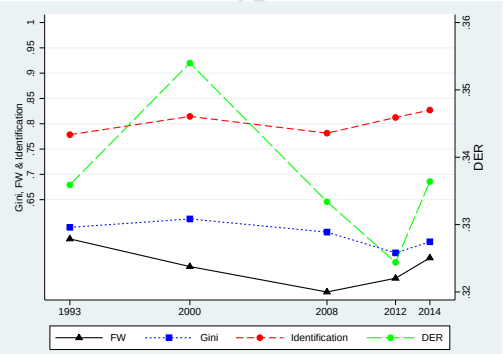
Figure 2.4.1: The extent of Income Polarization in rural, and urban areas, and for South Africa as a whole.



(a) South Africa



(b) Urban South Africa



(c) Rural South Africa

Notes: This figure presents the summary indices of polarization in South Africa. FW is the Foster and Wolfson (2010/1992) index of bi-polarization, DER is the Duclos et al. (2004) index of income polarization and identification is a component of DER index. All estimates are done using the Distributional Analysis Stata Package (DASP).
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012, and 2014-2015

Even though the magnitudes of the components of the FW index are different for urban areas, the story remains the same. That is, the growth in the degree of bi-polarization appears to be due to the narrowing of income distance within the two groups on either side of the median. In the distribution of income for rural areas, each of the three components demonstrates swings between 1993 and 2014-2015. For example, the mean/median ratio rises in 2000, then falls in 2008 and 2012 and rises again in 2014-2015. Importantly, between 1993 and 2012 the share of income held by the poorer half records an average annual growth rate of 1.04% (for a total growth of 19.8% for the period), and falls marginally in 2014-2015. The indicator of skewness (the mean/median ratio) and the Gini coefficient rise in 2000, decline between 2000 and 2012, and increase in 2014-2015. Thus, the drop in bi-polarization during the period

1993 to 2008 appears to be due to growth in the income share of the poorer half. It is important to note that the drop in inequality over the period from 2008 to 2012 leads to an increase in bi-polarity.

We next use components from Rodríguez and Salas (2000)'s restatement of the FW index (that is, the G^W, G^B, S). To estimate these components, we first partition the country into mutually exclusive groups based on median income. Partitioning the samples by the corresponding median income reveals that the income share of those above the median is about 0.91 across the sample periods. This confirms earlier conjectures as well as theoretical predictions that those below the median have very low incomes in polarized societies (Rodríguez & Salas, 2000). We then use the Yitzhaki and Lerman (1991) Gini subgroup decomposition method to find the between-group and within-group Ginis. The higher the between-Gini scores, the lower the within-Gini scores, and the further the top incomes are from the median, the higher the degree of bi-polarization. This decomposition confirms that narrowing distance between the incomes of those below and above the median (i.e lower G^B) influenced the increase in bi-polarization during the period 1993 to 2008. The increment in the skewness (i.e $S = {}^{2\mu}/_{m}$) and between-Gini (i.e G^B) is sufficient to counterbalance the downward pressure exerted by the rising income differences within the groups (i.e G^W). The three components appear to be reinforcing each other in the rural distribution.

A conclusion from the above discussion is that, while bi-polarization clearly increases during the 15 years leading up to 2008, it decreases between 2012 and 2014-2015. Nonetheless, the magnitude of the bi-polarization shows that the country is indeed composed of two groups, one poor and one very rich.

Table 2.4.1: Extent of polarization in South Africa

	1993	2000	2008	2012	2014	Differences		
						2008 - 1993	2012 - 2008	2014 - 2012
FW	0.9113	0.9049	0.9907	0.8323	0.7465	0.0794	-0.1584	-0.0858
	(0.0572)	(0.0227)	(0.0807)	(0.0618)	(0.0426)	(0.0989)	(0.0475)	(0.0376)
$Mean/Mdian$	2.83	3.01	3.37	2.75	2.71			
Gini	0.6749	0.6861	0.7085	0.6653	0.6753	0.0336	-0.0433	0.0100
	(0.0108)	(0.0055)	(0.0154)	(0.0173)	(0.0293)	(0.0188)	(0.0156)	(0.0298)
L(50)	0.082	0.0812	0.0718	0.0918	0.0936			
G^B	0.4178	0.4182	0.4269	0.4082	0.4063			
G^W	0.2571	0.2679	0.2817	0.2571	0.2689			
DER	0.4060	0.4231	0.4578	0.4239	0.4249	0.0785	-0.0365	-0.0046
	(0.0125)	(0.0066)	(0.0299)	(0.0285)	(0.0362)	(0.0357)	(0.0245)	(0.0374)
Alienation	0.6749	0.6861	0.7085	0.6653	0.6753			
Identification	0.8724	0.9192	0.9914	0.9716	0.9782			
Covariance	-0.3106	-0.3291	-0.3483	-0.3441	-0.3567			

Notes: All incomes are inflated to 2012 values. For a description of these indices and formulae, see Section 2.2. The polarization sensitivity parameter or identification effect weight (α) for DER index is set at 0.5. L(50) is the Lorenz ordinate for 50% - share of income held by the poorer half. $G^B$and $G^W$are between-group and within-group Ginis when groups are separated by median value. Numbers in parenthesis are linearized standard errors.

Source: Own calculation from weighted PSLSD 1993, IES 2000, NIDS 2008, 2012, and NIDS 2014-2015

Table 2.4.2: Extent of polarization in Urban South Africa

	1993	2000	2008	2012	2014	Changes		
						2008 - 1993	2012 - 2008	2014 - 2012
FW	0.7982	0.8920	0.9958	0.8208	0.7420	0.1976	-0.1750	-0.0788
	(0.0494)	(0.0232)	(0.0749)	(0.0648)	(0.0479)	(0.0897)	(0.0492)	(0.0445)
$Mean/Mdian$	2.27	2.60	2.91	2.48	2.63			
Gini	0.6177	0.6432	0.6806	0.6463	0.6650	0.0629	-0.0343	0.0187
	(0.0132)	(0.0064)	(0.0168)	(0.0179)	(0.0346)	(0.0213)	(0.0188)	(0.0360)
L(50)	0.1032	0.0927	0.0740	0.0941	0.0973			
G^B	0.3966	0.4073	0.4256	0.4059	0.4024			
G^W	0.2211	0.2359	0.2550	0.2404	0.2626			
DER	0.3596	0.3835	0.3990	0.3780	0.4138	0.0538	-0.0265	0.0450
	(0.0109)	(0.0062)	(0.0176)	(0.0175)	(0.0410)	(0.0248)	(0.0199)	(0.0412)
Alienation	0.6177	0.6432	0.6806	0.6463	0.6650			
Identification	0.7790	0.8646	0.8872	0.8896	0.9511			
Covariance	-0.2526	-0.3104	-0.3392	-0.3426	-0.3457			

Notes: All incomes are inflated to 2012 values. For a description of these indices and formulae, see Section 2.2. The polarization sensitivity parameter or identification effect weight (α) for DER index is set at 0.5. L(50) is the Lorenz ordinate for 50% - share of income held by the poorer half. $G^B$and $G^W$are between-group and within-group Ginis when groups are separated by median value. Numbers in parenthesis are linearized standard errors.

Source: Own calculation from weighted PSLSD 1993, IES 2000, NIDS 2008, 2012, and NIDS 2014-2015

Table 2.4.3: Extent of polarization in Rural South Africa

	1993	2000	2008	2012	2014	Changes		
						2008 - 1993	2012 - 2008	2014 - 2012
FW	0.5725	0.5178	0.4676	0.4947	0.5350	-0.1049	0.0272	0.0403
	(0.0336)	(0.0109)	(0.0286)	(0.0284)	(0.0282)	(0.0441)	(0.0236)	(0.0220)
$Mean/Mdian$	2.04	2.10	1.85	1.79	1.95			
Gini	0.5954	0.6119	0.5859	0.5448	0.5668	-0.0095	-0.0411	0.0220
	(0.0180)	(0.0154)	(0.0228)	(0.0162)	(0.0139)	(0.0290)	(0.0250)	(0.0158)
L(50)	0.1321	0.1326	0.1438	0.1583	0.1480			
G^B	0.3678	0.3664	0.3557	0.3408	0.3519			
G^W	0.2276	0.2455	0.2301	0.2039	0.2149			
DER	0.3359	0.3540	0.3334	0.3244	0.3364	0.0125	-0.0070	0.0069
	(0.0138)	(0.0125)	(0.0184)	(0.0134)	(0.0145)	(0.0243)	(0.0227)	(0.0142)
Alienation	0.5954	0.6119	0.5859	0.5448	0.5668			
Identification	0.7784	0.8145	0.7814	0.8124	0.8271			
Covariance	-0.2751	-0.2897	-0.2718	-0.2670	-0.2823			

Notes: All incomes are inflated to 2012 values. For a description of these indices and formulae, see Section 2.2. The polarization sensitivity parameter or identification effect weight (α) for DER index is set at 0.5. L(50) is the Lorenz ordinate for 50% - share of income held by the poorer half. $G^B$and $G^W$are between-group and within-group Ginis when groups are separated by median value. Numbers in parenthesis are linearized standard errors.
Source: Own calculation from weighted PSLSD 1993, IES 2000, NIDS 2008, 2012, and NIDS 2014-2015

What do these bi-polarization patterns say about the size of the middle-class in South Africa? Bi-polarization implies that the income distribution is dispersed from the central value are such that the middle of the distribution is hollowed out. In other words, the greater the degree of bi-polarization, the smaller the middle class. A convenient feature of measuring the extent of middle class this way is that there is no need to define a cut-off point for the middle class category.

The following conclusions are discernible from the results above. There is a significant decline in the size of the middle-class population from 1993 to 2008. While there is growth in the size of the middle class from 2008 to 2014, it is only statistically significant between 2012 and 2014-2015. The results further show an increase of incomes, including those of previously disadvantaged individuals, which suggest that the composition of the middle class has changed. All in all, we conclude that there has been an increase in the size and composition of the middle class in South Africa since the end of Apartheid. In the urban areas, the results suggest disappearance of the middle class from 1993 to 2008. Admittedly, there is a shift towards perfect bi-modality (i.e., higher values of FW index) during this period, which means the size of the middle-class was small in urban areas during this period. This decline is however is reversed between 2008 and 2012. In the rural areas, the middle-class grows significantly between 1993 and 2008. Overall, the rural middle class has increased in the post-Apartheid era.

Even though our evidence suggests an increase in the size and composition of the

middle class in the post-apartheid era, the magnitudes are very small, which means this category can easily be eroded by shocks to household income.

2.4.1.2 Income polarization Patterns

We complete our discussion on the patterns of polarization by estimating the DER index. In the empirical analysis that follows, we set the identification effect weight (α) to 0.5. The larger the value of the DER index, the higher the number of clusters (or more polarized) the distribution of income. The discussion therefore provides an answer to the question of whether South Africa's income distribution is composed of multiple groups. Overall, we discover similar patterns to those of bi-polarization. That is, that multi-polar income polarization rises from 1993 to 2008, then decreases between 2008 and 2012. From 2012 to 2014-2015, income polarization increases. Thus, incomes are indeed clustered around local poles in South Africa.

Table 2.4.1 present DER indicators for the South African income distribution as a whole. In this case, we ask whether multi-polar income polarization follows the same path as income bi-polarization. The answer is clearly that it does. For instance, we note that from 1993 to 2008 the score of DER index's annual growth rate is 0.73% (with total growth for the period of 10.9%). The changes in the DER index during these years are statistically significant at 5%. This means a significant growth in heterogeneity in the distribution of incomes. However, from 2008 to 2014-2015, the patterns change. That is, the polarization of income declines. Nonetheless, the changes in the score of DER index in these periods are not statistically significant, which means we reject the hypothesis of a decline in the clustering of incomes in post-Apartheid South Africa.

Tables 2.4.2 and 2.4.3 provide the patterns of polarization in the urban and rural distributions. There is evidence of clustering of incomes among urban residents from 1993 to 2008, a reduction between 2008 and 2012 and another increase in the years between 2012 and 2014-2015. As expected, the picture is quite different in the rural distribution. The DER index first rises by 5.4% in 2000, then falls by 5.8% in 2008 and falls by another 2.7% in 2012, before it finally rises by 3.6% in 2014-2015. This means that 7 years after the end of Apartheid, there was a formation of groups in the rural income distribution, and in the 12 years between 2000 and 2012, the groups tend to disappear. The wide coverage of government transfers at the dawn of democracy perhaps created the local means/poles in the rural distribution. A notable feature is that the distribution of income in urban areas is more polarised (i.e. has more clusters) than the distribution of income in rural areas.

To deepen our understanding of the patterns of clustering of incomes we decompose the DER index into identification, alienation, and normalised covariance between the two components. Identification is a function of the number of people in an income group, thus it reflects the extent of internal homogeneity such that, when it is high, the density of income groups is higher. Alienation is scaled to equal the Gini coefficient, thus it captures external heterogeneity. The normalised covariance indicates the extent to which income groups with high identification are alienated from other income groups.

Figure 2.4.1 shows that the identification line is everywhere and always above the Gini coefficient line, meaning the identification component is greater than the alienation component. The difference between the two tends to widen over time. This reflects greater clustering and a small number of significantly sized income groups in the income distribution. The rapid increase in the identification component during the study period suggests that the well populated poles become even more populated, at the expense of the less populated poles. This is evidence of bunching of incomes. The covariance between identification and alienation rises by 14.8% in the national distribution, which implies that the high identification groups have become more alienated towards others groups. Since all three components move in the same direction, we conclude that they reinforce each other to drive the observed patterns.

We conclude our discussion by noting that the magnitude of the FW index, regardless of the identification effect weight (α), is higher than that of the DER index, for all sample points. Interpreting this result to mean that there are few poles in the South African income distribution, supports the idea that South Africa's income distribution has only two income groups. The magnitudes of the DER index also suggest that the distribution of urban incomes, as well as the national income distribution, have multiple clusters. Moreover, the strong identification effect lends support to earlier findings that the country has near perfect bi-polarity, and also that the income groups are expanding in size. This result was first discovered when applying the relative distribution approach. Nonetheless, these results highlight the need to further investigate the spatial patterns of polarization in order to stall social conflict.

How do these polarization patterns compare to findings on income inequality? Are the conclusions obtained using Gini coefficients significantly changed when polarization measures are used instead? We attempt to determine the redundancy of polarization measured by comparing the relative ranking for rural and urban areas and for South Africa as a whole. We find that the three summary measures (Gini, FW, and DER) tend to agree on the relative ranking across the sample. Moreover, the overall trends

for these measures fluctuate similarly, but at substantially different rates during the 21 year period under review. We therefore conclude that, even though inequality and polarization are theoretically different concepts, empirically they are highly correlated and tend have similar trends. Nonetheless, the results do confirm that South Africa's income distribution cannot be analysed using only traditional inequality measures.

2.4.2 Decomposition of Polarization Patterns

In this section, we complement the above statistical analysis by decomposing the patterns of polarization using an approach proposed by Araar (2008). It is a well documented fact that subgroup and factor components decompositions (of either poverty and inequality) provide insights into the underlying forces driving the observed changes (Ogwang, 2014). Thus, our analytical decomposition of income polarization can assist in designing polarization-reduction strategies.

This section proceeds in two ways, first (in section 2.4.2.1), we decompose by different income components of total income. This exercise seeks to examine polarization patterns of various income sources (like labour earnings, remittances, capital income, state grants, and others), and find the differential impact the incomes on overall income polarization. Second (in section 2.4.2.2), we decompose by population subgroups to assess the contribution of incomes gaps between subgroups and within subgroups to overall income polarization. The subgroups we consider are region (urban and rural) and race (Blacks, Coloureds, Whites, and Indians).

2.4.2.1 Income Source decomposition

Table 2.4.4 presents the results of the factor components decomposition of the DER index. We use equation 2.2.8 on page 24 to examine the contribution of five income components to income polarization. Panel (a) shows the results for the national income distribution, panel (b) and panel (c) show the results for the distribution of urban incomes and of rural incomes. They provide information about the income share, polarization levels, and contributions (relative and absolute) of each component. An obvious conclusion from the results is that the distribution of government transfers and that of remittances contribute negatively to income polarization, whereas the distribution of labour market income contributes positively to the polarization. Additionally, we also find that the distribution of capital dividends has a tendency to disequalize and

polarize the income distribution.

Starting with panel (a), we see that the labour market income share varies between 75% and 85% during the study period. However, this share falls at an average annual rate of 0.57% in the 21 year period probably due to a fall in the proportion of households receiving labour income (see Table 2.3.2). The share of government transfers doubles between 1993 and 2012, and then slightly drops in 2014-2015. Government transfers generally accrue to the poor, which means its distribution can either lower the alienation component (that is, lessen the within-group inequality) or reduce the identification component (by equalizing income across race groups). Equally important is capital income, whose share rises from 0.071 in 1993 to 0.141 in 2014-2015. Leibbrandt et al. (2012) show that capital income is virtually zero for those in low and middle-income deciles, which means it will likely create a local pole at the top end of the distribution, thereby increasing polarization. The remittance income's share of total income remains largely unchanged during the period.

The columns labelled CP_k provide the concentration index (or pseudo-polarization index) for each income component for all sample points. Greater pseudo-polarization indicates higher clustering of incomes in the distribution. Therefore, labour market earnings and capital dividends tend to have multiple clusters. A possible explanation for the polarization of labour income could be disappearance of mid-level occupations which require moderate skills (like those from Grade 12 or Matric Certificate). This, in turn, leads to growth in employment for unskilled and highly skilled occupations. This phenomenon is known as Job Polarization (Acemoglu & Autor, 2011). This finding gives an insight in the dis-equalizing role of these income components. In the case of government transfers, pseudo-polarization is negative for 2012 and 2014-2015 sample points, implying government transfers contribute negatively to income inequality. Capital income contributes the most to pseudo-polarization, which means high capital income inequality.

The columns labelled RC_k provides information on the relative contribution of the distribution of each income source to polarization. We note that labour earnings contribute the most to the polarization of incomes in South Africa. For instance, their contribution ranges from 91% in 1993 to 82% in 2014-2015. The decrease in the income share of the labour earnings may partly explain the influence of labour earning on polarization. Capital income has the second largest relative contribution to polarization. The share of capital income in the overall DER index hovers around 8% and reaches a maximum of 16% in 2014-2015. The relative contributions of remittances and of government transfers are almost zero, meaning that they little effect on polarization. Interestingly,

government transfers made negative absolute and relative contributions to polarization during the years 2012 and 2014-2015, which means that if there were no government transfers, the DER index would have been higher in 2012 and 2014-2015.

A sufficient condition for an income source to be polarizing (positive effect) is for its concentration index to be greater than that of the overall income polarization ($CP_k > P^{DER}$). For all sample points, the distribution of labour income and that of capital income have a polarizing effect, while the distribution of government transfers and that of remittance income have a depolarizing effect. The insignificance of government transfers in determining polarization is in line with the literature on inequality in the country. That is, most studies agree that the state transfers have only reduced poverty rates, not inequality. The findings further support the view that the de-racialisation policies only changed the racial composition of the situates at the top end of the South African income distribution, thus leaving the majority of the formerly disadvantaged at lower income levels.

Next, we turn our focus to disaggregation by rural and urban areas. Beginning with panel (b) which provides results for the urban income distribution, a similar pattern to the national distribution emerges. That is, the share of labour income share ranges between 80% to 76% and decreases over the study period. Capital income's share reached a global maximum of 16% in 2014-2015, and the share of remittances remained fairly stable. The share of government transfers, though it rises during the period, is somewhat less. A notable difference is that government transfers contribute negatively to both inequality and polarization for all survey points, except in 2000. This indicates that if government transfers were zero in these years, both inequality and polarization would have been higher.

In the distribution in rural incomes (panel (c)), the patterns are quite distinctive. First, the labour income polarization share is between 63% and 72%, meaning labour income affects polarization less in rural areas. The second largest influence on polarization is from the distribution of government transfers. While this confirms the significance of government social grants as a source of income for rural residents, it shows that their importance declines from 2008 to 2014-2015. For instance, during the 15 year period from 1993 to 2008 the share of government transfers increases by 117%, then declines by 5.6% and 16.9% in 2012 and 2014-2015, respectively. The increase in government transfers nevertheless results in higher pseudo-polarization, especially during the period from 1993 to 2008. All in all, in the rural distribution, state grants and remittances are depolarizing, and labour earnings and capital incomes are polarizing.

Table 2.4.4: DER Decomposition by income sources

(a) South Africa (Total)

	1993				2000				2008				2012				2014			
	ψ_k	CP_k	AC_k	RC_k	ψ_k	CP_k	AC_k	RC_k	ψ_k	CP_k	AC_k	RC_k	ψ_k	CP_k	AC_k	RC_k	ψ_k	CP_k	AC_k	RC_k
Capital Income	0.0711	0.4623	0.0328	0.0797	0.0412	0.4818	0.0199	0.0456	0.0784	0.5269	0.0413	0.0892	0.0694	0.4972	0.0345	0.0811	0.1412	0.4938	0.0697	0.1633
Remittances	0.0309	0.0208	0.0006	0.0016	0.0708	0.2287	0.0162	0.0371	0.0442	0.4042	0.0179	0.0386	0.0284	0.3167	0.0090	0.0212	0.0358	0.2274	0.0081	0.0190
Labour income	0.8532	0.4407	0.376	0.9127	0.8254	0.4698	0.3878	0.8899	0.7935	0.5006	0.3972	0.8583	0.8117	0.4695	0.3810	0.8949	0.7501	0.4691	0.3518	0.8238
Givernment transfers	0.0425	0.0363	0.0015	0.0037	0.0473	0.1037	0.0049	0.0113	0.0806	0.0588	0.0047	0.0102	0.0862	-0.0120	-0.0010	-0.0024	0.0710	-0.0494	-0.0035	-0.0082
Other income	0.0023	0.402	0.0009	0.0023	0.0153	0.4616	0.007	0.0162	0.0033	0.5085	0.0017	0.0036	0.0043	0.5283	0.0023	0.0053	0.0020	0.4570	0.0009	0.0021
DER index	0.4060				0.4231				0.4578				0.4239				0.4249			

(b) Urban South Africa

	1993				2000				2008				2012				2014			
	ψ_k	CP_k	AC_k	RC_k	ψ_k	CP_k	AC_k	RC_k	ψ_k	CP_k	AC_k	RC_k	ψ_k	CP_k	AC_k	RC_k	ψ_k	CP_k	AC_k	RC_k
Capital Income	0.0755	0.4195	0.0317	0.0873	0.0450	0.4402	0.0198	0.0506	0.0861	0.4474	0.0385	0.0964	0.0783	0.4345	0.0340	0.0900	0.1598	0.4776	0.0763	0.1849
Remittances	0.0134	0.0830	0.0011	0.0031	0.0468	0.2027	0.0095	0.0242	0.0402	0.3450	0.0139	0.0347	0.0250	0.3093	0.0077	0.0204	0.0266	0.1814	0.0048	0.0117
Labour income	0.8870	0.3734	0.3312	0.9126	0.8597	0.4112	0.3535	0.9021	0.8200	0.4217	0.3458	0.8651	0.8379	0.4029	0.3375	0.8921	0.7684	0.4362	0.3352	0.8121
Givernment transfers	0.0214	-0.0877	-0.0019	-0.0052	0.0321	0.0886	0.0028	0.0073	0.0499	-0.0026	-0.0001	-0.0003	0.0538	-0.0619	-0.0033	-0.0088	0.0430	-0.1055	-0.0045	-0.0110
Other income	0.0027	0.3048	0.0008	0.0023	0.0163	0.3795	0.0062	0.0158	0.0038	0.4437	0.0017	0.0042	0.0050	0.4807	0.0024	0.0063	0.0022	0.4356	0.0010	0.0024
DER index	0.3596				0.3835				0.3990				0.3738				0.4138			

(c) Rural South Africa

	1993				2000				2008				2012				2014			
	ψ_k	CP_k	AC_k	RC_k	ψ_k	CP_k	AC_k	RC_k	ψ_k	CP_k	AC_k	RC_k	ψ_k	CP_k	AC_k	RC_k	ψ_k	CP_k	AC_k	RC_k
Capital Income	0.0537	0.3996	0.0214	0.0635	0.0232	0.3864	0.0089	0.0249	0.0304	0.4450	0.0135	0.0402	0.0225	0.3972	0.0089	0.0273	0.0470	0.4255	0.0200	0.0589
Remittances	0.0992	0.1041	0.0103	0.0306	0.1847	0.2723	0.0503	0.1401	0.0693	0.3029	0.0210	0.0624	0.0467	0.2275	0.0106	0.0324	0.0823	0.2697	0.0222	0.0653
Labour income	0.7211	0.3954	0.2851	0.8442	0.6625	0.4198	0.2782	0.7750	0.6290	0.4176	0.2627	0.7806	0.6742	0.4253	0.2867	0.8747	0.6573	0.4292	0.2821	0.8296
Givernment transfers	0.1250	0.1650	0.0206	0.0611	0.1195	0.1458	0.0174	0.0485	0.2712	0.1449	0.0393	0.1168	0.2560	0.0831	0.0213	0.0649	0.2127	0.0728	0.0155	0.0455
Other income	0.0009	0.2419	0.0002	0.0007	0.0102	0.4031	0.0041	0.0114	0.0001	0.2547	0.0000	0.0001	0.0006	0.4493	0.0003	0.0008	0.0007	0.3639	0.0003	0.0007
DER index	0.3359				0.3540				0.3334				0.3244				0.3364			

Notes: All income components are normalised by household size and inflated to 2012 prices. ψ_k is the income share of source k, CP_k is the concentration index (or pseudo-polarization) associated with source k and AC_k and RC_k are absolute and relative contributions of income source k to overall polarization. If $RC_k > \psi_k$ and/or $CP_k > P^{DER}$ then income component k is said to be polarizing.
Source: Own calculations from weighted PSLSD 1993, IES 2000, NIDS 2008, 2012, and 2014-2015.

2.4.2.2 Subgroup Decomposition

Tables 2.4.5 and 2.4.6 present the decomposition of the DER index by region and race. The idea in this section is to examine whether income differences between and within the two subgroups tend to create local means in the distribution such that people cluster around those means. As with inequality subgroup decompositions, between-group decomposition represents polarization, where every income in the subgroup is replaced by the subgroup's mean income. Within-group polarization is the sum of the product of population share, income share, and residual polarization, which is unity if subgroup incomes do not overlap. It is important to note that the between-group polarization created by merging the within-group polarization to one point makes the income distribution degenerate, that is, breaks the continuity. This is problematic because polarization is sensitive to the size of the group and its density[6].

Starting with the rural-urban decomposition shown in Table 2.4.5 we note the following: In 1993 and 2000, income disparities between the urban and rural areas contribute more to polarization than the disparities of incomes within the regions. In 2008 the income gaps between and within the regions contribute equally to polarization, and in 2012 and 2014-2015 within-group polarization becomes greater than between-group polarization. Put differently, the influence of income gaps between the rural and urban residents tend to declines, while the influence of income disparities within the regions has increased. This suggests a formation of of income clusters in each of the regions in recent times such that there is greater degree of internal heterogeneity within each region. Assuming that rural areas are "homelands" or "Bantustans"[7], and the urban areas the the previously White areas, this is evidence of reduction of economics distances across race.

Moving to Table 2.4.6, where we categorise the population into four race groups (African/Black, Coloured, Indian/Asian and White), the following results are apparent. The income share of Blacks increases from 35% to 52% from 1993 to 2014-2015, while the income share of Whites falls from 52% to 34% for the same period. This, in turn, translates into lower and higher deficit/surplus ratio values for Blacks and for Whites during the same period. Such a drop in the number of poor Black South Africans could lessen polarization. The situation of "Coloured" South Africans is quite surprising. This group's income share is rather stagnant in this period, while their deficit/surplus ratio tends to rise, implying an increase in the headcount poverty in their group. While we cannot say for certain, these changes point to convergence of in-

[6]Thanks to Jean Yves Duclos for pointing out this problem.
[7]For details about the homelands visit http://www.sahistory.org.za/article/homelands

comes of Blacks and Whites and also suggest that the incomes of Coloureds are being left behind.

The columns labelled P_g show that clustering of incomes is greatest in the distribution of income for Blacks. That is, the Black group's income polarization increases by 22.2% between 1993 and 2008, then declines by 6.75% in 2012, and remains unchanged thereafter. The larger population share of Blacks (about 75%) will surely heighten the identification component, and increase polarization in turn. The lower income share of Blacks, which may signal higher inequality, also explains the greater income polarization of this group. As expected, there is also evidence of formation of clusters in the distribution of Coloureds incomes from 1993 to 2008. A possible explanation for the rise in the clustering of Coloureds incomes could be the increasing share of the poor. The polarization of income for Whites rises almost twofold from 1993 to 2014-2015.

The columns titled RC_k in Tables 2.4.6 and 2.4.7 provide information about the relative contribution of income differences between and within the racial groups to the overall level of income polarization in the country. We find that the contribution of income differences between the groups is greater than that of income differences within the groups. For example, the between-group relative contribution is 0.702 in 1993 while the within-group relative contribution is 0.298. This means that income differences between racial groups contribute about 2.4 times more to polarization than income differences within the race groups. This does not necessarily mean that there are large income distances between the racial groups, as is the case with inequality. Rather, it suggests that the different racial groups' incomes may be clustered at distinct poles in the income distribution.

By and large we should point out that as within-group contribution increases (by an annual rate of 2.25% during the period), between-group contribution falls (by an annual rate of 0.95%). Even though the expansion of intra-group contribution and contraction of inter-group share signals convergence in incomes across the race groups, it also means the emergence of new strata within each of the racial groups.

Table 2.4.5: Decomposition of DER by rural-urban area

(a) **1993**

	ϕ_g	ψ_k	P_g	R	D	S	D/S	$AC.$	RC
Urban	0.497	0.796	0.366	1.053	0.115	0.057	2.012	0.12	0.292
Rural	0.503	0.204	0.34	0.886	0.221	0.019	11.525	0.049	0.118
Intra-Group								0.169	0.41
Inter-Group								0.243	0.59

(b) **2000**

	ϕ_g	ψ_k	P_g	R	D	S	D/S	$AC.$	RC
Urban	0.569	0.826	0.396	1.063	0.154	0.064	2.385	0.164	0.377
Rural	0.431	0.174	0.366	0.862	0.202	0.016	12.951	0.037	0.085
Intra-Group								0.201	0.462
Inter-Group								0.234	0.538

(c) **2008**

	ϕ_g	ψ_k	P_g	R	D	S	D/S	$AC.$	RC
Urban	0.609	0.861	0.41	1.144	0.185	0.075	2.473	0.207	0.447
Rural	0.391	0.139	0.341	0.863	0.19	0.014	13.926	0.027	0.058
Intra-Group								0.234	0.505
Inter-Group								0.229	0.495

(d) **2012**

	ϕ_g	ψ_k	P_g	R	D	S	D/S	$AC.$	RC
Urban	0.611	0.84	0.386	1.121	0.168	0.075	2.225	0.19	0.445
Rural	0.389	0.16	0.334	0.862	0.167	0.016	10.774	0.028	0.066
Intra-Group								0.218	0.511
Inter-Group								0.208	0.489

(e) **2014**

	ϕ_g	ψ_k	P_g	R	D	S	D/S	$AC.$	RC
Urban	0.619	0.835	0.422	1.036	0.174	0.074	2.34	0.194	0.455
Rural	0.381	0.165	0.346	0.871	0.162	0.016	10.059	0.029	0.068
Intra-Group								0.223	0.523
Inter-Group								0.204	0.477

Notes: ϕ_g is the population share of group g; ψ_g is the income share; P_g is Polarization of group g; R is residual polarization due to overlapping of groups; D is the deprivation; S is the surplus; D/S is Deprivation surplus ratio; AC and RC are absolute and relative contributions of group g to overall polarization.
Source: Own calculations from weighted PSLSD 1993, IES 2000, NIDS 2008, 2012, and NIDS 2014-2015.

Another notable development in this period is that Blacks are not just the largest contributors to overall polarization, but their contribution increases almost twofold. For instance, in 1993, Blacks' relative contribution is about 0.277, compared to 0.419 in 2014-2015. Perhaps the growth in the Black population and the persistence of inequal-

ity of opportunity are behind their large relative contribution, and, by extension, the growth of within-group polarization. This highlights the need for more effective social reforms for Black South Africans. In general, these racial decompositions present a strong argument in favour of race as a key factor in determining socio-economic outcomes. They, however, seem to suggest an emergence of new strata.

Table 2.4.6: Decomposition of DER by race, 1993 - 2008

(a) **1993**

	ϕ_g	ψ_k	P_g	R	D	S	D/S	$AC.$	RC
Black/African	0.759	0.345	0.315	0.934	0.305	0.035	8.807	0.114	0.277
Coloured	0.086	0.084	0.298	0.913	0.02	0.008	2.589	0.002	0.005
Indian/Asian	0.025	0.048	0.313	0.787	0.003	0.004	0.87	0	0.001
White	0.13	0.523	0.256	0.738	0.007	0.03	0.219	0.006	0.015
Intra-Group								0.123	0.298
Inter-Group								0.289	0.702

(b) **2000**

	ϕ_g	ψ_k	P_g	R	D	S	D/S	$AC.$	RC
Black/African	0.788	0.447	0.366	0.945	0.322	0.042	7.663	0.161	0.37
Coloured	0.089	0.09	0.317	0.984	0.024	0.008	2.849	0.003	0.006
Indian/Asian	0.025	0.045	0.341	0.789	0.004	0.004	1.026	0	0.001
White	0.097	0.419	0.298	0.857	0.007	0.026	0.253	0.005	0.011
Intra-Group								0.169	0.388
Inter-Group								0.267	0.612

(c) **2008**

	ϕ_g	ψ_k	P_g	R	D	S	D/S	$AC.$	RC
Black/African	0.783	0.441	0.385	0.937	0.334	0.042	7.872	0.166	0.359
Coloured	0.093	0.084	0.397	0.869	0.028	0.008	3.539	0.003	0.006
Indian/Asian	0.026	0.07	0.462	0.92	0.004	0.006	0.71	0	0.001
White	0.098	0.404	0.316	0.947	0.008	0.032	0.239	0.006	0.013
Intra-Group								0.175	0.378
Inter-Group								0.288	0.622

Notes: ϕ_g is the population share of group g; ψ_g is the income share; P_g is Polarization of group g; R is residual polarization due to overlapping of groups; D is the deprivation; S is the surplus; D/S is Deprivation surplus ratio; AC and RC are absolute and relative contributions of group g to overall polarization.
Source: Own calculations from weighted PSLSD 1993, IES 2000, and NIDS 2008.

Table 2.4.7: Decomposition of DER by race, 2012 and 2014-2015

(a) **2012**

	ϕ_g	ψ_k	P_g	R	D	S	D/S	$AC.$	RC
Black/African	0.798	0.495	0.359	0.948	0.3	0.047	6.362	0.171	0.402
Coloured	0.089	0.085	0.355	0.943	0.025	0.008	3.251	0.003	0.006
Indian/Asian	0.025	0.065	0.467	0.809	0.004	0.006	0.669	0	0.001
White	0.088	0.355	0.327	0.89	0.006	0.03	0.195	0.005	0.011
Intra-Group								0.178	0.419
Inter-Group								0.247	0.581

(b) **2014-2015**

	ϕ_g	ψ_k	P_g	R	D	S	D/S	$AC.$	RC
Black/African	0.806	0.519	0.359	0.956	0.298	0.049	6.068	0.179	0.419
Coloured	0.089	0.083	0.395	0.839	0.025	0.008	3.016	0.003	0.006
Indian/Asian	0.023	0.059	0.504	0.806	0.004	0.005	0.734	0	0.001
White	0.082	0.339	0.521	0.844	0.009	0.028	0.331	0.006	0.014
Intra-Group								0.188	0.439
Inter-Group								0.239	0.561

Notes: ϕ_g is the population share of group g; ψ_g is the income share; P_g is Polarization of group g; R is residual polarization due to overlapping of groups; D is the deprivation; S is the surplus; D/S is Deprivation surplus ratio; AC and RC are absolute and relative contributions of group g to overall polarization.
Source: Own calculations from weighted NIDS 2012, and NIDS 2014-2015.

2.5 Conclusion

In this chapter, we make a contribution to a much-discussed topic in South Africa, that is, the patterns of income distribution in the post-apartheid era. Specifically, we detail our analysis of the extent to which incomes are clustered around a small number of distant poles (polarization). Using survey data collected in 1993, 2000, 2008, 2012, and 2014-2015, our first objective is to examine if persistent income inequality happens in tandem with clustering of incomes around local means in the income distribution. This investigation is important because clustering of incomes could increase between-income-group conflict.

We find that from 1993 to 2008 the income distribution is highly dispersed from its central value, such that there is a disappearance of the middle class during this period. The size and composition of the income groups appear to be growing, which is evidence of increasing bi-polarity in the country. Between 2008 and 2014-2015, there is a positive (rightward) location shift of the distribution of income such that the extent of clustering is lowered. Actually, there is a decrease in the extent of bi-polarization and

income polarization in the post-Apartheid era.

Secondly, we investigate the relative contribution of different income sources and that of income differences between and within groups on polarization. While there is a reduction in the income disparities between the regions and between race groups, there is growth in within-group income disparities. The income source decomposition affirms the importance of government social grants in reducing the disparities in the income distribution. For instance, distribution of government transfers tend to have an impact on polarization of rural incomes. Finally, we find that the distribution of labour earnings and of capital dividends have a positive effect on polarization, that is, they tend to create poles in the overall income distribution.

There are, however, an important limitations of the decomposition approach. The between-group polarization is created by assigning each individual the mean income of his/her group. This procedure breaks the continuity of the income distribution, thus leads to a bias in the decomposition results. The source decomposition assumes linearity of polarization, and the DER index is not linear. Thus future research needs to develop and apply new decomposition methods that address these limitations.

From a policy perspective, this chapter shows the existence of distances between the rich and poor in the country. The poor may be Blacks and are located in the rural areas, and the rich may be Whites and residing in the urban areas. Therefore, public policy needs to focus on stimulating the income generating activities of rural residents and of Blacks.

2.6 Appendix

2.6.1 Variables included in analysing income sources

The five major components of total household monthly income are:

1. **Labour market income,** which includes earnings from main, secondary and part-time work, self-employment, profits, bonuses, benefits. and cash allowances.

2. **Capital income** includes interest or dividends, rental and property earnings, private pensions and annuities, as well as royalties.

3. **Remittances** include the value of food, clothing, and housing received, alimony, child maintenance, and similar allowances and all other inter-household remittances received.

4. **Government transfers** include old age pensions, child grants (including foster care and care dependency), disability grants, UIF income, as well as workman's compensation.

5. **Other income** includes all income not specified elsewhere.

2.6.2 Relative Distribution Concept

The relative distribution is a non-parametric approach that analyses changes in the income (or other) distributions of two groups, the reference and the comparison group (Handcock & Morris, 1998). Specifically, the relative distribution re-scales the density ratio of the two distributions such that it returns the proportion of the comparison group that falls in each percentile of the reference group (Clementi & Schettino, 2013; Massari et al., 2009). Thus, it is an informative graphical tool that shows where and by how much an income distribution changes (Clementi, Dabalen, Molini & Schettino, 2017).

Let Y_0 and Y to be incomes for the 2008 and 1993 populations, respectively. Then the relative distribution of Y to Y_0 is defined as: $R = F_0(Y)$. R is a random variable which is referred to as "relative data", and its probability density function is called the "relative density". The relative density ($g(r)$) gives the ratio of income density in the 1993 distribution to income density in the 2008 distribution evaluated at the r^{th} percentile of the 2008 income distribution. It is therefore a set of ranks that individuals in 1993 would have if they were placed in the 2008 income distribution. The relative distribution can be formally represented as:

$$g(r) = \frac{f[F_0^{-1}(r)]}{f_0[F_0^{-1}(r)]} = \frac{f(y_r)}{f_0(y_r)}\,, \quad 0 \leq r \leq 1\,,\ y_r \geq 0 \tag{2.6.1}$$

where $f(\cdot)$ and $f_0(\cdot)$ are density functions for both Y (1993) and Y_0 (2008), and $y_r = F_0^{-1}(r)$ is the quantile function of Y_0. This means if no income changes occur between the two distributions or they have the similar density at the r^{th} percentile of the 2008 distribution, then the ensuing relative density is uniform in [0,1]. A relative density less than 1 means the 2008 distribution (reference) has more density than the 1993 distribution (comparison) at the r^{th} percentile of the latter. And a relative density greater than 1 means that the 1993 distribution has more density than the 2008 distribution. Put differently, a relative density greater than 1 means individuals in 1993 have a higher probability than individuals in 2008 of having income that corresponds to the r^{th} percentile of the 2008 distribution.

The differences between the 2008 and 1993 distributions could be due to changes in the

first moment (i.e., location effect), or changes in higher order moments like variance or skewness, (i.e., shape effect). The location and shape effects are analogous to growth and distributional effects in the poverty and inequality decompositions. Thus relative distribution can be additively decomposed to distinguish these two effects. This decomposition goes through an *additive* location-adjusted population with reference to the median income, $Y_{0L} = Y_0 + \rho$. The value ρ is the difference between the medians of the 2008 and 1993 distributions. Thus, Y_{0L} is the counterfactual income distribution, with the same shape as the 2008 distribution, but with the median of the 1993 distribution. The CDF of Y_{0L} is given by $F_{0L}(y) = F_0(y+\rho)$, and its PDF is f_{0L}. Formally, the decomposition is given as:

$$g(r) = \underbrace{\frac{f(y_r)}{f_0(y_r)}}_{\text{Relative density}} = \underbrace{\frac{f_{0L}(y_r)}{f_0(y_r)}}_{\text{Location effect}[g_L(r)]} * \underbrace{\frac{f(y_r)}{f_{oL}(y_r)}}_{\text{Shape effect}[g_s(r)]} \tag{2.6.2}$$

From equation 2.6.2, it is apparent that if the two distributions have similar median incomes, then the density ratio for location difference is uniform in $[0,1]$. However, if the 2008 distribution, our reference group, has a lower (or higher) median, then the location effect decreases (or increases). The shape effect represents the relative density net of location effect, and it can detect redistribution that has occurred between the distributions. For example, a U-shaped effect is indicative of the 1993 income distribution being more spread around the middle than the location-adjusted population. A Bell-shaped effect suggests that the 2008 distribution is more spread around the median. This means we can assess the extent of income polarization (that is, how it increases in both tails) or convergence of incomes towards the median (how it decreases in both tails).

The relative distribution also includes the median relative polarization (MRP) index which quantifies the degree of polarization resulting from changes in the shape of the income distribution. This index measures the direction and magnitude of these shape changes towards the median or towards one or both tails. The index varies between -1 and 1 such that a value of zero represents no change in the distributional shape. Positive values mean an increase in polarization or that the median comparison distribution is more polarised than the median reference distribution. Negative values mean convergence towards the median. Formally, the relative polarization index of 1993 and 2008 is given as:

$$MRP = \frac{4}{n}\left(\sum_{i=1}^{n}\left|r_i - \frac{1}{2}\right| - 1\right) \tag{2.6.3}$$

where r_i is the proportion of median-adjusted 2008 incomes that are less than the i^{th} income from the 1993 sample, for $i = 1, \ldots, n$, and n is the sample size in 1993. The MRP is further decomposed into *lower relative polarization* (LRP) and *upper relative polarization* (URP) to figure out increases in the lower tail (downgrading) and increases in the upper tail (upgrading). Formally

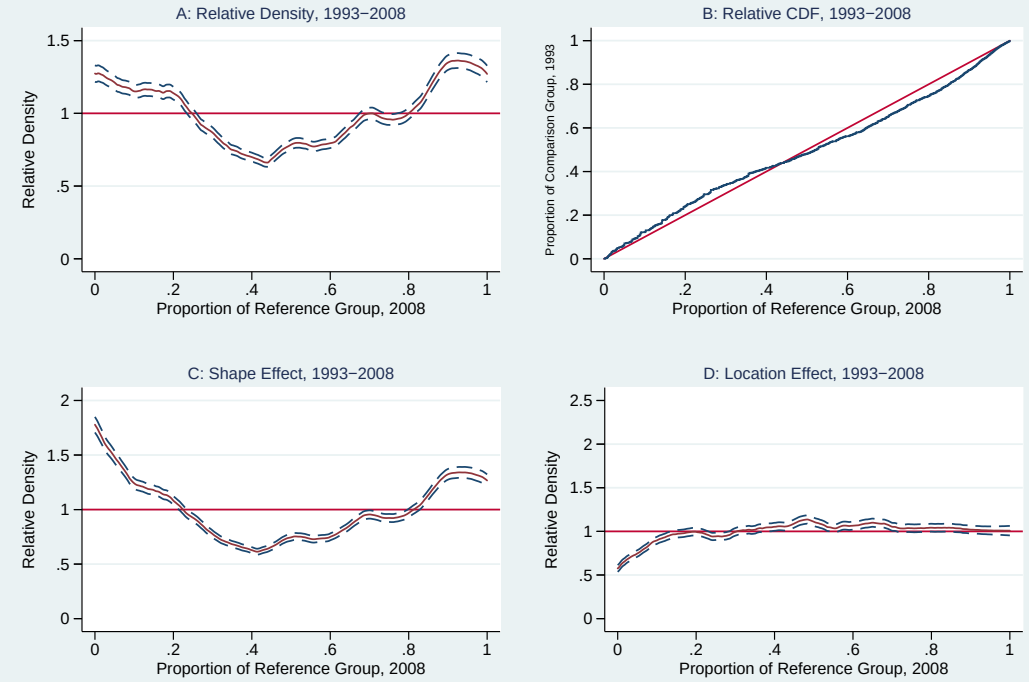
$$LRP = \frac{8}{n}\left[\sum_{i=1}^{n/2}\left(\frac{1}{2} - r_i\right)\right] - 1 \tag{2.6.4}$$

$$URP = \frac{8}{n}\left[\sum_{i=n/2+1}^{n}\left(\frac{1}{2} - r_i\right)\right] - 1 \tag{2.6.5}$$

where $MRP = 1/2\,(LRP + URP)$. Similar to MRP, both LRP, and URP range from -1 to 1.

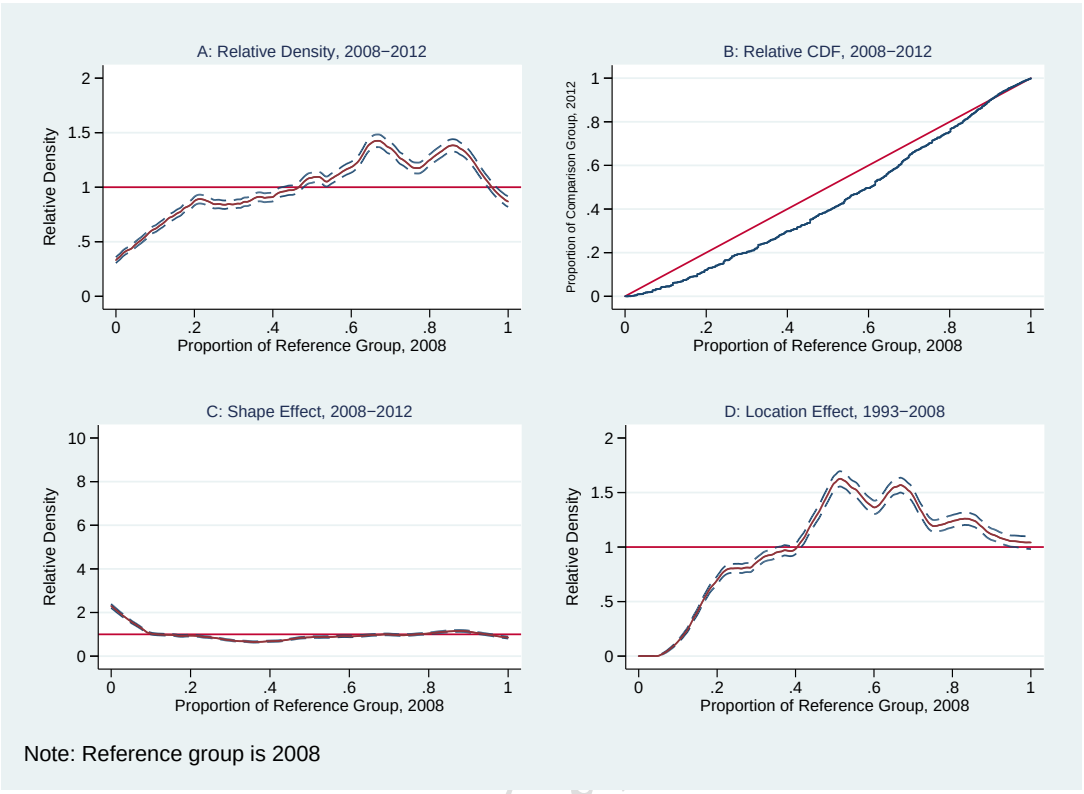
2.6.3 Extra Figures and Tables from the Relative Distribution Approach

Figure 2.6.1: Unweighted Relative Distributions of South Africa, 1993-2008



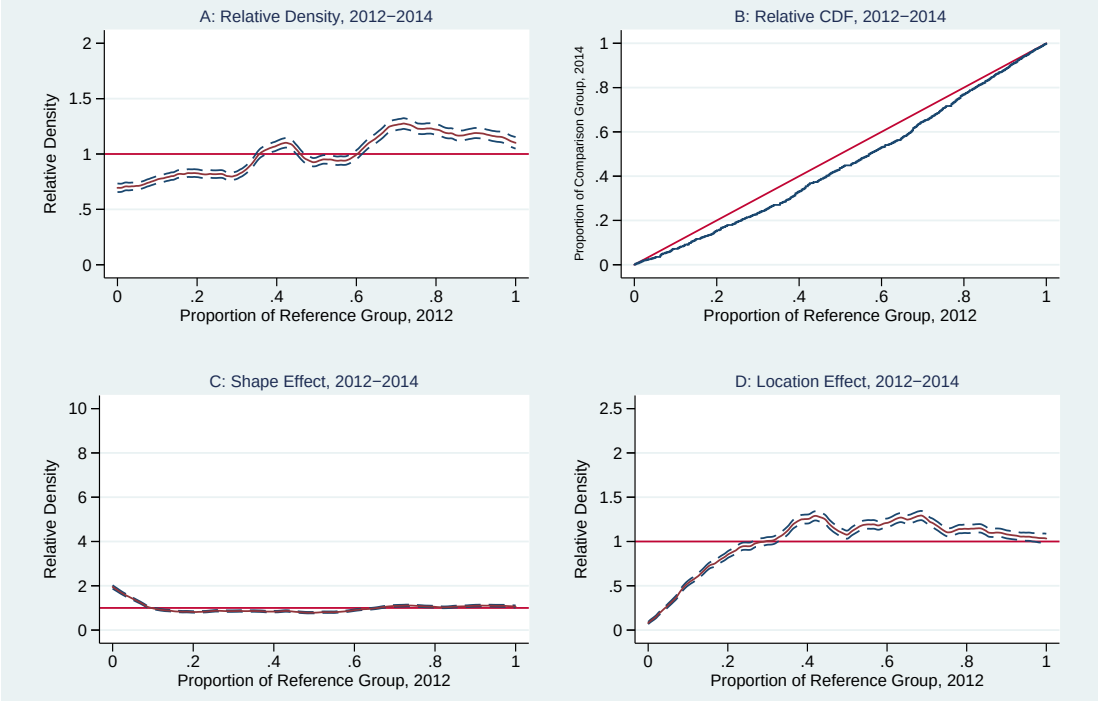
Notes: This figure shows changes in the South African income distribution using the relative distribution approach developed by Handcock and Morris (1998). The x-axis is the percentiles of the reference year, 2008 while the y-axis is the ratio share of individuals in comparison year, 1993 to the share of individuals in the reference year, 2008. Therefore, a y-value less than 1 means that the 1993 distribution has a lower share of individuals than the 2008 distribution at that percentile. All densities are estimated by epanechnikov kernel densities using the Silverman method to select optimal bandwidth. All estimates are done by *reldist* Stata code developed by Ben Jann.
Source: PLSLD 1993, IES 2000, NIDS 2008 and NIDS 2012.

Figure 2.6.2: Unweighted Relative Distributions of South Africa, 2008-2012



Notes: This figure shows changes in the South African income distribution using the relative distribution approach developed by Handcock and Morris (1998). The x-axis is the percentiles of the reference year, 2008, while the y-axis is the ratio share of individuals in comparison year, 2012 to the share of individuals in the reference year, 2008. Therefore, a y-value less than 1 means that the 2012 distribution has a lower share of individuals than the 2008 distribution at that percentile. All densities are estimated by epanechnikov kernel densities using the Silverman method to select optimal bandwidth. All estimates are done by *reldist* Stata code developed by Ben Jann.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008 and 2012

Figure 2.6.3: Unweighted Relative distribution of South Africa, 2012-2014



Notes: This figure shows changes in the South African income distribution using the relative distribution approach developed by Handcock and Morris (1998). The x-axis is the percentiles of the reference year, 2012 while the y-axis is the ratio of share of individuals in comparison year, 2014 to the share of individuals in the reference year, 2012. Therefore, a y-value less than 1 means that the 2014 distribution has a lower share of individuals than the 2014 distribution at that percentile. All densities are estimated by epanechnikov 2 kernel densities using the Silverman method to select optimal bandwidth. All estimates are done by *reldist* Stata code developed by Ben Jann.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014.

Chapter 3

Income Stratification in Post-Apartheid South Africa: A Gini Decomposition Approach

3.1 Introduction

It is a well-documented fact that over the last 20 years, South Africa has experienced persistence of income disparities. At the same time, there has been a slow reduction or disappearance of the clustering of incomes around local means in the income distribution. The persistence of these inequalities and of antagonistic groups has spurred great interest among both academics and policymakers. This chapter discusses our attempts to investigate the impact of the South African government's de-racialisation policies on these durable inequalities. In particular, we examine whether two decades after the end of Apartheid, the society is divided into a number of hierarchically ordered identity groups such that their members differ from the rest of the population. This investigation complements research in the previous chapter, by considering the extent to which the incomes of distinct identity groups cluster.

The chapter follows the literature that measures economic distance (or stratification) across groups (see, among others, Allanson (2014); Dagum (1987); Monti and Santoro (2011); Yitzhaki and Lerman (1991)). Stratification refers to the formation of observable layers, or the state of being comprised of layers (Yitzhaki, 1994). In the context of income, these layers may be segments of the overall income distribution. Perfect income stratification is equivalent to no overlap across different groups in their ranges of income (Zhou, 2012). Thus, stratification can be defined as the inverse of overlapping of distributions. Put differently, it refers to how much the poorest of one group descends into the richest of the group below it or the extent to which the richest of one group ascends into the poorest of the group above it.

Stratification is inversely related to within-group inequality and positively related to higher between-group inequality. For instance, high within-group inequality is likely to

increase overlap of income of the group with that of other groups, thus reducing stratification (Allanson, 2014; Monti & Santoro, 2011). Higher between-group inequality, on the other hand, indicates wider income distances across the groups. Therefore, stratification of incomes shows how different the members of a group are from the members of other groups. This implies that stratification of incomes is associated with horizontal inequalities. Horizontal inequality is concerned with disparities between groups, and thus enters into members' welfare function (Akerlof & Kranton, 2000). According to Stewart, Brown and Mancini (2010), this is partly because membership to the group constitutes a significant aspect of a person's identity, which increases perceptions of poverty traps if the group is impoverished relative to others. It follows that stratification of income across groups can be an obstacle to the achievement of other targets, like social and economic inclusion.

From a normative perspective, income stratification is therefore a social problem which ought to be tackled. This chapter sketches out trends in the stratification of income across groups, in order to provide an understanding of the relative fortunes of different groups. In countries undergoing socio-economic transformations, such as South Africa, this investigation can be an important indicator of the assimilation of different groups into the economy. Defining integration as the degree of overlapping of income distributions, this work provides, for the first time in South Africa, the dynamics of economic integration and its effect on within-group and between-group inequalities. This ties patterns of stratification to efforts by the post-Apartheid government to remove racial discrimination in the labour market and open up new economic opportunities. For instance, the Affirmative Action (or Employment Equity) and Black Economic Empowerment (BEE) policies enacted at the end of Apartheid advocated for promotion of Blacks/Africans, Coloureds and Indians as well as women to higher paid occupations in the labour market, and the expansion of entrepreneurial and business-owning classes of these groups (Seekings & Nattrass, 2008). While these de-racialization policies surely lowered the inter-racial inequalities, they may have contributed to the rise in intra-racial inequalities (Nattrass & Seekings, 2001). Thus, in our research covered in this chapter, we postulate that these inequalities signify income stratification.

The main proposition of the chapter is that the differences between income distributions of salient groups mirror income stratification. To define groups, we use race and education of the household head. Even though race has fallen out of academic favour, in South Africa it still forms the basis for many debates and conflicts, especially those relating to economic security. The choice of race is, therefore, meant to interrogate the extent of economic integration in post-apartheid South Africa. Grouping by education, on the other hand, is meant to test the emergence of education as the new strata

replacing race as a defining stratum. This chapter aims to answer the following questions: Has the income of previously disadvantaged groups converged to that of their White counterparts? What is the evolution of stratification of income across the relevant groups in the post-apartheid era? How has the change in the distribution of the five components of total income interacted to impact on the extent of stratification? This last question is analogous to assessing the impact of the de-racialization policies on stratification.

This chapter is at the intersection of studies that investigate the existence and extent of racial disparities in the South African income distribution. Most recently, Gradín (2013) and Gradin (2015) decompose the differences in the risk of poverty across racial and ethno-linguistic subgroups, while Schiel, Leibbrandt, Lam et al. (2016) apply a series of decompositions to examine the effect of social grants on income inequality. Our study differs from these in one aspect. We focus on the extent of economic integration of groups defined by race and education level. This kind of analysis has not previously been attempted using South African data. The findings will therefore provide new insights into the stratification of and convergence of income among groups. For policymakers, these insights include an evaluation of social process and opportunities for mobility and ways of tackling the economic disadvantage of low-income groups.

This study adds to the literature first by presenting new information on the extent of overlapping of income distributions of well-defined groups in South Africa, a country with persistent and socially embedded inequalities. Given that groups differ across societies, and are often dynamic, the South Africa perspective is therefore unique. We make another contribution by documenting the unconditional effects of various income sources on the level of stratification. That is, we examine the proximate causes of stratification of incomes across groups. To the best of our knowledge, this investigation has not been done in the literature.

Our proposition is motivated by three hypotheses. First, there has been a convergence of income across racial groups. Convergence means that the incomes of previously disadvantaged groups are catching up to that of their Whites counterparts. Thus, convergent incomes could signify higher overlapping (lower stratification) of income distributions across racial groups. Using survey data collected in 1993, 2008, 2012 and 2014-2015, our convergence analysis reveals significant convergence in education attainment and household per capita income of Blacks to that of Whites. Our second hypothesis is that stratification of racial groups' income ought to have declined because of the higher levels of convergence. The Analysis of Gini approach (ANOGI hereafter) reveals that the incomes of Blacks and Coloureds overlap with each other

and with the income of the population as a whole. The incomes of Whites' incomes have a low degree of overlapping with other groups, which means they are more stratified. We conclude the statistical analysis by showing that the findings are robust to disaggregating Blacks into seven groups based on linguistic identity.

The third and last hypothesis is that the distribution of labour earnings and that of government transfers have the largest effect on the stratification of incomes. The basis of this hypothesis is the effects of these income components on inequality and polarization. A series of shift-share simulations show that changes in government transfers have a tendency to lower stratification, while changes in the distribution of labour earnings tend to increase stratification. While these simulations are an accounting exercise and cannot offer any causal interpretations, they provide evidence which can inform the design of effective public policies.

The rest of the paper proceeds as follows. Section 3.2 provides a brief review of the related literature. Section 3.3 describes the data and presents summary statistics of selected variables for the identity groups. Section 3.4 describes our two analytical strategies. Section 3.5 discusses our results, elaborates on the findings and summarises results from the robustness checks. Section 2.5 concludes with a summary of findings.

3.2 Literature Review

In this section, we review some important studies related to the measurement of income stratification[1]. The primary goal is to summarise general conclusions that will facilitate an understanding of the terms discussed in the chapter and highlight contributions in the field.

The income stratification literature deals with the decomposition of the Gini coefficient by population subgroups. Early decompositions of the Gini coefficient follow Theil's approach by considering only two components, the between-group component, and the within-group component. The between-group component gives inequality

[1] Income stratification should not be confused with economic or income segregation, which deals with the extent to which individuals or households with different socio-economic characteristics are unevenly distributed throughout a society. Income stratification rather implies a hierarchical ordering of groups according to income. The idea of stratification is not exclusive to economics, but we rely on the measures developed in economics because we are not familiar with measures of stratification in other fields.

between the mean incomes of the groups, and the within-group component measures inequality within each group of the population. Mehran (1975) and Pyatt (1976) show that the decomposition of the Gini concentration ratio gives more information than the generalized entropy measures.

The decomposition of the Gini coefficient by Pyatt (1976) gives a third or residual term, which vanishes (i.e. equals zero) when income ranges of the subgroups do not overlap and is positive when income ranges overlap. The decompositions by Dagum (1998) and Deutsch and Silber (1999); Silber (1989) provide further information regarding the third term. This term is known as the overlapping term. For instance, Dagum (1987, 1998) introduces the concept of economic distances between distributions and relative economic affluence (REA) by interpreting the overlap term as the intensity of transvariazione between population subgroups. The concept "Transvariazione" was first defined by Corrado Gini as an indicator of overlapping of income distributions. Transvariazione occurs whenever a member of a poorer group has income higher than a member of a richer group (Deutsch & Silber, 1997; Monti & Santoro, 2009). Deutsch and Silber (1999); Silber (1989) focus on the correspondence between the Gini's transvariazione concept and the overlapping of distributions.

Most relevant to the research outlined in this chapter is the decomposition developed by Yitzhaki and Lerman (1991) and Yitzhaki (1994). Yitzhaki and Lerman (1991) decompose the extended Gini coefficient of Lerman and Yitzhaki (1984) by population subgroup to derive a measure for the sociological concept of stratification. Specifically, they define stratification as the inverse of overlapping. Yitzhaki (1994) extends the overlapping index presented in Yitzhaki and Lerman (1991) by decomposing the Gini coefficient into two terms, the between-group component, and a second term which is a sum of products of income shares, within group Ginis and overlaps of all groups. Several authors have since modified this two-term decomposition (see Allanson (2014); Frick, Goebel, Schechtman, Wagner and Yitzhaki (2006); Monti and Santoro (2011); Wodon (1999)).

The two-term decomposition by Yitzhaki (1994) has been applied in the literature. For instance, when examining whether the existence of several independent panel subsamples within the German Socio-Economic Panel Study (SOEP) represent the same population, Frick et al. (2006) rearrange and reinterpret the Yitzhaki (1994) decomposition in a manner analogous to Analysis of Variance (ANOVA), but performed with the Gini coefficient. They refer to their approach as an Analysis of Gini (ANOGI). Another important extension of the Yitzhaki (1994) decomposition approach was introduced by Wodon (1999), who analysed stratification by taking into account several

dimensions at once[2]. Extensions of this work by other authors like Monti and Santoro (2011) and Allanson (2014) are aimed at showing that the impact of stratification (or overlapping) on inequality is a function of the probability of transvariazione.

We apply the ANOGI approach in this chapter because of its simplicity and intuitive appeal. The notable applications of ANOGI concern the assessment of convergence of incomes across regions or countries (Frick & Goebel, 2008; Milanovic & Yitzhaki, 2002); the quality of classification into population subgroups (Heller & Yitzhaki, 2006; Liberati & Yitzhaki, 2012); the differences in the welfare of various groups (Zacharias & Vakulabharanam, 2011); the economic assimilation of immigrants (Ceccarelli, Giorgi & Guandalini, 2014; D'Agostino, Regoli, Cornelio & Berti, 2016), and the examination of whether panel sub-samples represent the same population because of attrition.

In a study of the relationship between wealth inequality and caste divisions in India between 1991/92 and 2002/03, Zacharias and Vakulabharanam (2011) find that forward Hindus caste are more stratified in terms of their wealth distribution, that is, they have a low degree of overlapping. The other caste divisions show a high degree of overlapping with the overall population, as well as with each other. D'Agostino et al. (2016) group the population by immigration status to investigate the extent of immigrant assimilation in Italy. Their results confirm that income ranges of the groups intersect, both among the groups, and with reference to the overall population. Heller and Yitzhaki (2006) use the ANOGI approach to examine the quality of the classification of families of prehistoric snails according to observable characteristics of their shells.

The conclusion from this literature review is that the extent of income stratification and economic integration depends on the study context, type of classification (or identities), and not so much on the number of population groupings. This literature is limited in that it is mostly focused on developed countries, which means little is known about the patterns of income stratification across salient identities in developing countries. Furthermore, it does not offer an explanation of the causes of stratification. The research discussed in this chapter makes a contribution in this regard by investigating income stratification across well-defined racial identities in the South African context.

We further contribute by documenting the unconditional effects of a range of income components on household income distribution and income stratification. Our conjec-

[2]Other notable contributions to the multi-level decomposition of the Gini index are presented in Mussard and Richard (2012); Mussini (2013).

ture is that changes in an income source can increase (decrease) the degree of stratification (overlapping) in a number of ways. For instance, if the distribution of an income source increases in favour of the richer group, the richer become stratified. To do this, we use a shift-share micro-simulation approach derived from Burtless (1999) and Daly and Valletta (2006). This approach, unlike most micro-simulation approaches[3] such as the technique of DiNardo, Fortin and Lemieux (1996), has the ability to observe how a range of income sources interact to account for changing income distribution. The shift-share technique we use is a rank-preserving income exchange similar to the one used by Larrimore (2014); Larrimore, Burkhauser and Armour (2015) to demonstrate how factors accounting for income inequality have evolved over time in the United States. It is important to note that our micro-simulation does not provide any causal relationship. Rather it is the first step in understanding the proximate causes of stratification. A detailed discussion of this approach is included in section 3.4.2.

3.3 Data and Descriptive Statistics

3.3.1 Data

The data used in this chapter come from the 1993 Project for Statistics on Living Standards and Development (PSLSD) and the 2008, 2012 and 2014-2015 waves of the National Income Dynamics Study (NIDS)[4]. A detailed description of these survey datasets is in section 2.3.1 of chapter 2. Despite a few comparability issues which are discussed in detail in Leibbrandt et al. (2012) and summarised in section 2.3.1.1 of chapter 2, these survey datasets have similarities that have resulted in them being important references for analysis of welfare dynamics in post-apartheid South Africa (see Burger and McAravey (2014); Leibbrandt and Levinsohn (2014); Leibbrandt, Woolard, Finn and Argent (2010)).

In our analysis, the main outcome variable is real per capita household income. We use income because it influences most dimensions of well-being, and also has a broad range of potential demand and supply policy interventions. We compute per capita

[3] Micro-simulation approaches involve the construction of counterfactuals (i.e simulated distribution) and their comparison with the actual distribution (Fortin, Lemieux & Firpo, 2011a). The difference between the outcome of interest (in our case income stratification or income overlapping) allows the influence of the characteristics to be assessed. Fortin et al. (2011a) provide a detailed survey of the common micro-simulation approaches.

[4] For more details about the PSLSD visit http://sada-data.nrf.ac.za/handle/10956/76, and for NIDS visit http://www.nids.uct.ac.za/

income by assigning to each individual the total monthly income of their household, divided by the household size[5]. This procedure assumes that intra-household allocation is egalitarian, that is, all members of the household get the same share of income, regardless of their individual incomes, their role in the household and other characteristics. To ensure comparability of income across these surveys. We follow the common precedent in the studies that use these datasets (see Leibbrandt et al. 2012). That is, we omit imputed rental income and agricultural income because they are not uniformly available across the surveys. Thus, total monthly income is the sum of household incomes from labour, remittances, capital, government transfers, and other incomes (see appendix 2.6.1 for a list of variables used for computing each income source). To arrive at real incomes, we inflate the per capita monthly household income to 2012 price levels using the national consumer price index of 2012. Household income per capita is considered the unit of analysis.

We allocate individuals to key identity groups based on their race and the level of education of their household head. Race is identified by four groups, Blacks, Coloureds, Indian/Asian and Whites[6]. Race is the primary partition because it reflects the stylised fact that membership of racial groups have been and remain a significant source of income disparities in the country. The second partition, by level of education of the household head, is largely to test for the emergence of education as a new stratum. Level of education is grouped into three groups. Firstly, an unskilled group, which includes individuals whose household head has up to seven years of schooling. Secondly, a semi-skilled group, which is made up of individuals in households whose head has at least seven years, but less than 12 years of schooling. Finally, a skilled group, which consists of individuals in households where the head has more than 12 years of education. Education is our secondary partition because its attainment is one of the surest pathways to poverty reduction.

All households with zero, missing, and negative incomes are removed which means the samples used in the analysis are slightly smaller than the actual samples for each survey. This loss of data may cause bias, but the excluded cases account for less than 1% of the observations in each sample. The final sample (pooled) has 135005 individuals from 30591 households.

[5] We need to ensure that the results do not depend on the type of transformation or equivalence scale used to take into account economies of scale. We therefore plotted kernel density curves for 2008 using different transformations. The plots (available on request from the authors) are similar, implying that the results are not sensitive to the choice of transformation.

[6] Due to very small (less three percent (3%)) proportions of the Indian/Asian race group in the surveys, the discussion will be limited to three races only.

3.3.2 Descriptive Statistics

It is instructive to start the analysis by aggregating a few facts regarding the relative gaps in education and income among the groups since 1993. Table 3.3.1 shows summary statistics of selected variables. There was a growth in real mean and median income for all race groups. However, the average income premium of Whites relative to Blacks declines from 8.8 times in 1993 to 7.2 times in 2008, and 6.5 and 6.4 times in 2012 and 2014-2015. The mean income of Whites stays at least 4 times higher than that of Coloureds over the 21 year period. Whites median income relative to that of Blacks also declines, from 12 times in 1993 to 9 and 5.9 times in 2012 and 2014-2015. In conjunction with the declining income share of Whites and the growing income share of Blacks, the mean and median incomes clearly indicate economic integration among the racial groups.

The Gini coefficient for Blacks, which ranges between 0.55 and 0.59, is higher than for Whites, which ranges from 0.43 to 0.51 between 1993 to 2008. In 2014-2015, however, the Gini coefficient for Whites is higher than that of Blacks, a result that may signal economic assimilation across the groups. The overall path of racial Ginis mimics the upward (2008) and downward (2012) tendency observed at the national level. These results are supported by the literature on the direction of inequality, if not the magnitude.

With the exception of labour income, Blacks are more likely to receive their income from government transfers, whereas Whites are more likely to receive income from capital income. That is, the income share of government transfers is highest among Blacks, and the share capital income is highest among Whites. A possible explanation is that during the apartheid regime, Whites owned most productive property and businesses, and thus have a higher share of capital dividends. It seems though, that while the de-racialisation policies did not always achieve their desired objectives (Seekings & Nattrass, 2008), the expansion of government transfers had the intended effect of increasing incomes of groups who are not expected to participate fully in the labour market, and therefore vulnerable to low income.

Household size and number of children of Blacks and Coloureds have remained larger than of White households, but the difference has narrowed over the years. Blacks' average household size relative to that of Whites declined from 1.55 to 1.26 between 1993 and 2014-2015, whereas the difference in the number of children in Black and White households has dropped from 1.12 in 1993 to 0.65 in 2014-2015. For summary

statistics on education, we convert education categories into years of schooling. In 1993, the average years of schooling of Whites (11.15) relative to that of Blacks (6.9) show a 62% relative discrepancy. There is, however, a clear trend of convergence in education levels of Blacks to that of their White counterparts, as the gap declines steadily to 40% in 2008, 32% in 2012, and 26% in 2014-2015. Convergence in education attainment can signal convergence in labour market earnings, which in turn could lead to overlapping of income distributions.

Table 3.3.1: Summary statistics of selected variables

	Black				Coloured				Indians				White			
	1993	2008	2012	2014	1993	2008	2012	2014	1993	2008	2012	2014	1993	2008	2012	2014
Population share	0.7587	0.7827	0.7981	0.8056	0.0861	0.0935	0.0888	0.0892	0.0255	0.0262	0.0255	0.0234	0.1297	0.0977	0.0876	0.0819
Income Share	0.3449	0.4410	0.4953	0.5190	0.0838	0.0845	0.0848	0.0829	0.0479	0.0702	0.0649	0.0588	0.5234	0.4043	0.3549	0.3393
Mean income	670	1019	1283	1580	1435	1634	1975	2280	2773	4844	5274	6177	5952	7482	8373	10161
Median	366	419	603	752	980	861	1055	1223	1803	2220	2322	2874	4478	5036	5500	4458
Gini coefficient	0.5540	0.6409	0.5958	0.5979	0.4990	0.5923	0.5646	0.5564	0.4692	0.6286	0.5993	0.5883	0.4252	0.5091	0.4875	0.6478
Share of Capital income	0.0272	0.0150	0.0182	0.0408	0.0099	0.0244	0.0209	0.0187	0.0568	0.1348	0.1355	0.1035	0.1111	0.1490	0.1403	0.3313
Share of Remittances	0.0713	0.0441	0.0455	0.0592	0.0253	0.0114	0.0172	0.0244	0.0121	0.0204	0.0272	0.0034	0.0069	0.0553	0.0075	0.0082
Share of Labour income	0.8001	0.7901	0.7935	0.7846	0.9241	0.8675	0.8700	0.8667	0.9047	0.8164	0.8060	0.8668	0.8721	0.7779	0.8241	0.6486
Share of Government transfers	0.1006	0.1490	0.1422	0.1129	0.0390	0.0848	0.0910	0.0832	0.0257	0.0284	0.0313	0.0258	0.0063	0.0141	0.0171	0.0117
Other	0.0008	0.0018	0.0006	0.0025	0.0017	0.0120	0.0009	0.0070	0.0006	0	0	0.0006	0.0036	0.0037	0.0111	0.0002
Average Household size	4.68	3.74	3.56	3.24	4.74	3.86	3.83	3.76	4.26	3.65	3.89	3.51	3.02	2.68	2.59	2.58
Average Number of children	2.05	1.57	1.44	1.21	1.87	1.40	1.39	1.21	1.43	1.11	1.05	0.93	0.93	0.66	0.65	0.56
Average Years of Schooling (Adult)	6.85	8.86	9.44	9.78	8.29	9.28	9.36	9.66	9.87	11.16	11.05	11.61	11.15	12.40	12.54	12.33
No Education (%)	15.53	7.79	6.03	4.35	5.24	5.67	4.86	3.51	6.81	2.98	2.79	2.03	6.06	0	0.09	0
Primary (%)	34.13	21.4	17.17	15.16	27.67	20.37	18.91	16.79	9.72	9.71	7.18	3.07	4.85	0.09	0.65	1.3
High School (%)	47.66	61.85	63.65	64.73	63.74	61.93	65.21	64.38	71.3	55.86	64.8	61.17	59.24	62.08	55.9	56.45
Tertiary (%)	2.68	8.96	13.15	15.75	3.35	12.04	11.02	15.32	12.17	31.44	25.23	33.73	29.86	37.83	43.37	42.25
Urban	35.76	52.42	53.66	54.91	93.34	91.9	92.7	91.36	99.44	64.97	60.04	64.57	92.2	97.76	97.52	97.4
Rural	64.24	47.58	46.34	45.09	6.66	8.1	7.3	8.64	0.56	35.03	39.96	35.43	7.8	2.24	2.48	2.6

Notes: All incomes are deflated to 2012 prices. All the income components values, which are conditional on receiving (that is, positive, non-missing values), represent income shares in total household income. All individuals aged less than 18 years are classified as children while adults are individuals aged 18 to 65 years. Years of schooling are derived from completed education levels. No education refers to those with zero years of schooling, while primary refers to those with 1 up to 7 years of education, high school to those with between 7 and 12 years of schooling and tertiary is those with more than 12 years of schooling or with college or university education.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014-2015

3.3.2.1 Education Convergence

To get a clearer idea about convergence in education attainment, we calculate difference-in-difference estimates in the average years of schooling. Between 1993 and 2014-2015, the gap in the years of schooling between Blacks and Whites falls from 4.3 to 2.55. That is, the education attainment of Blacks increases by 1.75 years relative to that of Whites. A comparison of Whites and Coloureds shows that the gap in average years of schooling increases from 2.86 in 1993 to 3.18 in 2012, and falls to 2.67 in 2014-2015. Thus, Coloureds' education attainment falls behind that of Whites by 0.32 years from 1993 to 2012, and increases by 0.51 in 2014-2015. The gap between years of schooling for Coloureds and Blacks falls from 1.44 to 0.42 between 1993 and 2008 and falls to -0.08 and -0.12 in 2012 and 2014-2015. This reflects that Coloureds have gained in education relative to Blacks between 1993 to 2008, while Blacks have gained during the latter period, 2008 to 2014-2015.

This demonstrates a convergence of education attainment of Blacks to that of their White and Coloured counterparts. These convergence trends are robust to using 25 years as the lower bound age cut-off for adults[7]. There is also a notable degree of divergence in the education attainment of Coloureds relative to Whites. The slow or lack of convergence for Coloureds forms the basis of the hypothesis that not all racial groups undergo the same integration, which explains the need to measure economic stratification.

The percentage of each racial group in the education categories can also explain some of these convergence patterns. Between 1993 and 2014-2015 the number of Blacks with no education drops, while the share of those with high school and tertiary education increases. The share of Coloureds with no education slightly increases (from 5.24% to 5.67%) between 1993 and 2008, then falls continuously thereafter. The number of Blacks and Coloureds with tertiary education increases between 1993 and 2014-2015. The urban proportion of Blacks rises (from 36% to 55%) from 1993 to 2014, and the urban Coloured population steadies above 90% during the same period. Assuming the proportion of a race group in this urban sector signals the group's absorption into the formal sector of the economy, then this is further evidence of reduction of distances across groups.

To test the statistical significance of this education convergence patterns, we follow an approach similar to Hnatkovska, Lahiri and Paul (2012). That is, we estimate an ordered probit regression with education categories as the dependent variable. Our main regressor is race, thus we attempt The control variables include age, gender, years of schooling of the household head, rural dummy, and province. Table 3.3.2 reports the marginal effects of these regressions. In all regressions, we use White as the reference category. Thus the marginal effects represent the probability of an individual belonging to each education category relative to Whites. In 1993 the marginal effects for Blacks and Coloureds are positive for the no-education and primary education categories, while they are negative on high school and tertiary levels of education. This means that, relative to Whites, both Blacks and Coloureds are more likely to have no education and primary education, and less likely to have high school and tertiary education.

During the period from 2008 to 2014-2015, the primary and high school marginal effects dropped moderately, while the no-education effects fell massively. For example, the probability of Blacks completing primary education fell from 18.8% in 1993 to

[7]The 25 years cut-off is common within the South African literature given that a number of individuals below 25 are still in the schooling system.

16.7% in 2008 and to 10.1% in 2014. This suggests a small drop in the probability of having primary and high school certificates and a huge drop in the probability of no-education. The changes for high school marginal effects are significant for the entire sample period, which confirms that convergence is mainly due to an increase in high school education among Blacks and Coloureds. The probability of attaining tertiary education for Blacks was 16.1% lower than that of Whites in 1993. In 2008 it increased to 28.9%, then to 22.3% in 2014. Thus, relative to Whites, Blacks are less likely to complete tertiary education. The same pattern emerges for Coloureds as well. This reflects an increase in the probability of Whites having a tertiary education relative to Blacks and Coloureds.

Table 3.3.2: Ordered Probit Regressions of Race for Education Categories

(a) Marginal effects

	1993		2008		2012		2014	
	(1)	(2)	(4)	(5)	(7)	(8)	(10)	(11)
	Blacks	Coloureds	Blacks	Coloureds	Blacks	Coloureds	Blacks	Coloureds
No Education	0.122***	0.0780***	0.0620***	0.0471***	0.0455***	0.0498***	0.0297***	0.0325***
	(0.00613)	(0.0119)	(0.00445)	(0.00945)	(0.00348)	(0.00806)	(0.00310)	(0.00697)
Primary	0.188***	0.147***	0.167***	0.141***	0.131***	0.138***	0.101***	0.108***
	(0.0135)	(0.0169)	(0.0143)	(0.0209)	(0.0122)	(0.0169)	(0.0121)	(0.0189)
High School	-0.149***	-0.0860***	0.0596**	0.0780***	0.107***	0.103***	0.0922***	0.0911***
	(0.00907)	(0.0176)	(0.0270)	(0.0300)	(0.0294)	(0.0312)	(0.0273)	(0.0275)
Tertiary	-0.161***	-0.139***	-0.289***	-0.266***	-0.283***	-0.291***	-0.223***	-0.231***
	(0.0161)	(0.0171)	(0.0407)	(0.0420)	(0.0414)	(0.0415)	(0.0402)	(0.0440)
Observations	20,230	20,230	14,074	14,074	16,818	16,818	19,345	19,345

(b) Changes in the Marginal effects

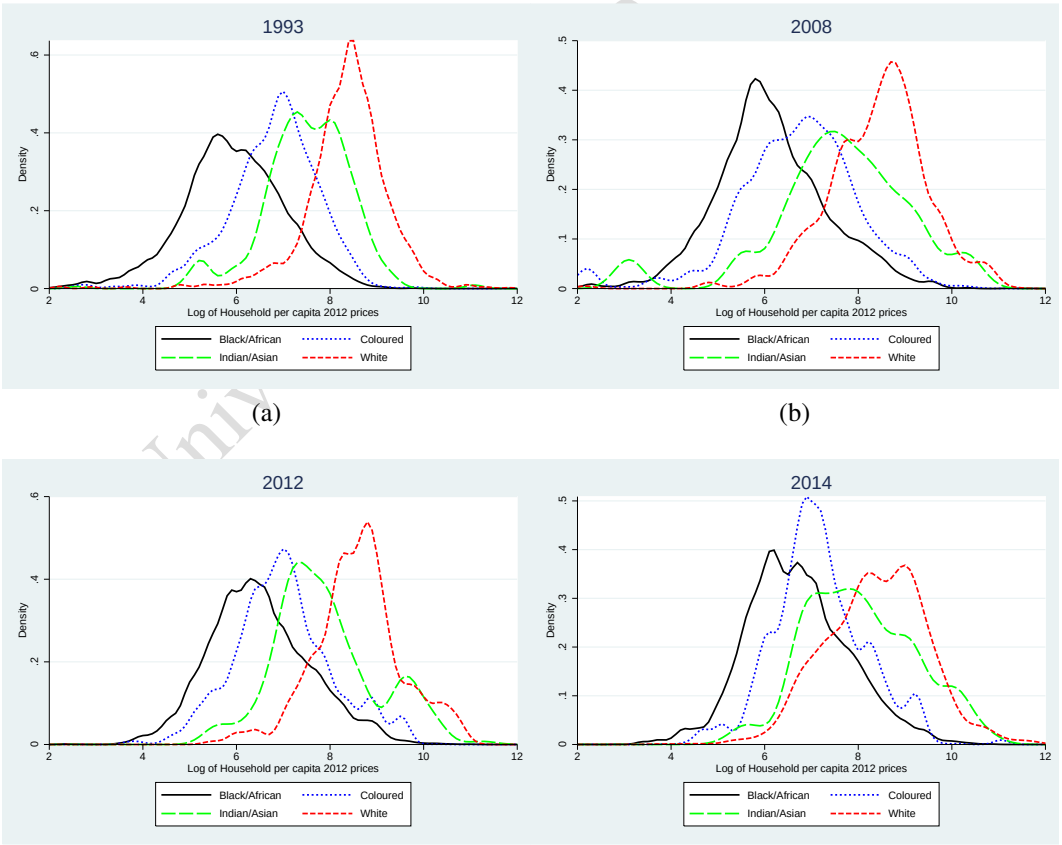
	1993-2008		2008-2012		2012-2014	
	Blacks	Coloureds	Blacks	Coloureds	Blacks	Coloureds
No Education	-0.0601***	-0.0309**	-0.0165***	-0.0123**	-0.0158***	-0.0173**
	(0.0045)	(0.0095)	(0.0045)	(0.0045)	(0.0031)	(0.0070)
Primary	-0.0213	-0.0064	-0.0366**	-0.0288**	-0.0295**	-0.0308
	(0.0143)	(0.0209)	(0.0143)	(0.0143)	(0.0121)	(0.0189)
High School	0.2090***	-0.0079	0.0473*	0.0435	-0.0147	-0.0120
	(0.0270)	(0.0300)	(0.0270)	(0.0270)	(0.0273)	(0.0275)
Tertiary	-0.1276**	-0.4054***	0.0059	-0.0025	0.0599	0.0601
	(0.0407)	(0.0420)	0.0407	0.0407	(0.0402)	(0.0440)

Notes: Panel A reports the marginal effects of race in an ordered probit regression of education categories, while Panel B reports changes in the marginal effects. The dependent variable reflects the categories of education and the control variables include race, age, gender, household head's years of schooling, a rural dummy, a set of province dummies. The reference group for race is White, thus he values (or coefficients) therefore report the probability of an individual belonging to each education category relative to a White individual. All regressions are based on individuals aged 18 years to 65 years. In parenthesis are linearised standard errors. *** Significant at 1%, ** Significant at 5%, * Significant at 10%.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and NIDS 2014-2015.

3.3.2.2 Income Profiles

Next, we examine profile income by presenting the distribution of incomes. Kernel density estimates of the distribution of the log of real per capita income are shown in figure 3.3.1. The Epanechnikov kernel is used in all the density estimation processes in this study, while the optimal bandwidth was selected using the Silverman plug-in method. Looking at figure 3.3.1 two features emerge. The income distributions seem to have shifted to the right over the years. The higher mode, median and mean of Whites can be appreciated by the rightward position of their distribution. The differences in skewness and kurtosis in the distribution of Black and White curves are immediately obvious, with the Blacks income distribution being more skewed to the left and having thicker tails. Overall, the Whites income distribution has the highest peak followed by the Coloureds income distribution.

Figure 3.3.1: Overlaid density plots, 1993 - 2014



Notes: Panels (a), (b) and (c) show the estimated epanechnikov 2 kernel densities of th log of real income per capita for all racial groups
Source: Weighted PLSLD 1993, NIDS 2008, 2012 and 2014-2015

To understand further the difference between the income distributions of the racial

groups, we performed the non-parametric Kolmogorov-Smirnov (KS)[8] two-sample test of equality of distributions. The KS test does not only confirm that Blacks and Whites do not have the same distribution function but also fails to reject the hypothesis that Whites have a higher income than Blacks. Moreover, the test also rejects the hypothesis that the 1993 and 2008 income distributions are similar. This finding is also true for Whites income distribution in 1993 and 2008. Repeating the KS tests for the five remaining pair-wise combinations lends support to the graphical results, that is, Whites, then Coloureds have higher per capita incomes than Blacks.

These differences in incomes, together with the education convergence results make it evident that the racial groups are likely to report different levels of income convergence and overlapping of incomes among each other and with the overall population. In the next section, we investigate whether there has been any convergence in per capita incomes of racial groups. Specifically, we discuss whether the incomes of both Blacks and that of Coloureds are catching up with those of their White counterparts.

3.3.3 Income Convergence

To examine the extent of income convergence across racial groups, we proceed in three ways. First, we highlight the gains and losses of each race group, relative to others, in terms of average per capita income. Second, we look at income gaps at each percentile of the income distributions. Lastly, we run quantile regressions to estimate the effect of race on income. Table 3.3.3 presents the marginal effects for race dummies from Recentered Influence Function (RIF) regressions of log income per capita. It is important to note that these regression coefficients reflect absolute income gaps, and the percentile gaps in figure 3.3.2 reflect relative gaps.

Table 3.3.1 presents the evidence on the gains and losses. We note that the mean income gap between Blacks and Whites rises from *R*5282 in 1993 to *R*6463, to *R*7090 and *R*8581 in 2008, 2012 and 2014. Put differently, the average per capita income of Blacks fell behind that of Whites by *R*1181 from 1993 to 2008, while between 2008 and 2014 Whites gained *R*2118 relative to Blacks. A possible explanation for the average income gains of Whites may be their higher probability of having tertiary education. Compared to Coloureds, Blacks have gained *R*150 between 1993 and 2008, and they have fallen behind by *R*85 in 2014-2015. By and large, the difference-in-difference estimates in average income per capita indicate that the incomes of Blacks

[8] All the KS tests were computed using the *ksmirnov* program in Stata, and the results are available on request.

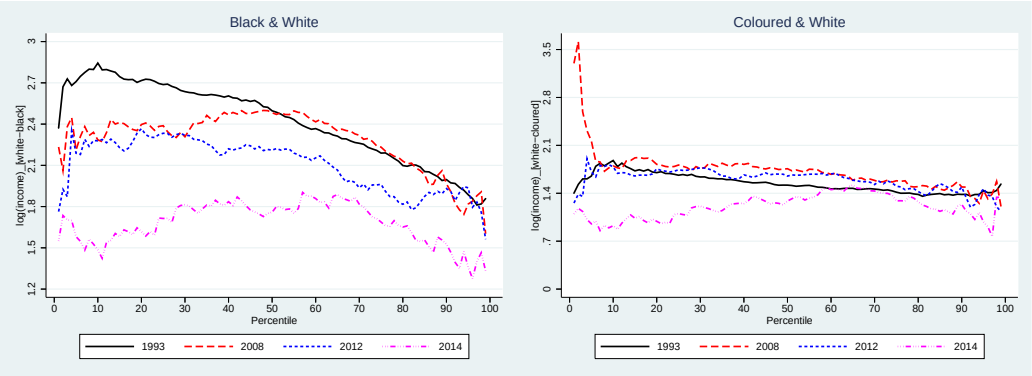
and that of Coloureds are not catching up to that of their White counterparts. However, these mean income comparisons mask where exactly along the income distribution divergence took place.

We proceed by looking at income differences among the racial groups at each percentile of the distribution to determine where the catching up happens. Figure 3.3.2 presents the difference in the percentiles of log income per capita of the racial groups. From panel (a), which reports the percentile gaps of Blacks and Whites, the following features are apparent. All four lines show evidence of first-order stochastic dominance of the Whites income distribution relative to the Blacks income distribution. That is, the lines are uniformly higher for Whites at every percentile. However, the degree of stochastic dominance declines because the line for 2014-2015 is closer to the zero line for all percentiles.

Second, lines for 1993, 2008 and 2012 slope downward indicating that the differences are higher for lower percentiles than for higher percentiles. These downward sloping lines also suggest that the income distribution of Blacks is more unequal than the Whites income distribution. The 2014-2015 line, although somewhat flatter, has a negative slope after the 70th percentile, which means smaller income distances between Blacks and Whites at higher incomes. Third, the 2008 line is lower than the 1993 line, up to the middle of the distribution (53rd percentile), which implies that income gaps only narrowed for situates at the lower end of the distribution. This result is further evidence in support of the higher degree of polarization during 2008. That is, the lower gaps at the lower and higher percentiles in 2008 suggest bunching of incomes or increasing bi-polarity in the country.

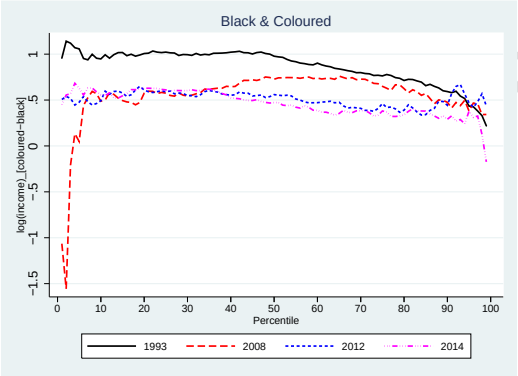
The plot suggests a convergence of incomes between Whites and Blacks. The declining distance between the 1993 and 2014-2015 lines as we move up the percentiles confirms the emergence of the "nouveau riche" within the Blacks. This rich strata among Blacks may explain the higher within-group polarization and lower between-group polarization observed in the previous chapter.

Figure 3.3.2: Difference in percentile log-income among the racial groups



(a)

(b)



(c)

Notes: The figure presents the differences in percentiles log income per capita of the racial groups plotted against the percentiles in the three sample periods. The lines above the horizontal axis suggest stochastic dominance.
Source: Own calculations from weighted PLSLD, NIDS 2008, 2012 and 2014-2015.

Panel (b) presents the income differences between White and Coloureds. From the plot, the 2014-2015 line is closer to the zero line, and the 2008 line is furthest from the zero line. This suggests that from 1993 to 2008, the income distances between Coloureds and Whites widened, and then narrowed somewhat in 2014-2015. The lines are flatter, suggesting that income differences are similar for all percentiles. A noteworthy feature is that in 2008, for the bottom 8 percentiles, the gap between the incomes of Whites and that of Coloureds is highest. This is driven by an emergence of the upper high-income class among Whites. All in all, the income gap between Whites and Coloureds narrowed between 1993 and 2014-2015, especially for situates at the bottom and middle of the income distribution (i.e., for bottom 58 percentiles).

Panel (c), which reports the differences between incomes of Coloureds and Blacks, shows that between 1993 and 2008, the gap is narrower for situates at the bottom half than for those at the top half. However, in 2012 and 2014-2015, the income gap

remains constant at the lower percentiles (less than 40th), and narrows further for those in the middle and top of the distribution. The flattening out of the 2012 and 2014-2015 line means a decrease in the income inequality of the two distributions. For the bottom 8 percentiles in 2008, incomes for Blacks are higher than those of Coloureds incomes. The incomes of Coloureds in 2008, when compared to those of Whites and Blacks, hints at contrasting levels of integration across race.

To investigate the significance of these income convergence patterns across races, we follow the literature that examines income gaps across salient groups by regressing income on a dummy of the relevant group(s). The coefficient of the dummy is interpreted as an indicator of group differential. To do this, we use Ordinary Least Squares (OLS) and Recentered Influence Function (RIF) regressions to estimate the effect of race on the mean and unconditional quantile of the log of income per-capita. Hnatkovska et al. (2012) use these approaches to estimate the effect of caste on wages in the case of India. We also use them to estimate regressions of log income on race and other covariates. The control variables include age (and age squared), gender, education level, household size, rural area, and province. The RIF regressions amount to evaluating income convergence across race conditional on the stated control variables. While the approach is valuable in highlighting income differences that are not due to pre-market individual characteristics, it is fails to observe how a range of income sources interact to account for changing inequality, which is the primary focus of this paper.

According to Firpo, Fortin and Lemieux (2009), RIF regression is similar to running a linear probability model of the probability of income exceeding the specific quantile on the set of covariates. Following the presentation in Porter (2015), RIF is based on a transformation of the dependent variable, household income per capita in our case, into a recentered influence function

$$RIF\left(y;\, q_\tau, F_y\right) = q_\tau + \frac{\tau - 1\left\{y \leq q_\tau\right\}}{f_y\left(q_\tau\right)} \tag{3.3.1}$$

where τ indicates a specific quantile (say 10th, or 0.10), q_τ is the value of the dependent variable, income per capita, y, at that specific quantile. F_y is the cumulative distribution function of y, and $f_y(q_\tau)$ is the density of y at q_τ. The indicator function, $1\{y \leq q_\tau\}$, identifies whether the value of the income per capita, y , for the individual is below q_τ. It equals 1 when the income per capita is less than or equal to the value of the income at quantile τ, and 0 otherwise.

Table 3.3.3 presents the marginal effects for race dummies from RIF regressions of log income per capita at the 10th, 50th and 90th quantiles. The columns labelled "Mean" report the OLS regressions results. In all regressions, Whites are the reference category, thus the coefficients represent the income differential relative to a corresponding White individual. Evident from this table is that the absolute income gaps are lowest at the low end of the distribution, and highest at the top end of the distribution.

Taking a closer look at Table 3.3.3, we see that the OLS coefficient of the Blacks dummy shows that the log of income for Blacks is, on average, over 1.4 less than that of Whites with similar characteristics. The OLS coefficient is lowest in 2014 (at 1.098) and highest in 1993 (at 1.532), which means Black-White income differentials are lower in 2014. The RIF regressions, however, tell a different story. In 1993, at the bottom end of the distribution, the White-Black differential is about 0.09, increasing to 0.94 at the middle (or median) and then to 3.99 at the 90th percentile. This suggests that the White-Black differential is small when income per capita is low, but much bigger when income per capita is high. Even though the magnitudes differ, this pattern is true for all the sample periods. For instance, in 2014, the White-Black differential increases from 0.212 at the 10th quantile to 2.695 at the 90th quantile. The White-Coloured income differential shows similar patterns. The differentials seem to have declined in the post-Apartheid era, which points to a reduction of distances across the groups.

Figures 3.7.1 and 3.7.2 in the appendix provide a clearer picture of the income differentials across the racial groups at different percentiles. The figures plot the marginal effects, at each percentile, of the regression of income on race dummies. The purpose is to show the direction of income differential at each percentile. They show that after the 80th percentile there is a reversal in the White-Black income differentials. That is, there is a sharp decline in the income differentials which suggests that convergence is happening mostly at the top of the income distribution. Nevertheless, the confidence bands are quite wide after the 80th percentile. Recall that these regression coefficients reflect absolute income gaps, and the percentile gaps in figure 3.3.2 reflect relative gaps. Therefore, the results show that the relative gaps are highest at the lower percentiles and the absolute gaps are lowest at the lower end of the income distribution. The White-Coloured income differentials show a similar pattern.

Given the convergence results above, we fail to reject the hypothesis of convergence

Table 3.3.3: Marginal Effects of Race of income per capita

(a)

	1993				2008			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Q0.10	Q0.50	Q0.90	Mean	Q0.10	Q0.50	Q0.90	Mean
Blacks	-0.0892***	-0.939***	-3.992***	-1.532***	-0.376***	-0.928***	-3.913***	-1.575***
	(0.0197)	(0.0203)	(0.0710)	(0.0708)	(0.0395)	(0.0379)	(0.202)	(0.120)
Coloureds	0.0931***	-0.240***	-3.770***	-1.055***	-0.159**	-0.564***	-3.472***	-1.219***
	(0.0259)	(0.0316)	(0.0878)	(0.0978)	(0.0694)	(0.0571)	(0.216)	(0.148)
Indians/Asians	0.281***	0.0822***	-2.833***	-0.570***	-0.265	0.224**	-2.331***	-0.521
	(0.0276)	(0.0312)	(0.141)	(0.127)	(0.169)	(0.0956)	(0.376)	(0.317)
Observations	38,360	38,360	38,360	38,360	26,814	26,814	26,814	26,817

(b)

	2012				2014			
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
VARIABLES	Q0.10	Q0.50	Q0.90	Mean	Q0.10	Q0.50	Q0.90	Mean
Blacks	-0.293***	-0.890***	-3.934***	-1.435***	-0.212***	-0.697***	-2.695***	-1.098***
	(0.0267)	(0.0404)	(0.270)	(0.103)	(0.0265)	(0.0607)	(0.255)	(0.117)
Coloureds	-0.0892	-0.462***	-3.472***	-1.094***	0.0519	-0.303***	-2.270***	-0.744***
	(0.0599)	(0.0606)	(0.290)	(0.154)	(0.0388)	(0.0661)	(0.286)	(0.137)
Indians/Asians	0.170***	0.353***	-2.226***	-0.297	0.119**	0.214**	-1.033**	-0.0229
	(0.0332)	(0.0786)	(0.456)	(0.201)	(0.0467)	(0.0909)	(0.434)	(0.172)
Observations	31,781	31,781	31,781	31,786	36,716	36,716	36,716	36,716

Notes: This table reports the marginal effects of race on the log of income per capita in South Africa. The columns labelled Q0.10, Q0.50 and Q0.90 display RIF regression results at the tenth, fiftieth and ninetieth quantiles of the income per capita distribution, the columns labelled mean (4, 8, 12 & 14) report the OLS regression results. In all regressions, White is the reference category, meaning the values report the individual income per capita differential relative to a similar White individual. The control variables include age, age squared, gender, household size, education category, rural dummy, and province dummies. In parenthesis are robust and linearised standard errors for RIF and OLS. *** Significant at 1%, ** Significant at 5%, * Significant at 10%.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014-2015.

of incomes across racial groups We therefore conclude that there has been a reduction of economic distances across racial groups in post-Apartheid South Africa. Does this convergence imply higher (lower) overlapping of income distributions (degree of stratification) of the racial groups? Defining stratification as the extent to which the poorest of one group descends into the richest of the group below it or vice-versa, we expect to see lower or declining levels of stratification. Further, how have different income components interacted to account for changes in income stratification? These questions lie at the heart of our next analytical exercise, which seeks to establish the degree of income stratification and the impact of different income sources on the degree of stratification.

3.4 Empirical Strategies

This section begins with an overview of the approach for measuring the degree of income stratification. We then explain the methodology for assessing the impact of different income sources on stratification. Finally, in section 3.5, we move into the discussion of the results on stratification.

3.4.1 Analysis of Gini (ANOGI)

This section explains the Analysis of Gini (ANOGI) approach we use to measure the stratification of incomes. Following the presentation in Liberati (2015) and Monti and Santoro (2011), let y_i, s_i, $F_i(y)$, $f_i(y)$, μ_i, p_i represent the income, income share of group i, cumulative distribution, the density function, the mean, and the share of group i in the overall population, respectively. Stratification index, Q_i - a measure of overlap between members of group i and the rest of the population is defined formally as;

$$Q_i = \frac{cov_i\left[y,(F_i - F_{ui})\right]}{cov_i\left[y,F_i\right]} \tag{3.4.1}$$

where Q_i is a ratio of two terms, such that on the numerator, we have the covariance between the income of the individuals in group i and these individuals' difference in ranking in their own group and in the rest of the overall population. The denominator, which can be treated here as a normalizing factor, is the covariance for individuals in group i between the incomes and the rankings in their own group. Assume that the population is composed of identity groups (for example by race and education level) such that $F_u(y) = \sum_i p_i F_i(y)$ (i.e cumulative distribution of the population is the weighted average of distributions of the groups and the weights are the relative size of the population in each group).

Yitzhaki (1994) combined the Lerman and Yitzhaki (1984)'s extended Gini coefficient and the stratification index, Q_i above to show that the decomposition of Gini coefficient by population subgroup encompasses an indicator of stratification. Frick et al. (2006) extended or rearranged the Yitzhaki (1994)'s decomposition in a manner analogous to Analysis of Variance (ANOVA), but performed with the Gini coefficient. They refer to their approach as an Analysis of Gini (ANOGI).

According to ANOGI the Gini coefficient of the entire population can be decomposed as follows:

$$\begin{aligned} G_u &= \underbrace{\sum_{i=1}^{n} s_i G_i O_i}_{G_{wo}} + G_b \\ &= \underbrace{\sum_i s_i G_i}_{\text{IG}} + \underbrace{\sum_i s_i G_i (O_i - 1)}_{\text{IGO}} + \underbrace{G_{bp} + \underbrace{(G_p - G_{bp})}_{BGO}}_{BG} \end{aligned} \tag{3.4.2}$$

where $G_b = {}^{2cov(\mu_i, \bar{F}_{ui})}/_{\mu_u}$ is the Gini coefficient of gross between-inequality or across group inequality; $G_{bp} = {}^{2cov(\mu_i, \bar{F}_i)}/_{\mu_u}$ is the between-Gini coefficient of the Pyatt (1976)'s decomposition; and O_i is the overlapping index of the distribution of identity/subgroup group i with the overall national distribution (explained below).

The overlapping index measures the extent to which one group is overlapped by the other or how much the distributions are intertwined. In other words, it tells us about the degree of assimilation. It is described formally as;

$$O_i = O_{ui} = \frac{cov_i(y, F_u(y))}{cov_i(y, F_i(y))} \tag{3.4.3}$$

The numerator of O_i is the covariance between incomes in group i and their ranking in the national distribution - $F_u(y)$. The denominator is the covariance between the same incomes and their ranking within each identity group. The denominator can be treated as a normalizing factor.

This means that $O_i = 1$ if the incomes of a given group i have the same ranking as the national income distribution. That is, group i has a range of income that coincides with the range of income of the population or the two distributions perfectly overlap. More generally, $O_i < 1$ when the scatter of the ranks of a given group is narrower than that of the total population. $O_i > 1$ when the scatter of ranks of the individuals in a given group i is larger than that of the total population, which suggests that the distribution of income within the subgroup is much more polarized than in the overall distribution. The implication is that the members of the subgroup constitute two strata, one that has much higher incomes and the other that has much lower income than μ_u - the average income of all individuals in all groups (Zacharias & Vakulabharanam, 2011). The minimum value of O_i is given by the share of identity group i in the population and its maximum value is equal to 2. When the index equals the minimum possible value, it

suggests that the identity group in question is a perfect stratum, that is, it occupies an exclusive segment of the overall income distribution. These properties of O_i make it an insightful index of stratification.

The overlapping index can further be written as the weighted sum of overlapping of group i with all other groups j as follows:

$$O_i = \sum_j p_j O_{ji} = p_i O_{ji} = p_i + \sum_{j \neq i} p_j O_{ji} \tag{3.4.4}$$

where

$$O_{ji} = \frac{cov_i(y, F_j(y))}{cov_i(y, F_i(y))} \tag{3.4.5}$$

and p_i is the share of group i in the total population and O_{ji} is the overlapping of group j by group i - that is the degree by which members of group j are included in the range of group i. It follows that $O_{ji} \geq 0$ if no member of the distribution j lies within the range of distribution i. That is, if group j is a perfect stratum then $O_{ji} = 0$. In this case, $O_i = p_i$, i.e. total overlapping is equal to the share of group i. However, if over the range of distribution i, the shape of the distribution of group j is similar to the shape of distribution i, then $O_{ji} = 1$ and $O_i = p_i + \sum_{j \neq i} p_j = 1$.

The extreme upper bound O_{ji} occurs when all observations belonging to distribution j are located in the range of group i and are concentrated around the mean of distribution i, with no member of group i lying inside the range of group j. In this case, $O_{ji} \leq 2$, which means it is bounded from above by 2. In general, the higher the overlapping index O_{ji}, the lower O_{ij} will be. That is, the more group j is included in the range of distribution i, the less distribution i is expected to be included in the range of j. Therefore, overlapping index (O_{ji}) describes the extent to which different groups are stratified.

Given these properties, it becomes clearer that *IGO* (see equation 3.4.2) provides either a negative or a positive revision of intra-group variability (IG) for $O_i < 1$ and $O_i > 1$ respectively. This explains how overlapping may affect within-group components. The BG component is the weighted covariance between the various group's mean income and their mean rank. BGO represents the loss of between-group inequality (BG) due to overlapping. It is always non-positive and reaches the upper limit (zero) if the ranges occupied by the different groups do not overlap. Thus, the higher the degree of overlapping between subgroups the higher the *IGO* and the lower the BGO.

To clarify this, consider the difference between G_b and G_{bp}. The decomposition of Yitzhaki and Lerman (1991) defines G_b as the covariance between the mean income of each group and the average rank of its members in the overall population -$\bar{F}_{ui}(y)$. Alternatively, Pyatt's (1976) decomposition defines G_{bp} as the covariance between mean income of each subgroup and the ranking of mean income in the distribution of mean incomes - $\bar{F}_i(y)$. Thus, the main difference between them is the way group ranks are established. Therefore, when there is no overlapping between groups, the two ranks are equal, and the two methods yield the same results. However, incomes generally overlap which makes the correlation between the rank of mean incomes and the mean rank of incomes less than 1.

3.4.2 Shift-Share Analysis

This section presents the shift-share micro-simulation method we use to examine the association between income components and income stratification. The method is similar to that employed by Larrimore (2014).

To assess the importance of each income type, each is added sequentially and the resulting stratification (or overlapping) is compared to what would have occurred had the specified source remained unchanged. Following the presentation in Fortin, Lemieux and Firpo (2011b) and Larrimore (2014), consider a general income formation model for individual/household i at time t to be expressed as $y_{it} = g\{x_{it}, w_u, e_{it}\}$, where $g(\bullet)$ is the unknown function of a set of individual or household characteristics or some policy variables (e.g. taxes), x, a set of sampling weights, w, and some unobservable characteristics or error term, e. The function $g(\bullet)$ is not constrained to be linear nor parametric and can represent a single income-generating equation or a system of income-generating functions.

In this paper, we assume $g(\bullet)$ to be a system of income-generating functions. We use a rank-dependent transformation that was proposed by Burtless (1999), Daly and Valletta (2006) and Larrimore (2014) to perform our counterfactual analysis. It does not involve estimation of a regression model and does not consider $g(\bullet)$ as the income-generating function but more simply as the function that aggregates different individual incomes (such as labour earnings or government transfers) into total individual income and, eventually, into household income. It incorporates the fact that the income distribution within each sub-population group is changing as well. These changes can result from any income source. Therefore, each individual's income, y_{it}^k can be represented as the sum of their incomes from each income source, f_{1it}^k through f_{Nit}^k:

$$y_{it}^{k} = f_{1it}^{k} + f_{2it}^{k} + \ldots + f_{Nit}^{k} \tag{3.4.6}$$

We assign individuals a percentile rank, p_{fik}, for each income source based on the rank of their source-level income within their sub population group, k. To estimate the impact that changes to the distribution of source f_1 have on income stratification, each individual's income from the source f_1 in year t is replaced with the income of the individual at the same percentile rank of the source f_1 income distribution in year t^t.

$$y_{it^t}^{k}(p_{fik}) = f_{1it^t}^{k}(p_{fik}) + f_{2it}^{k} + \ldots + f_{Nit}^{k} \tag{3.4.7}$$

The counterfactual income vector is defined by using the inverse rank function such that the lowest income at year $t+1$ is replaced with the lowest at year t. the second lowest with the second lowest and so on. This transformation preserves the conditional income rank of each individual from source f_1 and the rank correlation of incomes from source f_1 with other income sources while capturing changes in the source-level income distribution of source f_1 within each population group. As in any micro-simulation analysis, a base year had to be chosen and 2008 was selected as our base year.

3.5 Results

3.5.1 ANOGI results

In this section, we present results from the subgroup decomposition of the Gini coefficient in order to find evidence suggestive of stratification. Tables 3.5.1 and 3.5.3 report the outcomes of the ANOGI by race. Specifically, Table 3.5.1 provides information on the extent of economic integration of racial groups. Columns headlined "Overlapping (O_i)" give evidence on the extent of income stratification. Note that if $O_i = p_i$, then racial group i forms a perfect stratum whereas a value of 1 indicates that the income distribution of that racial group mimics the national income distribution, and $O_i > 1$ signals two strata (one poor and the other rich) in the income distribution of group i. Column $s_i G_i$ gives the size of intra-group component while $s_i G_i(O_i - 1)$ identifies the revision of the contribution of each subgroup to intra-group variability.

In Table 3.5.1 the overlapping coefficient for Blacks is close to 1 in 1993 and from 2008 to 2014, it is greater than 1.This means in 1993, there is a a high degree of synonymy between the income distribution of Blacks and the national distribution. Put differently, the income of Blacks form less of a stratum (or have a high degree of overlapping with) in the national income distribution. Given the larger population share of Black people (at least 75%), this is to be expected. Interestingly, during the same period, the degree of overlapping of income of Whites is 0.29. This means that Whites form a stratum in the national income distribution. The overlapping of Coloureds is 0.70, meaning their income distribution is less stratified or overlaps more with the national income distribution.

The growth in the score of overlapping index for Blacks between 2008 and 2014 means an increase in the degree of heterogeneity of this racial group with respect to the overall population. That is, the income distribution of Blacks is characterized by the presence of extreme observations, some richer and some poorer than the rest of the country. The overlapping of incomes of Coloureds increases to above 0.80 during the same period. This could be evidence of an increase in the economic assimilation of this racial group. Incomes of Whites, on the other hand, overlap the least with the national distribution, which indicates greater stratification of the income of Whites. The score of overlap indices for Whites is smaller in 2012 than in 2008 and 2014-2015. This is an increase in stratification, which means the incomes of Whites increased much faster than those of other race groups between 2008 and 2012 (see section 3.3.3).

Adjusting the scores of the overlapping indices by $O_i - p_i / 2 - p_i$ to account for the population share of each group the following is apparent. Incomes of Whites still have the lowest amount of overlapping, suggesting near- perfect stratification. The incomes of the Coloured group have generally the most notable degree of overlapping. Nonetheless, even after controlling for population shares, the overlap indices still suggest higher levels of stratification in 1993 than in 2008 and 2014-2015. There is, however, evidence of higher stratification of incomes in 2012.

This evidence supports the claims of the failure of de-racialisation policies enacted at the dawn of democracy in 1994. The de-racialisation policies were expected to increase employment and equalise incomes, thereby resulting in the greater degree of economic assimilation of previously disadvantaged individuals. Although we find evidence of declining income stratification of Whites, they still overlap less. This higher stratification of income of Whites casts further doubt on the success of the government's de-racialisation policies. Seekings and Nattrass (2008) argue that these policies only managed to change the racial composition at the top end of the income

distribution.

The results, in general, are not surprising because Liberati (2015) finds that the overlap index of South Africa with respect to the world is always and increasingly above 1. A note worthy finding that emerges from the above discussion of values scores of overlapping indices is that the education convergence levels observed are translated into less stratification of income among the races. The divergent of income levels in the 2008-2012 period, however, led to more income stratification among the races during the same period.

To further illustrate the extent of income stratification in the country, Table 3.5.2 presents information on the income differences among races. In particular, panel A shows the decomposition of the overlap index to reflect pair-wise indices of overlapping among the groups (see equation 3.4.5). Each term of the overlap matrix (O_{ji}) reports the extent to which the distribution of group j (row) is included in the reference distribution of group i (column). Thus, O_{ji} is the overlapping of the distribution of group i by that the distribution of group j. It is worth noting that the matrix is not symmetric, rows represent the group whose distribution is used as the base distribution.

For instance, the overlapping of incomes of Blacks by that of Whites is 0.16 in 1993, increasing to 0.24 in 2008, then declining to 0.22 in 2012, and rising to 0.33 in 2014-2015.This means the share of White population intersecting the range of income distribution of Blacks increases between 1993 and 2008, declines in 2012 and rises in 2014-2015. Another way to conceptualise the overlapping of Blacks incomes by that of Whites is to interpret it as the extent to which the incomes of the poorest of Whites descends into the income of the richest of Blacks. In this case, between 1993 to 2008, the incomes of more Whites have descended into the Blacks income distribution. This indicates similarities between the income distribution of Blacks and Whites between 1993 and 2008. However, from 2008 to 2012 less Whites descended into the range of income of Blacks, which supports the wider income distances highlighted under the income convergence discussion. For the entire post-apartheid period, however, more Whites have intersected the range of income of Blacks, which suggest some degree of homogeneity between the income distributions of Blacks and White.

The extent to which the income distribution of the Black group is incorporated into the

Table 3.5.1: Analysis of Gini by racial groups, 1993, 2008, 2012 and 2014

	Overlapping (O_i)				s_iG_i				$s_iG_i\,(O_i-1)$				Mean rank ($\bar{F}_{ui}(y)$)			
	1993	2008	2012	2014	1993	2008	2012	2014	1993	2008	2012	2014	1993	2008	2012	2014
Black/African	0.9365	1.0000	1.0002	1.0147	0.1911	0.2827	0.2951	0.3103	-0.0121	0.0000	0.0001	0.0046	0.4114	0.4379	0.4424	0.4510
Coloured	0.7018	0.8364	0.8291	0.8178	0.0418	0.0500	0.0479	0.0461	-0.0125	-0.0082	-0.0082	-0.0084	0.6192	0.5716	0.5724	0.5785
Indian/Asian	0.5010	0.6344	0.5393	0.5852	0.0225	0.0441	0.0389	0.0346	-0.0112	-0.0161	-0.0179	-0.0144	0.7645	0.7334	0.7599	0.7566
White	0.2947	0.3368	0.3099	0.4116	0.2225	0.2058	0.1730	0.2198	-0.1569	-0.1365	-0.1194	-0.1293	0.8875	0.8669	0.8759	0.8236
Total					**0.4779**	**0.5827**	**0.5549**	**0.6108**	**-0.1928**	**-0.1608**	**-0.1454**	**-0.1475**				

Notes: O_i is the overlapping index of the distribution of identity group i with the overall national distribution, and the its minimum value is the population share of the group (p_i). Thus a large group is more likely to have a greater overlapping index than a smaller group. s_iG_i gives the size of the intra-group component while $s_iG_i\,(O_i-1)$ identifies the revision of the contribution of each subgroup to intra-group variability determined by overlapping.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014-2015

income distribution of the White group increases from 0.455 in 1993 to 0.864 in 2008, declines to 0.812 in 2012, and rises to 0.969 in 2014-2015. This is further evidence of greater homogeneity in the income distribution of the two groups. A possible explanation for the growth in the degree of similarity between the shapes of the income distributions of these two racial groups is the expansion of government transfers. This result ties with the income per capita convergence results between Blacks and Whites. The oddity of less overlapping (or higher stratification) in 2012 is still observed. Particularly interesting is the overlapping of the income distribution of Coloureds by that of Blacks. That is, the extent to which the distribution of Blacks is included in that of Coloureds is greater than unity for all sample points, that is $O_{ji} > 1$. Actually, the score of the overlap index between Blacks and Coloureds increases from 1.118 in 1993 to 1.178 in 2014. This suggests that the income distribution of the base group, Blacks, forms two strata, one poorer and one richer, in the income distribution of the Coloured group. This distributional characteristic has not changed in the past 21 years.

The extent to which the income distribution of Whites is included in the income distribution of Coloureds ranges from 0.33 in 1993 to 0.48 in 2014-2015. This shows a slight increment in the convergence of incomes of Coloureds to that of Whites. The overlapping of Whites' income distribution by that of Coloureds increases by a value equivalent to 17% from 1993 to 2008, then by 7.7% and by 3.9% in 2012 and 2014-2015. Put differently, the extent to which Coloureds are included in the incomes of Whites increased from 0.78 in 1993 to 1.021 in 2014-2015. This means that Coloureds form two income groups in the distribution of Whites.

All in all, we find that the overlap of the income distribution of each racial group by the income distribution of the White group is lower than the overlapping of the income distribution of Whites by those of other groups. This affirms that Whites still have higher incomes, and consequently, a low share of the income distributions of other racial groups is likely to be found in the upper half of the Whites' income distribution. This supports our view that not all racial groups undergo the same integration process, nor are they uniformly integrated. We therefore conclude that the government's de-racialisation policies have not significantly reduced the imbalances of Apartheid.

Another way of looking at the evolution of the distances between incomes is by looking at mean ranks. The mean ranks give information on the average position of individuals in each racial group calculated on the basis of the national income distribution. From

Table 3.5.2: Matrices of Overlapping and Ranks

	1993				2008			
	Black	Coloured	Indian	White	Black	Coloured	Indian	White
Panel A - Overlapping								
Black/Africa	1	1.118	0.884	0.455	1	1.139	1.014	0.864
Coloured	0.643	1	1.043	0.780	0.802	1	0.984	0.913
Indian/Asian	0.373	0.725	1	1.005	0.535	0.745	1	1.231
White	0.160	0.326	0.625	1	0.236	0.390	0.689	1
Panel B - Ranks								
Black/Africa	0.5	0.267	0.130	0.044	0.5	0.357	0.204	0.080
Coloured	0.733	0.5	0.281	0.097	0.643	0.5	0.299	0.138
Indian/Asian	0.870	0.719	0.5	0.230	0.796	0.701	0.5	0.322
White	0.956	0.903	0.770	0.5	0.920	0.862	0.678	0.5

	2012				2014			
	Black	Coloured	Indian	White	Black	Coloured	Indian	White
Panel A - Overlapping								
Black/Africa	1	1.154	1.099	0.818	1	1.178	1.059	0.969
Coloured	0.784	1	1.105	0.983	0.770	1	1.045	1.021
Indian/Asian	0.433	0.630	1	1.286	0.502	0.709	1	1.152
White	0.221	0.343	0.620	1	0.332	0.480	0.833	1
Panel B - Ranks								
Black/Africa	0.5	0.361	0.177	0.077	0.5	0.365	0.196	0.134
Coloured	0.639	0.5	0.266	0.129	0.635	0.5	0.283	0.197
Indian/Asian	0.823	0.734	0.5	0.288	0.804	0.717	0.5	0.409
White	0.923	0.871	0.712	0.5	0.866	0.803	0.591	0.5

Notes: The overlap matrix (panel A) shows the overlapping of the column group (reference) by the row group. The rank matrix (panel B) shows the average rank of the row group in the distribution of the group.

Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014-2015

table 3.5.1 the average rank of a Black individual in 1993 is located at the 41.1^{st} percentile of the national distribution, and the rank of that individual rises to 43.8^{th}, 44.2^{th} and 45.1^{th} percentiles in 2008, 2012 and 2014-2015. Individuals in other racial groups have an average position that is always above the 50^{th} percentile. Interestingly, their mean ranks drop between 1993 and 2008, and rise again, though slightly in 2012 and 2014. For example, a Coloured and White individual in 1993 are positioned at the 61.9^{th} and 88.6^{th} percentiles, but in 2008, their positions decline to 57.1^{th} and 86.7^{th} percentiles, respectively. Only the average ranks of Blacks increases monotonically over the period. This confirms the earlier finding that the income distance between the average positions of the different racial groups narrows from 1993 to 2008. However, in 2012 the income distances either increases or shows no significant change from 2008. In order words, stratification of the distribution according to race ought to decline between 1993 and 2008. In other words, the degree of economic integration should be higher in 2008. The increase in economic assimilation continues in 2012 and 2014-2015. The degree of assimilation is, however, different across racial group due to differing average percentile ranks.

Panel B of table 3.5.2 presents the average ranking of groups. An average rank greater than 0.5 means individuals in race group j (rows) have, on average, higher rank in the income distribution of race group i (columns) than in their own distribution. They form a richer group relative to the other race groups. As expected, White individuals have this characteristic in all sample periods, compared to other racial groups. Whites' income distribution on average rank around the 93^{rd} and 88^{th} percentile of the income distributions of Blacks and Coloureds, respectively. Since the sum of average rank of group j in the distribution of group i and average rank of group i in the distribution of group j is unity (i.e., $F_{ji} + F_{ij} = 1$), this means that the average ranks of the other groups are at their lowest levels when they are placed beside the distribution of Whites. Quite strikingly, the situation appears to have worsened from 2008 to 2012.

Finally, we look at the association between overlapping and inequality. Table 3.5.3 gives the data on between-race inequality, within-race inequality and the impact of overlapping on both. The standard within-group inequality (G_{wo}) increases from 1993 to 2008, declines slightly in 2012, before increasing again in 2014. That is, the within race Gini increases by 0.14 points, or 47.8% between 1993 and 2008, and by another 9.8% in 2014-2015. This shows that racial income distributions are becoming internally heterogeneous. Given that within-group inequality and income stratification are inversely related, these results confirm a reduction in income stratification by race between 1993 and 2008. The contribution of between-race inequality decreases by 45% between 1993 and 2014, another indication that the race groups are becoming

externally homogeneous. The Pyatt (1976)'s between-Gini (G_{bp}), where each race is represented by mean income and its rank (instead of mean ranks of the members), gives a clear picture of declining income differences between races from 1993 to 2014.

Table 3.5.3: Within-group and Between-group inequality, 1993, 2008, 2012, and 2014-2015

ANOGI components	1993	2008	2012	2014
Within-group Gini (G_{wo})	0.2852	0.4218	0.4095	0.4633
Between-group Gini (G_b)	0.3898	0.2867	0.2558	0.2119
Within-inequality without Overlapping (IG)	0.4779	0.5827	0.5549	0.6108
Impact of Overlapping on within-inequality (IGO)	-0.1928	-0.1608	-0.1454	-0.1475
Pyatt (1976) Between-group Gini (G_{bp})	0.4571	0.3792	0.3338	0.3165
Difference ($G_b - G_{bp}$) BGO	-0.0674	-0.0925	-0.0780	-0.1045

Notes: All rows correspond to the components of equation 3.4.2
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014

We further decompose the standard within-group inequality to isolate within-group inequality without overlapping (IG) and the impact of income overlapping (IGO). We observe a decline, in absolute terms, in IGO (of almost 16.6%) between 1993 and 2008, another 8.3% decline in 2014-2015. If IGO is equal to zero, it implies that the income distribution of each race group perfectly overlaps with that of the entire population. Thus, the decline signifies an increase in the degree of overlapping of income distribution across race groups. The effect of overlapping on the between-group component (BGO) increases between 1993 and 2008 before it falls in 2012, and rises again 2014-2015. That is, the loss of the between-race component due to overlapping of incomes is 6.7 Gini points in 1993, and 9.3, 7.8 and 10.5 Gini points in 2008, 2012, and 2014-2015. Given that a BGO of zero indicates that the groups are perfectly stratified, this attests to the income stratification decline between 1993 and 2008, and the slight increase in 2012. Overall, between-group inequality shows evidence of cohesive tendencies towards equality of incomes across race.

We supplement the results from Table 3.5.3 by considering them in conjunction with the size of intra-group component (sG in able 3.5.1) and the contribution of each race group to intra-group variability ($sG(O-1)$). From sG we note that in 1993, 2008, 2012 and 2014-2015, Blacks are responsible for 19.11, 28.3, 29.5 and 31 Gini points of inequality, which translates to 40%, 49%, 53% and 51% of intra-group inequality. Whites are responsible for 46%, 35%, 31% and 35% of intra-group inequality and Coloureds' share of intra-group inequality is 8.7%, 8.6%, 8.6% and 7.5% during the same period. The largest contribution to intra-group variability comes from Blacks and the lowest from Coloureds. These findings, together with the negative slope of percentile differences between Blacks and Whites (seen in panel (d) of figure 3.3.1),

affirms that Blacks have higher income inequality than Whites. These findings support those observed by Leibbrandt et al. (2012).

Columns $sG(O-1)$ identifies the revision of the contribution of each race to intra-group variability determined by the overlapping component. Here we notice a systematic negative revision for all races in all the years except for Blacks in 2008, 2012, and 2014-2015. This means that the scatter of ranks for Blacks in these years is larger than the scatter of ranks of individuals in the national income distribution. This result suggests an emergence of rich strata among Blacks, which may lead to higher clustering of incomes the Black group. This distributional characteristic is not surprising and gives a partial explanation for why Gini coefficients are greater for Blacks. The larger revision of the contribution White individuals to intra-group variability means that this race forms a stratum in the national distribution, or overlaps less with the country's overall distribution.

3.5.1.1 Education level strata as the defining stratum

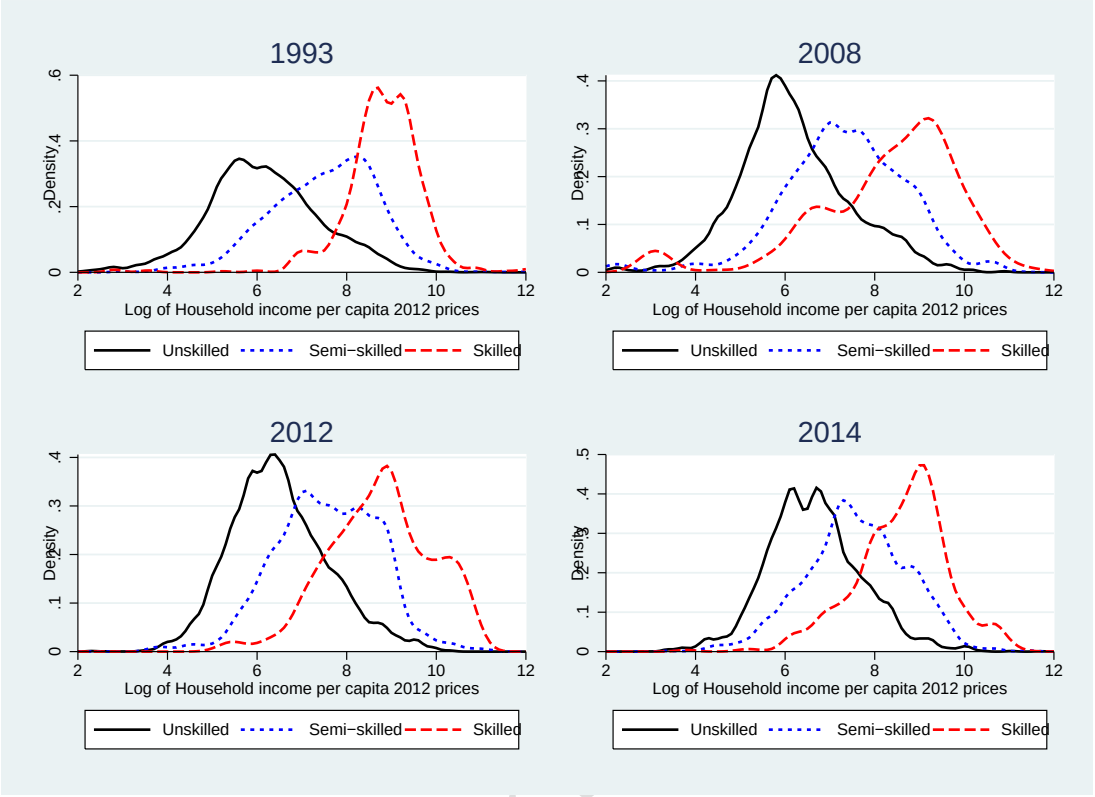
To supplement our analyses, we look at the extent to which these distributional patterns suggest the emergence of new strata replacing race as a defining stratum. We follow Heller and Yitzhaki (2006) who deal with the quality classification of snails into groups according to observable characteristics like the shells, and Frick and Goebel (2008) who decomposes well-being in Germany based on region.

For this purpose, we use years of schooling or education attainment to examine whether a grouping by race or education attainment is more stratified. We chose to use education because of its positive impact on probability of finding a job and earning more, which in turn helps people to integrate into the economy and society. While there are multiple ways that education attainment could be measured, we rely on the education attainment of the household head for two reasons. First, the decision to register into formal schooling is generally made by the head of the household. Second, the head of the household is usually a role model for younger members of the household. Thus, household heads with more years of schooling are likely to invest in human capital and encourage other members to invest in education. To categorise the education attainment of households heads, we group all household heads with no formal schooling up to seven years of schooling together. We label this group the Unskilled. The second group includes household heads with between seven and 12 years of schooling. We refer to them as Semi-Skilled. The third and last group includes those households heads with more than 12 years of schooling and we refer to them as Skilled.

Race is a better classifier of a society if inequality within races is lower than inequality within education groups, and the overlapping between races is lower than the overlapping between education groups. Thus, a grouping is better if it is based on low intra-group inequality and minimal overlapping of income distributions, that is, high between-group inequality. To assess this, we decompose the Gini coefficient by education level group and compare the results with those from the racial decomposition. Table 3.5.4 presents the ANOGI outcomes by these groups of education.

A number of features of the income profiles of the three education groups, shown in figure 3.5.1, deserve a comment. First, the income distribution of individuals living with an unskilled household head is to the left in the four sample years. This reflects that they have, on average, low incomes, compared to individuals living with a household head who is semi-skilled or skilled. A possible explanation for this is that educated or skilled household heads are more likely to encourage other household members to improve their education, and they possibly serve as role models of education attainment for other members. A simple average of adult years of schooling across the skill categories reveals that individuals who live in households with less educated or unskilled households heads have fewer years of schooling. However, this gap has been reduced over the years. The convergence in education attainment across race groups appears to have resulted to income distributions across the skills groups becoming closer in 2012 and 2014-2015.

Figure 3.5.1: Overlaid densities for Household head education groups



Notes: The figure shows the estimated epanechnikov 2 kernel densities of log real income per capita for for individuals grouped by the level of education of household head.
Source: Weighted PLSLD 1993, NIDS 2008, 2012, and 2014-2015.

We now investigate the ANOGI outcomes, shown in table 3.5.4, for evidence of stratification based on education groups. Starting with the data in the columns labelled overlapping (O_i), it is clear that the income distribution of individuals in households with unskilled household head tends to be bi-polarised. That is, the scores of the overlapping indices are always above unity, which indicates the existence of two income groups. Incomes of individuals in households with a skilled household head are more stratified, as there is a very little overlap with the income distributions of other groups. The overlapping of incomes for individuals who live with a skilled household head more than doubles between 1993 to 2008, and then declines sharply by 2012. This remarkable turn-around in the degree of stratification in 2012 is consistent with other previous findings in the paper. The mean ranks in the columns labelled $\bar{F}_{ui}(y)$ indicate that the average position of individuals living with unskilled heads remains somewhat constant across the four survey years. However, for individuals living in households headed by either a semi-skilled or a skilled individual, the average percentile ranks decrease by 12.1% and 7.6%, between 1993 and 2008. In other words, the results confirm the narrowing of income distances across these groups. To sum up, we see that the incomes of individuals in households with more educated (or skilled) household

head are more stratified (overlap less with the national income distribution), whereas incomes of those in households with less skilled household heads are less stratified.

Next, we examine which grouping between race and education level has the least income overlap (the highest stratification). We argue here that, if education is an emerging stratum replacing race, then the stratification of incomes of those grouped by education levels should approach that of race groups with the possibility of overtaking in the future. Comparing tables 3.5.4 and 3.5.3, we see that both the intra-group inequality and overlapping among racial groups are lower than their counterparts in the years of schooling groupings. This situation is true for both 1993 and 2008 years. Therefore, we conclude that racial grouping is the best income grouping in these years since it has the highest stratification and between-group inequality. However, intra-group income variability and overlapping coefficients by education groups are similar in 2008. This is unmistakably a key element in support of education emerging as the defining stratum. The picture becomes clearer when we examine data for in 2012, where those grouped by years of schooling had the lowest intra-group inequality.

A conclusion that emerges from the measurement and analysis of stratification above is that, even though income stratification, especially for Whites, falls between 1993 and 2014, it is still evident. This indicates the slow pace at which we are overcoming the economic legacy of Apartheid. Given that ANOGI provides unconditional convergence of income across the racial groups, the following emerges. The conditional (i.e., the RIF regressions) and unconditional convergence results allude to greater income gaps between the Blacks and Whites. A portion of these income gaps can be explained by occupational segregation (Naidoo, Stanwix & Yu, 2014). That is, Blacks are over-represented at low and median skill jobs, while whites hold higher paying jobs. The higher convergence at the top of the income distribution is portrayed by the decrease in stratification of the income distribution of Whites. Moreover, race still emerges as a better classifier of South African society. The evidence also hints at education as a stratum which could replace race.

Having established this patterns of stratification, we move to examine how different income sources interact to impact the degree of income stratification in the population. Before undertaking the analysis, we first check the robustness of the above results.

Table 3.5.4: Analysis of Gini by level of education of household head, 1993, 2008, 2012 and 2014-2015

	1993	**2008**	**2012**	**2014**	**1993**	**2008**	**2012**	**2014**	**1993**	**2008**	**2012**	**2014**	**1993**	**2008**	**2012**	**2014**
	Population share (p_i)				Mean (μ)				Income share (s_i)				Gini (G_i)			
Unskilled	0.8704	0.7997	0.7876	0.7636	1090	1186	1323	1489	0.6437	0.5243	0.5012	0.4552	0.6486	0.6713	0.6093	0.5967
Semi-skilled	0.1146	0.1701	0.1753	0.1851	3355	3442	3570	4841	0.2609	0.3237	0.3009	0.3587	0.5475	0.6280	0.5624	0.6675
Skilled	0.0149	0.0303	0.0371	0.0514	9409	9082	11092	9052	0.0953	0.1521	0.1979	0.1861	0.4214	0.5688	0.5314	0.5047
	Overlapping (O_i)				Mean rank ($\bar{F}_{ui}(y)$)				s_iG_i				$s_iG_i\,(O_i-1)$			
Unskilled	1.0089	1.0221	1.0132	1.0143	0.4604	0.4479	0.4401	0.4358	0.4175	0.3520	0.3054	0.2716	0.0037	0.0078	0.0040	0.0039
Semi-skilled	0.6069	0.6934	0.6931	0.7184	0.7444	0.6880	0.6900	0.6663	0.1429	0.2033	0.1692	0.2394	-0.0562	-0.0623	-0.0519	-0.0674
Skilled	0.1928	0.5119	0.3463	0.3862	0.9340	0.8207	0.8746	0.8549	0.0402	0.0865	0.1052	0.0939	-0.0324	-0.0422	-0.0687	-0.0577
									0.6006	**0.6417**	**0.5798**	**0.6050**	**-0.0849**	**-0.0968**	**-0.1167**	**-0.1212**
G_{wo}	0.5157	0.5450	0.4631	0.4837												
G_b	0.1593	0.1646	0.2026	0.1930												
IG	0.6006	0.6417	0.5798	0.6050												
IGO	-0.0849	-0.0968	-0.1167	-0.1212												
G_{bp}	0.2337	0.2915	0.3100	0.3244												
BGO	-0.0745	-0.1269	-0.1074	-0.1314												

Notes: O_i is the overlapping index of the distribution of identity group i with the overall national distribution, and its minimum value is the population share of the group (p_i). Unskilled refers to up to 7 years of schooling, semi-skilledto between 7 to 12 years of schooling, and skilled to those with more than 12 years of education.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012, and 2014-2015

3.5.2 Robustness of results

In this section, we examine the sensitivity of our income stratification results to membership of identity groups. The accuracy of the results may stem from the argument of Elbers, Lanjouw, Mistiaen and Özler (2008) that between-group inequality is a function of a groups' mean income, number, and size of the groups. Thus, the high degree of income overlap for the Blacks may be due to their large population share. Disaggregating Blacks into smaller groups may therefore tend to raise (reduce) their degree of stratification (overlapping). Though we have partially addressed this issue by adjusting the overlap indices for group size, here we disaggregate the Black group into seven smaller groups, based on ethno-linguistic identity[9]. This gives a total of 11 identity groups which we use in the ANOGI analysis. The aim is to investigate whether the increase in the number of groups might significantly affect the results.

The tables in Appendix 3.7.3 report the outcomes of the ANOGI decomposition by ethno-linguistic identities. Tables 3.7.1 and 3.7.2 clearly show that the incomes of Whites still have the least amount of overlapping with the incomes of the rest of the population, compared to other groups. Across Black identities, all levels of overlapping are considerably large, and close to one. From tables 3.7.3 and 3.7.4 where the richest group - Whites - is used as the baseline, the other groups form an almost perfect stratum with respect to the income distribution of Whites. However, when the low income groups are used as a baseline, the overlapping indices are, as expected, higher. These differences suggest that there are more (poor) White individuals in the range of the Black group's distribution, than there are Blacks in the income distribution range of Whites.

Tables 3.7.5 and 3.7.6 confirm these results by showing that the average rank of Whites would be at the 90^{th} percentile in the distribution of the Black identities. None of the Black identity groups would be above the 10^{th} percentile of the White income distribution. Looking across the years, similar patterns are observed, with more overlapping of incomes in 2008 than in 1993, and less overlapping in 2012 and 2014-2015 than in 2008. At this stage, we can conclude that the stratification results are robust to the number of groups in the decomposition of the Gini coefficient.

[9]The linguistic identity is derived from the question regarding the most spoken language in the household. Respondents are asked to choose any of the 11 official languages in the country. The Ndebele-Swati, Venda-Tsonga and Indian identities have small population shares in the sample which may result in biased findings. Their results are presented for sake of completeness. It worth noting that we could have used the 11 linguistic identities instead of only languages of African origin. The problem with this approach however is that it groups Whites, Coloureds and Indians into Afrikaans and English identity groups.

3.5.3 Shift-Share results

As pointed out, the above findings leave unexplained the factors behind the changing patterns of stratification. For instance, they fail to explain the impact of different income sources on the degree of overlapping of income across groups. In this section, we detail our analysis to measure the effects of income components on the stratification of incomes. We use the microsimulation approach outlined in section 3.4.2.

Table 3.5.5 presents the simulated effects of the four income sources on between-group inequality, within-group inequality and the impact of income overlap on both. The table shows what happens to these ANOGI components when the headlined income source changes to its 1993 distributions, while all other income components remain at their 2008 levels. The simulated effects are reported as percentage changes from 2008 - the base year. A negative value, in this case, suggests that the component in question falls, and positive values indicate an increase from the base year. Before discussing the results, two observations must be pointed out. First, the simulations are path dependent, that is, the effects depend on the order in which the incomes are added. Second, the simulated effects are unconditional on group characteristics.

The table clearly shows that the simulated effects of changing labour earnings, capital dividends and remittances to their 1993 levels are generally negative, whereas the effects of state transfers are positive. This implies that South Africa's income distribution would be less unequal (that is, have a lower G_u, G_w, G_b), and more stratified (have a higher BGO and a lower IGO) than the one observed in 2008 if labour income had stayed at its 1993 distribution. For example, looking at labour income effects in column 1 labelled "Labour" of table 3.5.5, we see that national income inequality (G_u) falls by 0.0508, an amount equivalent to 7.2%, standard within-race inequality (G_{wo}) by 6.2% and between-race inequality (G_b) by 8.7%. The revision of intra-group variability due to overlapping (IGO) falls by 10.5%, while the loss of between-group inequality due to overlapping rises by 3%.

Similarly, there is a drop in the overall Gini and between-group Gini when both capital income (shown in column 4) and remittances (shown in column 3) assume their 1993 distributions. The within-group inequality, however, rises in both scenarios. The fall of both G_u and G_b suggests an increase in external heterogeneity while the rise inG_w means an increase in internal homogeneity across race. Taken together with the fall of *IGO* and the rise *BGO*, this suggests a decrease in the degree of stratification. Data in column 2 labelled "Government" shows that all ANOGI components rise by an amount

no less than 6%. This suggests that income distribution would have been more unequal (with a higher G_u, G_w, G_b) had government transfers assumed their 1993 state. The extent of stratification would however be indeterminate. This is because IGO and BGO move in the same direction, which could mean either a fall or a rise in the degree of stratification.

Table 3.5.5: Simulated Within and Between inequalities

ANOGI components	(1)	(2)	(3)	(4)
	Labour	Government	Remittances	Capital
G_u	-7.21	6.66	-1.17	-0.55
G_{wo}	-6.16	6.55	0.65	2.12
G_b	-8.74	6.81	-3.88	-4.69
IG	-7.33	6.44	-0.57	0.56
IGO	-10.50	6.15	-4.04	-4.11
G_{bp}	-5.93	6.81	-2.58	-2.86
$G_b - G_{bp} = BGO$	2.96	6.80	1.06	2.03

Notes: The values are percentage changes from the base year, 2008 if the headed income component remains unchanged at its 1993 level. The simulations are done sequentially meaning the government transfers simulated affects are conditional on labour income changes, and remittances effects are conditional on government transfers and labour income changes. A reverse order simulation barely alters the percentage changes of each income component. A negative value suggests that the component in question would have fallen, and a positive value signals an increase.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014-2015

Repeating the simulations with 1993 as the base year corroborates the above findings. That is, holding all other incomes constant at their 1993 levels while changing labour income to its 2008 distribution, Gini coefficient increases to 0.7288. This is equivalent to an 8.4% increment in inequality. However, when government transfers are at their 2008 levels, the overall Gini would have fallen by an amount of no less than 3%.

The results from the labour income simulations appear to accord with evidence from earlier studies (Leibbrandt et al., 2012; Schiel et al., 2016), showing the strong positive effects of the labour market on inequality. Several hypotheses have been proffered to explain the labour market effects of inequality. One of these is the Job Polarization hypothesis. Job polarization results from high demand for unskilled and highly-skilled workers, thereby leading to the disappearance of mid-level occupations. The results relating to the influence of capital and remittances are also consistent with those of Leibbrandt et al. (2012). But unlike their finding, in the current context, these incomes appear to widen between-group inequality and to reduce within-group inequality. We further find a strong negative effect of government transfers on inequality. This finding

seems to repudiate the research results of Leibbrandt et al. (2012) who find practically no impact of state grants on inequality.

There is a lack of studies measuring the extent of stratification and those investigating the effect of different income sources on the degree of stratification. This knowledge gap limits comparison of our research results with other findings. Nevertheless, the literature theorises an inverse relationship between stratification and inequality (Allanson, 2014; Monti & Santoro, 2011). Using these studies as the basis, the above results give a first indication of the stratifying role of labour earnings, capital dividends, and remittances. Though the effect of government transfers on income stratification is indeterminate, they tend to move their recipients from lower income deciles into middle quantiles (Leibbrandt et al., 2012). This would increase the degree of overlapping of these groups' income distributions.

The above deductions on stratification are consistent with expectations. For instance, if an income source k moves group i members from lower income deciles into middle-income quantiles, and leads to no significant movement of recipients in group j, then income source k should curtail stratification. These movements and the resultant effects on stratification are due , in part, to the differential impact of each income source across identity groups. Based on this assumption, we move to analyse how each income source affects the income distribution of different racial groups.

Table 3.5.6 presents detailed simulated effects of the four income sources on the extent of income overlapping in the groups. Each table shows the effects of a change in the income source to its 1993 distribution while holding all other incomes at their 2008 levels. The values represent a percentage change from the base year, 2008. A negative value suggests the component in question would have decreased, and a positive value signals an increase. Panel A in the tables provides general information on the racial groups, while panels B and C provide changes in an overlapping matrix and rank matrix.

Looking closely at Panel A of Table 3.5.6a titled "Labour income simulations", the following is evident. Even though average income per capita (μ_i) falls for all racial groups, only the income share (s_i) for Whites in total income falls. One explanation for the rise in the income share of Blacks and Coloureds is that between 1993 and 2008, Whites increased their labour market earnings more than other racial groups. This may have occurred for two reasons. First, during the Apartheid regime most positions of power were reserved for Whites, and non-Whites were confined to lower paying occupations. This is thus a lingering footprint of Apartheid. Secondly, the

probability of attaining tertiary education for Whites is almost double that for Blacks and Coloureds. This is shown in Table 3.3.2.

The column labelled O_i shows that the overlapping of the income distribution of Whites with the national distribution increases by an amount equivalent to 8.3%. This means incomes of Whites are less stratified. Therefore, the labour income changes between 1993 and 2008 lead to Whites' incomes being more stratified in 2008. The overlapping of the income distribution of Blacks and that of Coloureds fall by 2.2% and 0.3%. This shows that the incomes of Blacks and that of Coloureds would, however, be more stratified if labour income had its 1993 distribution. More specifically, the labour income changes that occurred increased the degree of economic assimilation of Blacks and Coloureds.

The average percentile ranks in the column labelled F_{ui} show a 0.09% rise to the 44^{th} percentile for mean ranks of incomes of Blacks in the national distribution. The average percentile ranks of Coloureds in the national distribution rise by 0.64% to the 57^{th} percentile. The average position of the incomes of Whites, on the other hand, falls by 0.39% to the 87^{th} percentile. Even if this change is small, this means that labour income changes tend to widen the distance between the incomes of the races.

The overlapping of income distributions across racial groups (shown in Panel B of table 3.5.6a) shows that the labour income changes between 1993 and 2008 reduced the of stratification of the incomes of Whites relative to those of Blacks and Coloureds. That is, the extent to which the incomes of Whites are included in the income distribution of Blacks and in that of Coloureds falls by 13.4% and 6.8%. This is evidence in favour of labour incomes creating a stratified society. A comparison between Blacks and Coloureds shows a rise (of 2.4%) in the extent to which the income distribution of Blacks is included in the Coloureds' income distribution. This suggests that labour income changes have increased the similarity between the income distributions of Coloureds and Blacks.

Panel C presents changes in the percentile ranks of incomes of one race group (row) in the income distributions of another race group (column). The average percentile rank of incomes of Whites in the Black distribution would have increased by an amount equivalent to 0.48% to the 91^{st} percentile. In the Coloureds income distribution, the mean rank of Whites incomes would have grown by 0.16% to the 86^{th} percentile. The implication therefore is that, between 1993 and 2008, the labour incomes of Whites have grown faster than those of Blacks and Coloureds, thereby creating layers in the income distribution. The average ranks of incomes of Blacks and that of Coloureds

in the income distribution of Whites would have fallen by 5.6% and 1.05% . That is, they would rank around the $8^{th}$and 14^{th} percentile. Therefore, despite the convergence in income, Whites still form a relatively wealthier group within other racial groups' income distributions.

Taken together, the evidence presented in Table 3.5.6a is consistent with the findings of other studies using labour income simulations to investigate inequality (Schiel et al., 2016). That is, labour income changes between 1993 and 2008 had a disequalizing effect. Our research finds further evidence of the stratifying role of labour incomes. This evidence is consistent with expectations.

Table 3.5.6: Shift Share analysis of Income Stratification, 1993 vs 2008

(a) Labour income simulations

	Panel A						
	μ_i	s_i	G_i	O_i	F_{ui}	s_iG_i	$s_iG_i(O_i-1)$
Black/African	-7.06	4	-11.27	-2.15	0.09	-7.72	463
Coloured	-0.95	10.84	-4.76	-0.29	0.64	5.57	7.13
Indian/Asian	-5.34	5.93	1.64	4.6	-1.69	7.66	-1.1
White	-17.47	-7.66	-6.27	8.3	-0.39	-13.45	-17.18
Total	**-10.63**		**-7.21**			**-7.33**	**-10.5**

Panel B. Overlapping matrix				
	Black/	Coloured	Indian	White
Black/Africa	0	2.38	12.32	19.41
Coloured	0.88	0	-1.38	-3.22
Indian/Asian	-6.78	-1.08	0	-0.09
White	-13.36	-6.77	-3.00	0
Panel C. Ranks matrix				
Black/Africa	0	1.18	-6.93	-5.64
Coloured	-0.66	0	-2.64	-1.03
Indian/Asian	1.78	1.13	0	1.83
White	0.48	0.16	-0.84	0

(b) Government Transfers simulations

	Panel A						
	μ_i	s_i	G_i	O_i	F_{ui}	s_iG_i	$s_iG_i(O_i-1)$
Black/African	-9.8	-4.85	12.15	0.12	-0.1	6.71	1.91
Coloured	-4.49	0.76	6.08	-1.31	0.64	6.89	13.9
Indian/Asian	-0.89	4.56	1.64	-0.88	0.28	6.28	8.16
White	-0.61	4.85	1.03	0.75	-0.04	5.94	5.47
Total	**-5.21**		**6.66**			**6.44**	**6.15**

Panel B. Overlapping matrix				
	Black/	Coloured	Indian	White
Black/Africa	0	-0.97	-1.04	0.15
Coloured	1.67	0	0.33	0.50
Indian/Asian	1.37	-0.76	0	0.21
White	-0.95	-1.65	-0.39	0
Panel C. Ranks matrix				
Black/Africa	0	1.26	1.21	-0.33
Coloured	-0.69	0	-0.59	-1.04
Indian/Asian	-0.34	0.26	0	-0.29
White	0.03	0.16	0.13	0

(c) Remittances simulations

	Panel A						
	μ_i	s_i	G_i	O_i	F_{ui}	s_iG_i	$s_iG_i(O_i-1)$
Black/African	-0.82	1.83	-1.39	0.12	0.02	0.41	-4.53
Coloured	0.29	2.96	-0.53	-0.15	0.54	2.42	3.11
Indian/Asian	-0.53	2.13	0.55	1.49	-0.39	2.69	-0.31
White	-5.69	-3.18	-0.81	2.21	-0.34	-3.96	-5.22
Total	**-2.6**		**-1.17**			**-0.57**	**-4.04**

Panel B. Overlapping matrix				
	Black/	Coloured	Indian	White
Black/Africa	0	0.19	1.17	-2.58
Coloured	0.51	0	0.60	-2.39
Indian/Asian	-1.91	-1.50	0	-0.26
White	-2.98	-3.88	-1.29	0
Panel C. Ranks matrix				
Black/Africa	0	0.86	-1.88	-3.19
Coloured	-0.46	0	-1.68	-4.85
Indian/Asian	0.52	0.75	0	-2.79
White	0.29	0.77	1.24	0

(d) Capital income simulations

	Panel A						
	μ_i	s_i	G_i	O_i	F_{ui}	s_iG_i	$s_iG_i(O_i-1)$
Black/African	-0.92	2.19	0	0.32	0.21	2.19	2.19
Coloured	-1.37	1.73	-0.24	0.08	0.79	1.48	1.83
Indian/Asian	-10	-7.18	-2.98	0.67	-0.37	-9.95	-4.92
White	-4.51	-1.51	2.33	6.16	-1.29	0.79	-1.15
Total	**-3.04**		**-0.55**			**0.56**	**-4.11**

Panel B. Overlapping matrix				
	Black/	Coloured	Indian	White
Black/Africa	0	-0.04	-1.17	-4.24
Coloured	-0.02	0	-0.64	-0.38
Indian/Asian	-1.75	-1.15	0	3.45
White	-8.41	-8.49	-6.29	0
Panel C. Ranks matrix				
Black/Africa	0	0.03	-0.52	-10.00
Coloured	-0.02	0	-0.58	-9.35
Indian/Asian	0.15	0.27	0	-4.04
White	0.93	1.57	1.88	0

Notes: The values show percentage changes from the base year, 2008, when the income source changes to its 1993 level, and all other income sources remain unchanged at their 2008 levels. A negative value suggests that the components in question would have fallen, and a positive value signals an increase. All the simulations are sequential, thus they may have the restrictive path dependence property.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014

We now turn to government transfer simulations, which are shown in Table 3.5.6b. Similar to the labour earnings analysis, the average income falls for all races, though Blacks instead of Whites record the largest magnitude. Income share (s_i) falls for Blacks while it rises for Whites and Coloureds. The Gini coefficient for Blacks rises

by an amount not less than 12%, meaning the changes in the government transfers between 1993 and 2008 did lower inequality. As pointed out earlier, Blacks are the major beneficiaries of post-Apartheid state transfers. It is not surprising that they have worse income distribution when government transfers assume their 1993 levels. The degree of income overlap (stratification) for Blacks rises (falls) by 0.12% to 0.98. This means greater similarity between the income distribution of Blacks and the national distribution. Similarly, the overlapping of the income distribution of Whites increases (by 0.75%), meaning this distribution becomes less stratified. The overlapping of the income distribution of Coloureds by 1.31%, reflecting an increase in the intersection of the income distribution of Coloureds and the national distribution. Put differently, the transvariazione of Coloureds increases due to an increase in social grants between 1993 and 2008.

The simulated overlapping matrix in Panel B of the same table (3.5.6b), shows that the income range of Whites included in the income range of Blacks and that of Coloureds falls by 0.95% and 1.7%. This is another indication that government grants heightened the similarity between income distributions, and reduced the degree of income stratification. It therefore follows that the income of Blacks and of Coloureds included in the income range of Whites should increase. This is systematically true as overlapping of incomes of Blacks and of Coloureds by those of Whites rises by 0.15% and 0.5%. The simulated ranks matrix in Panel C shows a 1.26% rise to the 35^{th} percentile, and a 0.33% fall to the 8^{th} percentile for average ranks of Blacks in the income distributions of Coloureds and Whites. The average ranks of incomes of Coloureds and those of Whites within the income distribution of Blacks fall by 0.69% to the 65^{th} percentile, and rises by 0.03% to the 92^{nd} percentile. The evidence presented in Table 3.5.6b shows a tendency for government transfers to narrow income gaps across race groups, and thereby attenuate income stratification and expand economic integration.

Table 3.5.6c shows the effects of adjusting remittances to 1993 levels, conditional on labour income and government transfers. Similar, to the labour income simulations, average income falls for all races except the Coloured group. And only the income share of Whites falls as remittances take their 1993 distribution. Overlapping of the income distributions of Whites, of Blacks, and of Coloureds by that of the overall population rises by 2.2% to 0.38, by 0.12%, and by 0.15%, respectively. A direct implication is that the reduction in remittances has a tendency to increase stratification. This is clearly shown by the overlapping matrix in Panel B of the same table. Overlapping of the income distribution of Whites by those of Blacks and those of Coloureds falls by 2.9% and 3.9%. The role of remittances in enhancing income stratification is further shown by the growth (of about 0.3% and 0.8%) in the mean rank of incomes of

Whites incomes in the income distributions Blacks and Coloureds.

We complete our discussion with capital income simulations in table 3.5.6d. Panel A shows that, as expected, Whites experience the largest fall in their mean income. The income share of Blacks and of Coloureds rise by 2.2% and 1.7%, while that of Whites falls by 1.5%. The income distribution of Whites turns out to be more unequal (their Gini coefficient rises by 2.3%) while that for Blacks remains unchanged at 0.62. These changes translate to lower degree of stratification of incomes of Whites. More precisely, the overlapping of the income distribution of Whites with that of the general populace increases by an astounding 6.2%. Pairwise comparison across the groups is, however, indicative of income convergence across racial groups. That is, the extent to which Whites' income distribution is included in either the Blacks income distribution or that of Coloureds declines by about 8%.

Considered in conjunction with the fall in the mean rank of Blacks and Coloureds in the White distribution, and the rise of the mean rank of the incomes of Whites in the Black and Coloured distribution, these results further confirm that capital income increases the stratification of Whites' incomes relative to other groups. This is not surprising because changing capital income to its 1993 distribution means reverting to its Apartheid-era level, where Whites owned most of the productive property. It is therefore worth noting that the simulated effects capture the effects of policies like Black Economic Empowerment (BEE)[10]. Thus, they indicate assimilation of other races into the economy.

3.6 Conclusion

High and persistent levels of economic inequality are one of the defining characteristics of South Africa in the post-Apartheid era. These inequalities demonstrate a larger within-race component and a smaller between-race component. A great deal of research has been devoted to the measurement of income inequalities across racial groups (Gradín, 2013; Leibbrandt et al., 2012; Leibbrandt & Levinsohn, 2014).

This study is an attempt to understand the extent of economic integration and its proximate drivers. We show that underlying these increasing income inequalities, there has been an overall increase in convergence in education attainment and household income. Education attainment convergence is most evident at middle education levels

[10]For some details about BEE, see Krüger (2011, 2014)

(i.e. high school followed by primary), and there is some degree of divergence with tertiary education attainment. Income convergence is greater for situates in lower income percentiles. We take this as evidence for different degrees of stratification across racial groups.

Motivated by these convergent patterns, we perform an ANOGI decomposition to find evidence of income stratification. From this, we find a large decrease in the stratification of income distributions across racial groups from 1993 to 2008, a small increase in 2012, and a decrease again in 2014-2015. More importantly, even though the stratification of the incomes of Whites decreases, it is still large (that is, their income distribution overlaps less with that of the overall population and those of other race groups). This shows the rather slow pace of economic change since the end of Apartheid. We also sought to investigate whether the observed changes in South Africa's income distribution suggests the emergence of education as a new stratum replacing race as a defining stratum in the economy. A key finding in this regard is that race is still a better classifier of our society.

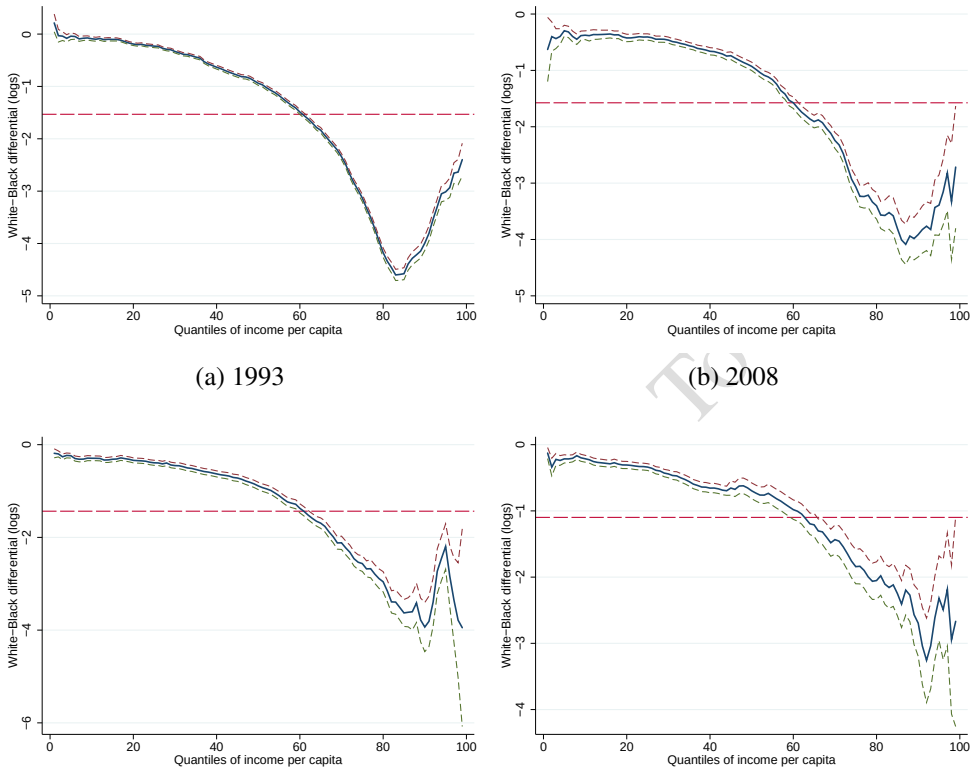
We next apply a rank preserving income exchange method developed by Burtless (1999) and Larrimore (2014) to assess how unconditional changes in a range of income sources (like labour income, and government transfers) account for changes in household income distribution among race groups. The simulated effects of income stratification suggest that increases in government transfers have a tendency to lower income stratification of Blacks, whereas changes in labour income, remittances, and capital income tend to increase stratification of incomes of White people. In summary, these results suggest some uplifting findings, that is, in the past two decades, some Blacks and some Coloureds have sharply narrowed their historical income gaps relative to the Whites.

More research is, however, needed to investigate other factors that could strengthen (weaken) economic integration (stratification). For example, does the convergence in education attainment of racial groups decrease or encourage income stratification? Another area of interest involves examining which type of capital income has the largest effect on the income distribution in general.

3.7 Appendix

3.7.1 Figures

Figure 3.7.1: Black and White income differentials

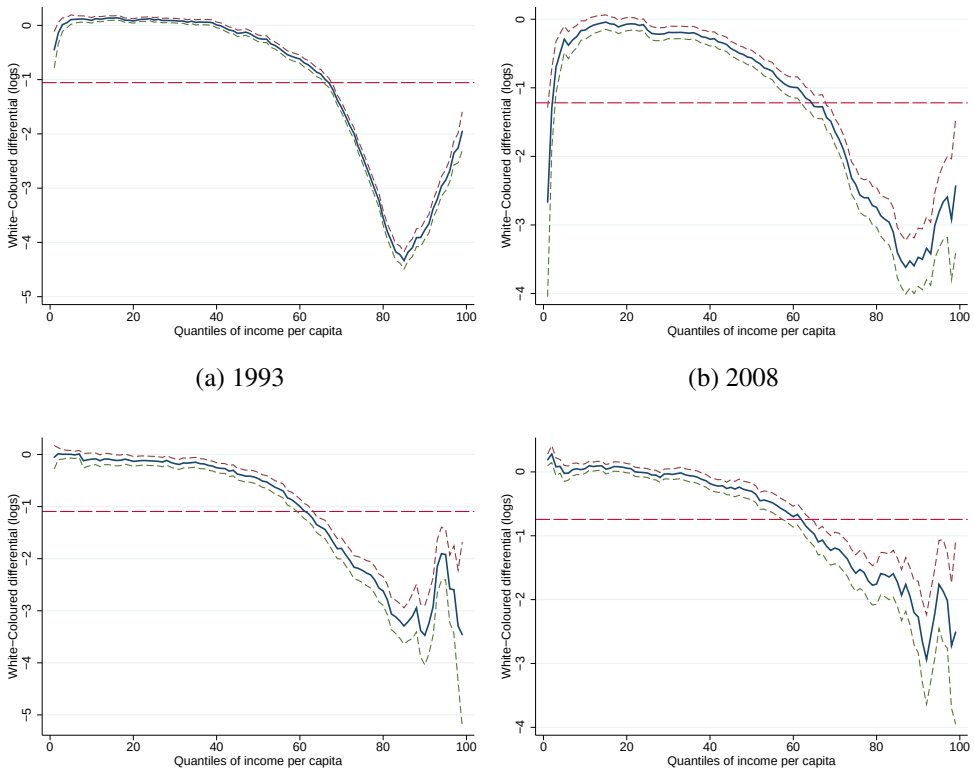


(a) 1993 (b) 2008

(c) 2012 (d) 2014

Notes: This figure reports the marginal effects, and their respective 5% confidence bands, of the Blacks dummy in the RIF regressions of log of income per capita in South Africa. In all regressions, White is the reference category, meaning the values report log of household income per capita of a Black individual relative to a similar White individual. The control variables include age, age squared, gender, household size, education level, rural dummy, and province dummies.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and NIDS 2014-2015

Figure 3.7.2: Coloured and White income differentials



(a) 1993 (b) 2008

(c) 2012 (d) 2014

Notes: This figure reports the marginal effects, and their respective 5% confidence bands, of the Coloured dummy in the RIF regressions of log of income per capita in South Africa. In all regressions, White is the reference category, meaning the values report log of household income per capita of a Coloured individual relative to a similar White individual. The control variables include age, age squared, gender, household size, education level, rural dummy, and province dummies.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and NIDS 2014-2015

3.7.2 Variables included in computing income sources

The five major components of total household monthly income are:

1. **Labour market income** includes earnings from main, secondary and part-time work, self-employment, profits, bonuses and benefits, and cash allowances.

2. **Capital income** includes interest or dividends, rental or property earnings, private pensions and annuities as well as royalties.

3. **Remittances** include value of food, clothing and housing received, alimony, child maintenance and similar allowances and all other inter-household remittances received.

4. **Government transfers** include old age pensions, child grants (including foster care and care dependency), disability grants, UIF income, as well as workman's compensation.

5. **Other income** includes all income not specified elsewhere.

3.7.3 Robustness tables

Table 3.7.1: ANOGI by ethnic group, 1993 and 2008

(a) ***1993***

	p_i	μ_i	s_i	G_i	O_i	$s_i G_i$	$s_i G_i (O_i - 1)$	$\bar{F}_{ui}(y)$
Ndebele & Swazi	0.037	814	0.021	0.527	0.861	0.011	-0.002	0.473
Xhosa	0.173	574	0.067	0.571	0.975	0.039	-0.001	0.368
Zulu	0.227	593	0.091	0.529	0.908	0.048	-0.004	0.397
Pedi	0.097	599	0.040	0.586	1.000	0.023	0.000	0.369
Sotho	0.078	755	0.040	0.538	0.898	0.021	-0.002	0.448
Tswana	0.091	910	0.056	0.504	0.819	0.028	-0.005	0.511
Venda &Tsonga	0.054	679	0.025	0.554	0.944	0.014	-0.001	0.413
Coloured	0.087	1435	0.084	0.499	0.701	0.042	-0.013	0.620
Indian	0.026	2773	0.048	0.469	0.499	0.023	-0.011	0.765
White	0.130	5952	0.527	0.425	0.294	0.224	-0.158	0.888

(b) ***2008***

	p_i	μ_i	s_i	G_i	O_i	$s_i G_i$	$s_i G_i (O_i - 1)$	$\bar{F}_{ui}(y)$
Ndebele & Swazi	0.037	992	0.020	0.622	0.961	0.013	0.000	0.452
Xhosa	0.170	816	0.077	0.614	1.002	0.048	0.000	0.409
Zulu	0.247	740	0.102	0.586	0.971	0.060	-0.002	0.403
Pedi	0.099	1198	0.066	0.677	1.028	0.045	0.001	0.447
Sotho	0.111	1241	0.077	0.635	0.977	0.049	-0.001	0.480
Tswana	0.073	1355	0.055	0.594	0.870	0.033	-0.004	0.535
Venda &Tsonga	0.042	1316	0.031	0.745	1.100	0.023	0.002	0.414
Coloured	0.095	1634	0.086	0.592	0.834	0.051	-0.008	0.574
Indian	0.027	4844	0.072	0.629	0.630	0.045	-0.017	0.735
White	0.099	7482	0.413	0.509	0.333	0.210	-0.140	0.868

Notes: ANOGI by ethnic group results.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014-2015

Table 3.7.2: ANOGI by ethnic group, 2012 and 2014

(a) ***2012***

	p_i	μ_i	s_i	G_i	O_i	s_iG_i	$s_iG_i(O_i-1)$	$\bar{F}_{ui}(y)$
Ndebele & Swazi	0.038	1047	0.019	0.511	0.913	0.010	-0.001	0.444
Xhosa	0.180	1055	0.092	0.602	1.051	0.055	0.003	0.392
Zulu	0.253	1137	0.139	0.578	0.987	0.081	-0.001	0.426
Pedi	0.108	1446	0.076	0.597	0.997	0.045	0.000	0.467
Sotho	0.098	1543	0.073	0.601	0.952	0.044	-0.002	0.488
Tswana	0.079	1664	0.064	0.572	0.921	0.036	-0.003	0.519
Venda &Tsonga	0.040	1413	0.027	0.658	1.069	0.018	0.001	0.421
Coloured	0.090	1975	0.086	0.565	0.827	0.048	-0.008	0.574
Indian	0.026	5274	0.066	0.599	0.537	0.039	-0.018	0.761
White	0.088	8373	0.358	0.487	0.309	0.175	-0.121	0.876

(b) ***2014***

	p_i	μ_i	s_i	G_i	O_i	s_iG_i	$s_iG_i(O_i-1)$	$\bar{F}_{ui}(y)$
Ndebele & Swazi	0.038	1432	0.022	0.591	1.019	0.013	0.000	0.432
Xhosa	0.188	1323	0.102	0.597	1.057	0.061	0.003	0.407
Zulu	0.250	1316	0.135	0.570	1.004	0.077	0.000	0.424
Pedi	0.110	1953	0.088	0.599	1.000	0.053	0.000	0.496
Sotho	0.094	1777	0.068	0.542	0.899	0.037	-0.004	0.520
Tswana	0.082	2146	0.072	0.609	0.961	0.044	-0.002	0.518
Venda &Tsonga	0.043	1398	0.024	0.601	1.054	0.015	0.001	0.416
Coloured	0.090	2280	0.084	0.556	0.818	0.047	-0.009	0.579
Indian	0.024	6177	0.060	0.588	0.585	0.035	-0.015	0.757
White	0.083	10161	0.344	0.648	0.411	0.223	-0.131	0.824

Notes: ANOGI by ethnic group results.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014-2015

Table 3.7.3: Overlapping matrix by ethnic groups, 1993 and 2008

(a) ***1993***

	Nde. & Swa.	Xhosa	Zulu	Pedi	Sotho	Tswana	Ven. &Tso.	Coloured	Indian	White
Ndebele & Swazi	1	0.819	0.893	0.786	0.954	1.056	0.873	1.146	0.952	0.472
Xhosa	1.130	1	1.051	0.960	1.092	1.135	1.032	1.108	0.881	0.499
Zulu	1.070	0.948	1	0.903	1.037	1.075	0.971	1.043	0.774	0.368
Pedi	1.168	1.042	1.095	1	1.134	1.174	1.070	1.143	0.874	0.430
Sotho	1.046	0.877	0.943	0.842	1	1.080	0.922	1.124	0.932	0.494
Tswana	0.942	0.771	0.843	0.743	0.903	1	0.819	1.090	0.916	0.484
Venda &Tsonga	1.113	0.963	1.026	0.923	1.076	1.142	1	1.142	0.875	0.384
Coloured	0.726	0.567	0.625	0.569	0.702	0.816	0.639	1	1.043	0.780
Indian	0.448	0.305	0.343	0.333	0.413	0.520	0.390	0.725	1	1.005
White	0.203	0.132	0.139	0.144	0.183	0.220	0.166	0.326	0.625	1

(b) ***2008***

	Nde. & Swa.	Xhosa	Zulu	Pedi	Sotho	Tswana	Ven. &Tso.	Coloured	Indian	White
Ndebele & Swazi	1	0.917	0.916	0.936	0.978	1.102	0.875	1.123	1.034	0.895
Xhosa	1.082	1	1.031	1.006	1.026	1.116	0.970	1.107	0.914	0.729
Zulu	1.068	0.968	1	0.976	0.997	1.097	0.936	1.087	0.880	0.667
Pedi	1.066	0.973	0.989	1	1.038	1.146	0.950	1.170	1.099	1.008
Sotho	1.027	0.941	0.954	0.967	1	1.107	0.907	1.126	1.008	0.845
Tswana	0.883	0.813	0.810	0.845	0.891	1	0.781	1.034	0.980	0.866
Venda &Tsonga	1.119	1.021	1.033	1.056	1.106	1.217	1	1.248	1.240	1.213
Coloured	0.824	0.766	0.756	0.802	0.853	0.957	0.737	1	0.984	0.913
Indian	0.520	0.490	0.464	0.560	0.613	0.672	0.505	0.745	1	1.231
White	0.223	0.197	0.182	0.252	0.302	0.326	0.227	0.390	0.689	1

Notes: ANOGI by ethnic group results.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014-2015

Table 3.7.4: Overlapping matrix by ethnic groups, 2012 and 2014

(a) **2012**

	Nde. & Swa.	Xhosa	Zulu	Pedi	Sotho	Tswana	Ven. &Tso.	Coloured	Indian	White
Ndebele & Swazi	1	0.867	0.969	0.917	0.985	0.977	0.901	1.053	0.890	0.533
Xhosa	1.130	1	1.096	1.066	1.116	1.120	1.040	1.181	1.049	0.718
Zulu	1.040	0.902	1	0.988	1.049	1.060	0.937	1.145	1.075	0.797
Pedi	1.051	0.910	1.003	1	1.057	1.072	0.952	1.151	1.108	0.835
Sotho	0.981	0.845	0.928	0.946	1	1.024	0.877	1.117	1.145	0.927
Tswana	0.962	0.818	0.903	0.923	0.977	1	0.852	1.090	1.109	0.834
Venda &Tsonga	1.093	0.953	1.057	1.054	1.119	1.139	1	1.230	1.225	1.050
Coloured	0.826	0.694	0.758	0.819	0.862	0.905	0.724	1	1.105	0.983
Indian	0.420	0.364	0.377	0.497	0.497	0.571	0.405	0.630	1	1.286
White	0.185	0.183	0.188	0.259	0.257	0.309	0.207	0.343	0.620	1

(b) **2014**

	Nde. & Swa.	Xhosa	Zulu	Pedi	Sotho	Tswana	Ven. &Tso.	Coloured	Indian	White
Ndebele & Swazi	1	0.941	0.999	1.016	1.118	1.046	0.957	1.177	1.045	0.978
Xhosa	1.059	1	1.058	1.060	1.157	1.081	1.017	1.205	1.024	0.906
Zulu	1.001	0.942	1	1.006	1.101	1.027	0.957	1.155	0.998	0.888
Pedi	0.967	0.903	0.962	1	1.105	1.042	0.919	1.182	1.084	1.007
Sotho	0.864	0.805	0.865	0.894	1	0.944	0.818	1.077	0.989	0.902
Tswana	0.916	0.861	0.912	0.961	1.045	1	0.876	1.121	1.101	1.048
Venda &Tsonga	1.046	0.984	1.045	1.054	1.155	1.081	1	1.217	1.062	0.949
Coloured	0.749	0.693	0.741	0.809	0.905	0.873	0.699	1	1.045	1.021
Indian	0.463	0.431	0.448	0.588	0.608	0.628	0.437	0.709	1	1.152
White	0.295	0.281	0.282	0.411	0.405	0.435	0.290	0.480	0.833	1

Notes: ANOGI by ethnic group results.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014-2015

Table 3.7.5: Ranks matrix by ethnic groups, 1993 and 2008

(a) ***1993***

	Nde. & Swa.	Xhosa	Zulu	Pedi	Sotho	Tswana	Ven. &Tso.	Coloured	Indian	White
Ndebele & Swazi	0.5	0.624	0.588	0.624	0.529	0.452	0.574	0.317	0.163	0.057
Xhosa	0.376	0.5	0.464	0.503	0.406	0.335	0.450	0.223	0.104	0.037
Zulu	0.412	0.536	0.5	0.538	0.441	0.368	0.485	0.246	0.113	0.036
Pedi	0.376	0.497	0.462	0.5	0.406	0.340	0.447	0.236	0.117	0.040
Sotho	0.471	0.594	0.559	0.594	0.5	0.424	0.542	0.298	0.148	0.052
Tswana	0.548	0.665	0.632	0.660	0.576	0.5	0.614	0.363	0.188	0.062
Venda &Tsonga	0.426	0.550	0.515	0.553	0.458	0.386	0.5	0.273	0.138	0.045
Coloured	0.683	0.777	0.754	0.764	0.702	0.637	0.727	0.5	0.281	0.097
Indian	0.837	0.896	0.887	0.883	0.852	0.812	0.862	0.719	0.5	0.230
White	0.943	0.963	0.964	0.960	0.948	0.938	0.955	0.903	0.770	0.5

(b) ***2008***

	Nde. & Swa.	Xhosa	Zulu	Pedi	Sotho	Tswana	Ven. &Tso.	Coloured	Indian	White
Ndebele & Swazi	0.5	0.546	0.560	0.510	0.473	0.400	0.551	0.356	0.197	0.077
Xhosa	0.454	0.5	0.504	0.460	0.426	0.363	0.498	0.325	0.181	0.065
Zulu	0.440	0.496	0.5	0.458	0.421	0.352	0.495	0.312	0.169	0.059
Pedi	0.490	0.540	0.542	0.5	0.466	0.408	0.532	0.368	0.218	0.089
Sotho	0.527	0.574	0.579	0.534	0.5	0.445	0.569	0.406	0.240	0.103
Tswana	0.600	0.637	0.648	0.592	0.555	0.5	0.629	0.452	0.263	0.112
Venda &Tsonga	0.449	0.502	0.505	0.468	0.431	0.371	0.5	0.334	0.198	0.083
Coloured	0.644	0.675	0.688	0.632	0.594	0.548	0.666	0.5	0.299	0.138
Indian	0.803	0.819	0.831	0.782	0.760	0.737	0.802	0.701	0.5	0.322
White	0.923	0.935	0.941	0.911	0.897	0.888	0.917	0.862	0.678	0.5

Notes: ANOGI by ethnic group results.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014-2015

Table 3.7.6: Ranks matrix by ethnic groups, 2012 and 2014

(a) **2012**

	Nde. & Swa.	Xhosa	Zulu	Pedi	Sotho	Tswana	Ven. &Tso.	Coloured	Indian	White
Ndebele & Swazi	0.5	0.562	0.521	0.475	0.455	0.420	0.529	0.360	0.162	0.058
Xhosa	0.438	0.5	0.457	0.422	0.398	0.368	0.466	0.311	0.147	0.062
Zulu	0.479	0.543	0.5	0.460	0.433	0.400	0.512	0.335	0.152	0.065
Pedi	0.525	0.578	0.540	0.5	0.479	0.446	0.545	0.393	0.207	0.092
Sotho	0.545	0.602	0.567	0.521	0.5	0.466	0.574	0.407	0.207	0.092
Tswana	0.580	0.632	0.600	0.554	0.534	0.5	0.603	0.444	0.241	0.110
Venda &Tsonga	0.471	0.534	0.488	0.455	0.426	0.397	0.5	0.338	0.169	0.077
Coloured	0.640	0.689	0.665	0.607	0.593	0.556	0.662	0.5	0.266	0.129
Indian	0.838	0.853	0.848	0.793	0.793	0.759	0.831	0.734	0.5	0.288
White	0.942	0.938	0.935	0.908	0.908	0.890	0.923	0.871	0.712	0.5

(b) **2014**

	Nde. & Swa.	Xhosa	Zulu	Pedi	Sotho	Tswana	Ven. &Tso.	Coloured	Indian	White
Ndebele & Swazi	0.5	0.530	0.509	0.435	0.405	0.413	0.518	0.343	0.178	0.119
Xhosa	0.470	0.5	0.479	0.409	0.379	0.389	0.489	0.320	0.166	0.113
Zulu	0.491	0.521	0.5	0.427	0.397	0.404	0.511	0.333	0.169	0.111
Pedi	0.565	0.591	0.573	0.5	0.474	0.479	0.581	0.413	0.238	0.172
Sotho	0.595	0.621	0.603	0.526	0.5	0.497	0.612	0.436	0.237	0.163
Tswana	0.587	0.611	0.596	0.521	0.503	0.5	0.601	0.444	0.255	0.180
Venda &Tsonga	0.482	0.511	0.489	0.419	0.388	0.399	0.5	0.326	0.171	0.117
Coloured	0.657	0.680	0.667	0.587	0.564	0.556	0.674	0.5	0.283	0.197
Indian	0.822	0.834	0.831	0.762	0.763	0.745	0.829	0.717	0.5	0.409
White	0.881	0.887	0.889	0.828	0.837	0.820	0.883	0.803	0.591	0.5

Notes: ANOGI by ethnic group results.
Source: Own calculations from weighted PSLSD 1993, NIDS 2008, 2012 and 2014-2015

Chapter 4

The Evolution of Social Polarization in Post-Apartheid South Africa

4.1 Introduction

During the past two decades, there have been many studies on the understanding and measurement of polarization. One of the reasons that motivate a study of polarization as a separate dimension of welfare (or inequality) is its deleterious effect on a number of social, economic, and political outcomes. Studying the evolution of polarization and its correlates gives important insight into the prevailing state of cohesion and or diversity in the society. Proponents of polarization believe that social conflict is more probable in polarized (or heterogeneous) societies because people feel less alike and less identified with each other. Therefore, patterns of polarization give important clues to social unrest and the possible directions of social policy. This chapter explores the patterns and evolution of social polarization in post-Apartheid South Africa.

Although much can be learned from the nascent literature on polarization, its focus is largely on income polarization. That is, individuals identify with those belonging to the same income group, and are alienated from those belonging to other income groups (Esteban & Ray, 1994). However, income may not be the only relevant (or even be a relevant) dimension of an individual's sense of identity and alienation (Permanyer & D'ambrosio, 2015). An individual's identity is influenced by exogenously given social factors like race, ethnicity, or religion. Similarly alienation (between- and within-groups) can be measured by any indicator of well-being. This conceptualization is known as *social polarization*. Social polarization therefore captures the formation of and gaps between social groups in a population.

Most studies agree that identification is generally defined by social characteristics of the individual. The measurement of alienation has, however, been viewed from different perspectives. From one perspective, the distance between individuals is constant,

implying that alienation levels are the same no matter which factors one uses to partition the population. This perspective is known as *pure social polarization* and is usually measured along ethnic lines (ethnicity broadly defined to include religion, race, and language) (see Esteban and Ray (2011); Montalvo and Reynal-Querol (2005c)). On the other hand, the distance between individuals is captured by any cardinal or ordinal measure of well-being. The empirical literature on this second perspective, known as *hybrid or socio-economic polarization,* lags behind theory though. To the best of our knowledge, only a handful of papers attempt to offer information about socio-economic polarization (Duclos et al., 2004; Fusco & Silber, 2014; Gradín, 2000; Permanyer, 2012; Zhang & Kanbur, 2001). Besides the few studies that offer an illustration of the proposed indicators of socio-economic polarization, it is generally difficult to measure it. One reason for this is the absence of requisite data for operationalizing the proposed measures. This is particularly true for developing countries. Another key factor is the lack of appropriate methods to effectively measure social distances between groups. The present chapter therefore contributes to the literature by providing new and detailed information about the evolution of social polarization patterns in South Africa.

Since the end of Apartheid in the early 1990s, South Africa has undertaken a number of socio-economic reforms designed to accelerate economic and social integration. There is, however, a lingering perception that these initiatives are yet to have a strong mark on the extent of social cohesion in the country. Anecdotal evidence suggests low and declining levels of social cohesion in the country in recent times. Social cohesion is highly correlated with social polarization because social polarization weakens the commonality of values and commitments among people, thereby affecting their capacity to pursue collective goals (Esteban & Schneider, 2008). Therefore, the development of measures of social polarization can be useful from a policy perspective, by providing evidence for a comprehensive analysis of social cohesion in the country. Apart from that, because of the history of Apartheid, people may still form coalitions based on race to secure their interests. For instance, data from the South African Social Attitudes Survey 2003-2012 shows that at least three in five South Africans believe that different racial groups will never trust or like each other (see Figure 4.7.3). These perceptions of mistrust and dislike warrant an investigation of convergence of social distances between racial groups in post-Apartheid South Africa. Findings from this research will deepen our understanding of this phenomena. Finally, using inter-race and intra-race relations to measure alienation may provide a new perspective on the gains achieved in inter-race relations in the country.

We expect to find results that are specific to South Africa, for two reasons. First, social

identities, or factors that distinguish one group from another, tend to be context specific. For instance, caste is usually specific to India and "Hukou" is specific to China. In this chapter, we use race or racial classifications from the Apartheid system. Though race is usually replaced by ethnicity, in South Africa race differences are the most pronounced. We need to use the racial classifications stemming from Apartheid in our analysis, to evaluate to what extent apartheid's damage has been undone (Posel, 2001). Moreover, the availability of relevant measures of well-being often dictates the measurement of alienation. Previous studies have used either health status or the degree of religiosity. Each one of the measures is bound to give different results concerning alienation. In this chapter, we use the degree to which an individual defends the interests of their racial group (that is, their degree of racial radicalism).

The research discussed in this chapter makes its first contribution to the literature by investigating the correlates of an indicator for distances between racial groups in the country. We argue that the greater the integration of Blacks into the mainstream economy, the lower the alienation between racial groups. We use data from the South African Social Attitudes Survey (SASAS) for the period 2003 - 2012, and aggregate data from six questions using Polychoric Principal Component Analysis to compute an index of the *degree of racial radicalism.* The degree of radicalism captures the strength with which the individual defends the interests of their racial group. Thus, alienation is indicated by the force with which a person defends his racial group's interests. We find that an individual's radicalism decreases with an increase in household wealth, education attainment and, to some extent, with working either full-time or part-time and with being relatively satisfied with life.

This chapter makes a further contribution to the literature by tracking trends in social polarization using an index of Permanyer (2012). Having established a decline in income polarization (see chapter 2), we assess how social polarization compares. We use the distributions of the degree of racial radicalism to show that social polarization declines from 2003 to 2012. Specifically, the results reveal a decline in between-group polarization and a rise in within-group polarization. This implies that, as racial groups become more alike in terms of social characteristics (that is, their distributions of the degree of radicalism converge), they also become internally more heterogeneous (that is, the disparity in the degree of radicalism within racial groups increases). This finding supports the results in the previous chapters which show that between-race income inequality and income polarization have declined, while within-race differences have increased.

The rest of the chapter is organized as follows: Section 4.2 discusses the social po-

larization literature, including the Reynal-Querol (2002), Permanyer (2012) and Permanyer and D'ambrosio (2015) indices of social polarization. Section 4.3 describes the SASAS datasets, and explains the calculation of the degree of radicalism. Section 4.4 discusses summary statistics of key variables and the determinants of the degree of racial radicalism. The polarization results appear in section 4.5, while section 4.6 provides a summary and conclusion.

4.2 Social Polarization: Theory and Evidence

Duclos and Taptue (2015) list five different types of polarization, namely: multi-polar income polarization, income bi-polarization, social polarization, socio-economic polarization, and multi-dimensional polarization. To measure the first two types, they partition society into groups (identification), measure the distances between these groups (i.e., alienation) by income or any other cardinal indicator of well-being (Fusco & Silber, 2014). Group membership (internal homogeneity) and distances across individuals (external heterogeneity) under multi-dimensional polarization are influenced by a set of social and economic characteristics or multivariate distances (Duclos & Taptue, 2015; Gigliarano & Mosler, 2009). Similar to multi-polar income polarization, a statistical examination of social polarization involves identifying the appearance of poles in a population distribution. However, in the case of social polarization, the population is categorised into social groups, which form the poles, and the distance between the groups is measured by some measure of well-being. In this section, we briefly review the literature on the concept of social polarization. There are two strands within the social polarization literature; namely studies on *pure social polarization* and *hybrid or socio-economic polarization*. We review both types of studies and highlight some of the notable research in each. For more on the subject, Chakravarty (2015); Duclos and Taptue (2015) provide a detailed review of social polarization measures.

In these two types of social polarization, alienation and identification are driven by social factors. That is, people are clustered into groups according to social characteristics. The groups are internally homogeneous but different from each other. The implication is that people feel alienated from others who do not share their social characteristics. In this case, identification deals with qualitative and non-cardinal variables and does not depend on the distribution of income. Examples of characteristics that may nourish identity include religion, race, ethnicity, language, gender, education, occupation, and political opinion. Alienation, on the other hand, captures the perception of differences and distance among members of the different social groups. Alienation is thus

the cause of distinction between these two. These two types of social polarization are related to the emergence or sharper definition of social groups in a society.

4.2.1 Measurement of Social Polarization

4.2.1.1 Reynal-Querol (2002) Index

Pure social polarization is concerned with the distribution of subgroup sizes and sets the distances between the subgroups to a constant. This means that, as the number of groups increase, the subgroups become weaker in terms of population share and social polarization is likely to decrease. According to Montalvo and Reynal-Querol (2005a) "what matters is not only how many groups there are but also if they view other groups as a potential threat for their interests. For a given number of groups, the threat is higher the larger the size of another group relative to the size of the reference group".

Reynal-Querol (2002) is among the first to develop an index of pure social polarization along religious and ethnic lines. This index, known as the RQ in the literature, modifies the income polarization index of Esteban and Ray (1994) by replacing the Euclidean distance/alienation function $d(y_i, y_j) = |y_i - y_j|$ with the discrete distance function $\delta(y_i, y_j) = 1$ if $i \neq j$, and $\delta(y_i, y_j) = 0$, otherwise. Thus, the index sets alienation between individuals of the same group to zero, whereas alienation between individuals belonging to different groups is set to unity. This means the feeling of animosity between members of any two groups is similar. If the population is split into n groups of sizes π_i $(i = 1, \ldots, n)$, then the RQ index can be given as follows:

$$\begin{aligned} RQ &= \sum_{i=1}^{n} \sum_{j \neq i}^{n} \pi_i^{1+\alpha} \pi_j \\ &= 1 - \sum_{i=1}^{n} (0.5 - \pi_i)^2 \pi_i / 0.25 \end{aligned} \tag{4.2.1}$$

with $\alpha \in (0, \infty)$. Montalvo and Reynal-Querol (2005a) use axioms and properties to show that $\alpha = 1$. From equation 4.2.1, it can be seen that the RQ index achieves its minimum value of zero if all individuals are concentrated in one group, and it takes its maximum value of unity when the population is split evenly into two groups. Therefore, this index measures how far a given population distribution is from a bi-modal distribution.

Despite the RQ index's disregard for distances between individuals and groups, as well as the differences in their economic status, it is widely used to examine the effects of ethnicity (broadly defined to include religious, racial and linguistic identities) on numerous social and economic outcomes like economic growth, conflict, trust, social cohesion, trade, public infrastructure, human capital accumulation and government transfers. In a seminal paper, Montalvo and Reynal-Querol (2005c) construct a religious polarization index and show that religious polarization has negative effects on development. Overall, ethnic polarization or ethnic diversity seems to be associated with the probability of civil wars.

With hybrid or socio-economic polarization, one set of social variables is used to partition the population into subgroups or define group identification. The same factors that may nourish identity may be used to partition the population. A second set of economic variables, or some other variable representing a standard of living, yields distances, that is, alienation between the groups (Duclos & Taptue, 2015; Fusco & Silber, 2014). This means splitting the population along, say, racial lines (as is the case in our study), and using the differences in any other indicator of well-being as the measure of alienation. Alienation or hostility between individuals can be due to differences in income (Duclos et al., 2004), religiosity or religious radicalism degree (Permanyer, 2012) or health status (Fusco & Silber, 2014; Permanyer & D'ambrosio, 2015).

Despite its intuitive appeal as a predictive variable, the empirical literature on hybrid or socio-economic polarization is still sparse. A number of studies (see, among others, Apouey (2007); Fusco and Silber (2014); Permanyer (2012); Permanyer and D'ambrosio (2015)), which propose summary measures of socio-economic polarization have also offered an empirical illustration of their indices. Zhang and Kanbur (2001) are among the first to quantify socio-economic polarization in China using the ratio of between-group inequality to within-group inequality of the generalized entropy indices. The presumption is that between-group inequality captures external heterogeneity while within-group equality captures internal homogeneity, such that increments in either increases polarization. Following a ground-breaking study by Allison and Foster (2004) which examines inequality using ordinal variables, Apouey (2007) proposes and axiomatizes a polarization measure that uses ordinal self-reported health status. She uses median health status as the reference point to develop a bi-polarization index which takes into account the distribution of self-reported health status. Like Zhang and Kanbur (2001), she concludes that polarization and inequality are empirically different.

4.2.1.2 Permanyer (2012) indices

Partly as a critique of and an improvement to the RQ index, Permanyer (2012) relies on identification-alienation behavioural framework to argue that any measure of social polarization must take into account role alienation. He develops two indices that use the extent to which individuals feel involved and identified with their identity group as a measure of alienation. This feeling of involvement with their group is referred to as *"radicalism degree"*, denoted by a non-negative real number, y. Duclos and Taptue (2015) explain radicalism as the strength with which a person compares himself with others in different groups. It can also fuel a person's sense of identity or difference within the same group. Radicalism is, thus, an indicator of the force with which a person defends the interests, identity, and objectives of their group (Duclos & Taptue, 2015) or their involvement when pursuing the interests of their racial group (Permanyer, 2012). Alienation increases monotonically with the sum of the radicalism felt by individuals of different groups, $(x+y)$. This implies that, given any two people from two distinctive groups, the greater their involvement in pursuing the interests of their group, the greater will be the animosity felt between these groups, and the greater the extent of social polarization, and the risk of social tension among them. Identification, on the other hand, can depend on the size of one's group and on the extent of radicalism felt by individuals within that group.

Using the identification-alienation behavioural framework, and the radicalism degree concept, Permanyer (2012) proposes two indices of social polarization. The first index assumes no within-group alienation, meaning the focus is only on between-group alienation. The second index incorporates between-group and within-group alienation. Looking first at the between-group polarization index, he postulates that identity depends on a group's size n_i, while alienation between any two groups with radicalism degrees x and y is defined by an increasing function of the sum $(x+y)$. The greater the force with which an individual defends their group's advantages, the greater the hostility between the groups. Therefore, for each group i, there is an unnormalised density f_i which indicates how radicalism is distributed within the group. Defining effective antagonism as the non-negative function $T(\iota,a)$, such that T is continuous, increasing in its second argument and $T(\iota,0) = T(0,\iota) = 0$, and assuming social polarization to be proportional to the sum of all effective antagonisms, then we have:

$$Per = \sum_{i=1}^{n}\sum_{j\neq i}^{n}\int\int T(n_i, x+y)\, f_i(x)\, f_j(y)\, dydx \tag{4.2.2}$$

where f_i and f_j are the distributions of radicalism in groups i and j. Following the

axiomatic framework presented in Esteban and Ray (1994) and Duclos et al. (2004) (see appendix 4.7.1), the following axioms are imposed on the equation 4.2.2 to derive a more specific and estimable social polarization index.

Axiom 1: *A slide of the basic densities within a group increases social polarization.* Assume a given sub-group is subdivided into two sub-groups, where the populous sub-group is less radicalised, and the smaller subgroup has more radicalism. All other things being equal, if the radicalism of these two subgroups is increased and decreased by the same amount, then within-group radicalism and social polarization increase.

Axiom 2: *A smaller group becoming less radical and a bigger group becoming more radical does not decrease social polarization.* This is the between-group axiom which says that, given two unequal groups, if the smaller group becomes less radical and the larger group becomes more radical, then social polarization should increase. This means that the index must give more emphasis to the transformations of the bigger group, such that the effect of the increase in the radicalism of the bigger group should be more than that of the reduction in the radicalism of the smaller group.

Axiom 3: *An equal movement of the population from a large group to two equally sized smaller groups, with the same normalised density, should not decrease social polarization*. This means that the equalisation of population sizes across groups with the same distribution of radicalism will generate more social polarization.

Permanyer (2012) shows a social polarization index of the form defined in equation 4.2.2 that satisfies these three axioms and is proportional to:

$$Per(\alpha) = \sum_{i=1}^{n} \sum_{j \neq i}^{n} \pi_i^{1+\alpha} \pi_j (\mu_i + \mu_j) \tag{4.2.3}$$

where $\alpha \in (0.71, 1)$. Similar to Esteban and Ray (1994) and Duclos et al. (2004), α is a polarization sensitivity parameter such that the larger the value of α, the greater the departure from inequality.

The previous index, equation 4.2.3, ignores within-group alienation. Alienation may exist within a group if the members of the group have different levels of radicalism. More radical members may alienate less radical members and vice-versa. Permanyer (2012) incorporates this by letting within-group alienation be measured by an increasing function of radicalism distance $|y-x|$, while, as before, between-group alienation is related to the sum $(y+x)$. In this setting, the social polarization index becomes:

$$
\begin{aligned}
Per &= \sum_{i=1}^{n} \int \int T(f_i(x_i), |x-y|) f_j(x) f_i(y) dy dx \\
&+ \sum_{i=1}^{n} \sum_{j \neq i}^{n} \int \int T(n_i, x+y) f_i(x) f_j(y) dy dx
\end{aligned} \tag{4.2.4}
$$

The first component is the contribution of within-group polarization and the second component is the contribution of between-group polarization. Invoking axioms similar to DER 2 and DER 3 (see Appendix A1) and a new axiom which says that population transfer across two identical groups should lower polarization, the index becomes:

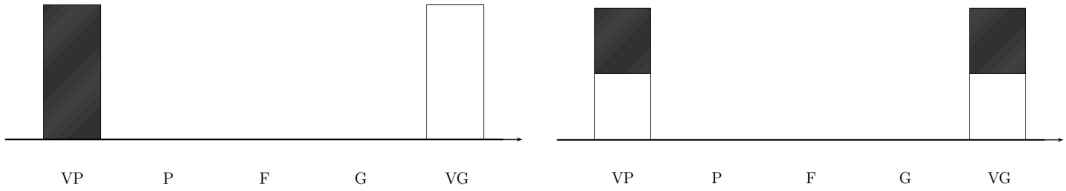
$$
Per = \underbrace{\sum_{i=1}^{n} \int \int f_i^{1+\alpha}(x) f_j(y) |x-y| dy dx}_{\text{Within-group polarization}} + \underbrace{\sum_{i=1}^{n} \sum_{i \neq j}^{n} \int \int f_i^{1+\alpha}(x) f_j(y) (x+y) dy dx}_{\text{Between-group polarization}} \tag{4.2.5}
$$

where $\alpha \in (0.5, 1)$. The first component represents the contribution of within - group polarization and the second component is the contribution of between- group polarization.

4.2.1.3 Permanyer and D'Ambrosio (2013) Index

Based on the same identification-alienation framework, but using a variable defined on an ordinal scale, Permanyer and D'ambrosio (2015) develop two indices that take into account the extent to which different groups are clustered around privileged or unprivileged regions of an ordinal variable. To illustrate their contribution, consider a population divided into two racial groups (say Black and White) with five self-reported health status categories: Very Poor, Poor, Fair/Neutral, Good and Very Good. Figure 4.2.2a presents a situation where all Blacks (represented by Dark rectangles) have Very Poor health and all Whites (the white rectangles) have Very Good health. This should exhibit more tension and more polarization than the situation in Figure 4.2.2b, where neither Blacks nor Whites are privileged. In the traditional social and income polarization settings, the situation in these two figures leads to the same degree of polarization.

Figure 4.2.1: A hypothetical distribution of self-reported health status in two groups (Blacks and Whites).



(a) (b)

Notes: This figure presents a hypothetical distribution of self-reported health in two different groups (Blacks and Whites). The initials stand for: Very Poor (VP), Poor (P), Fair (F), Good (G) and Very Good (VG).

Under this setting, identification is still a function of group sizes (n_i), while between-group alienation is captured by an overlap coefficient (θ_{ij}) between groups i and j. The greater the extent of overlap between groups, the more similar the groups, and the smaller the alienation between them (Permanyer & D'ambrosio, 2015). Following Duclos and Taptue (2015), the overlap coefficient (θ_{ij}) between groups i and j of an ordinal variable with C categories, where $\pi_i(y_c)$ is the population share of group i with health status equal to y_c, can be written as

$$\theta_{ij} = \sum_{i}^{C} min\left\{\pi_i(y_c),\ \pi_j(y_c)\right\} \tag{4.2.6}$$

where $0 \leq \theta_{ij} \geq 1$ such that $\theta_{ij} = 1$ when the groups are disjoint and $\theta_{ij} = 1$ when groups perfectly overlap. Alienation is thus defined as $1 - \theta_{ij}$, such that it is one when groups are completely distinct and zero in the case of perfectly overlapping groups.

The overlap coefficient assumes that the alienation between groups is symmetric ($\theta_{ij} = \theta_{ji}$). However, we might expect alienation between groups to be different, depending on their representation in the different categories of the ordinal variable. (Permanyer & D'ambrosio, 2015) define asymmetric alienation between group i and j as a function of the following coefficient:

$$A_{ij} = \frac{\sum_{s=1}^{Ni}\sum_{t=1}^{Nj}\delta_{st}}{N_i N_j} \tag{4.2.7}$$

where δ_{st} equals 1 if individual $'s'$ from group i is ranked below individual $'t'$ from group j and 0 otherwise. A_{ij} is an asymmetric function ($A_{ij} \neq A_{ji}$) which measures

the extent to which group i is underprivileged with respect to group j. For instance, when $A_{ij} = 1$, all of the members of group i are ranked below any member of group j with respect to health status, and alienation is maximized. Alternatively, when $A_{ij} = 0$ then no member of group i is ranked below any member of group j, and this refers to minimal alienation. When there is absolutely no overlap between groups i, j, then $A_{ij} + A_{ji} = 1$, and if some members of group i and j belong to the same health category then $A_{ij} + A_{ji} < 1$.

Following the identification-alienation framework, and imposing axioms similar to those in Duclos et al. (2004) (see Appendix 4.7.1) but adapted to the socio-economic setting with multiple groups, the indices Permanyer and D'ambrosio (2015) can be given as;

in the case of symmetric alienation:

$$PD_S = \sum_{i=1}^{n} \sum_{j \neq i}^{n} \pi_i^{1+\alpha} \pi_j (1 + \theta_{ij}) \tag{4.2.8}$$

and in the case of asymmetric alienation:

$$PD_A = \sum_{i=1}^{n} \sum_{j \neq i}^{n} \pi_i^{1+\alpha} \pi_j A_{ij} \tag{4.2.9}$$

where the degree of polarization sensitivity lies within $[\alpha = 0.71, 1]$. These indices (PD_s and PD_A) are multiplied by 4 and $\frac{27}{4}$ so that they take values between $[0, 1]$

In their empirical illustration, Permanyer and D'ambrosio (2015) use ethnicity as the partitioning variable and ordinal self-reported health data from Chile in 2008/2009, to show that polarization and inequality result in substantially different rankings.

Fusco and Silber (2014) extend the work of Permanyer and D'ambrosio (2015) by proposing two other measures of the degree of social polarization of an ordinal variable. Their first index, which is borrowed from the measurement of segregation, examines the degree of non-overlapping of distributions of the ordinal variable. The second measure, which is borrowed from the equality of opportunity literature, emphasises bi-polarization and considers that social polarization will be maximal if individuals belonging to one group are clustered in either the lowest or the highest ordinal status.

Partitioning by immigrant status and using self-reported health information, they find different patterns of social polarization across the European Union.

Taken together, these studies on pure social polarization and hybrid social polarization can be grouped into two categories. The first category, which appears to be common in the pure social polarization literature, attempts to evidence the deleterious effects of social polarization on economic outcomes. The second category, which is common in the hybrid or socio-economic polarization literature provides information on social polarization in comparison to inequality. These studies concur on the negative effects of social polarization, and similar to income polarization studies, they also confirm the empirical difference between polarization and inequality. In this chapter, we follow the hybrid or socio-economic literature to investigate the evolution of social polarization in South Africa.

Studies in the socio-economic literature use different factors to partition the population. The choice of which social identities to use is rarely obvious, even in divided societies such as South Africa. This is because identities are fluid and often are politically constructed. Thus one has to ensure the chosen identities reflect the distinctive groups in the society. The second choice is the indicator used to measure the difference between individuals or groups. That is, there has to be a clear interaction between the chosen indicator and group identities which is influenced by socio economic characteristics. These are likely to limit the generalisability of the studies in this literature. In this study, we use racial groups to partition the population and measure alienation by racial radicalism degree, which is the extent to which one defends the interests of one's racial group. We expect to find results that are specific to South Africa.

4.3 Data and Description of variables

4.3.1 Data

The paper uses data sourced from the South African Social Attitudes Survey (SASAS) for each year over the period 2003 - 2012. The SASAS consists of repeated cross-sectional surveys administered annually since 2003 by the Human Sciences Research Council (HSRC). Each round of SASAS is designed to yield a nationally representative sample of adults aged 16 and older living in private residences. The survey normally has two or three questionnaires which are administered concurrently. The first questionnaire collects data on individuals and core modules, and is administered to about

7000 respondents for the years 2003 - 2006 and to 3500 respondents thereafter. The second (and third in some years) questionnaire includes rotating modules directed at measuring a range of policy concerns at a specific time and is administered to a sample of approximately 3500 respondents. We use data from the first questionnaire except for 2005 and 2006, where the second questionnaire had more relevant information.

Each round of SASAS uses a two-stage stratified sampling method. In the first stage, a sub-sample of 500 primary sampling units (PSUs) is drawn from the HSRC's Master Sample of PSUs. These PSUs are drawn with probability proportional to size from a sampling frame that is updated annually to coincide with Statistics South Africa's (StatsSA) mid-year population estimates. The population is divided into three explicit strata, namely province, geographic type (rural/urban/tribal), and majority population group. Within each stratum, the allocated number of PSUs are drawn using probability proportional to size sampling with the number of dwelling units as the measure of size. In each PSU selected, 21 or 14 dwelling units or visiting points are selected as secondary sampling units (SSUs). The SSUs are then systematically grouped into two or three sub-samples for each SASAS questionnaire used. The PSUs in the Northern Cape and other provinces like KwaZulu Natal are over-sampled to ensure representativeness of some population groups like Indians/Asians.

Owing to these sampling fluctuations and other non-coverage biases, the design weights (inverse selection probability weights) are adjusted to the most recent population totals from StatsSA. As the benchmark or control variables when adjusting the weights, SASAS uses province, gender, population group (or race), and 5-year age group. One issue with these sampling weights is that they do not consider temporal consistency. Their main focus is on producing best estimates of the population, given the information available at the time. This is usually because the auxiliary data (StatsSA's mid-year population projections) are inconsistent as a series over time (Branson & Wittenberg, 2014). It is therefore imperative to improve the provided weights by further calibrating them to the recent (2015) StatsSA mid-year population projections.

The identification component of social polarization indicators relies heavily on population weights of the racial groups. We therefore needed to calibrate the sampling weights to improve the representativeness of each sample point and provide marginal totals (or subpopulation shares) that are somewhat consistent as a time series. The reason behind calibration is because StatsSA revises its mid-year population projections annually to reflect the true structure of the population, thus we wanted to use this new series as the benchmark.

We apply an iterative proportional fitting known as *raking* to calibrate the weights (see Battaglia, Hoaglin and Frankel (2013), Wittenberg (2010) and Kolenikov et al. (2014) for details on raking). The *raking* is done in two stages. The first calibration is done before the Polychoric Principal Component Analysis (*PPCA*), an approach we use to compute the index of *the degree of racial radicalism*. This is so that we can use the resulting new weights when calculating this index. The second stage of calibration is done after the *PPCA* approach. This is mainly because we dropped all observations with missing values for the *radicalism* index, and this resulted in an underestimation and overestimation of populations and racial group shares in some years. It is, however, vital to note that the calibrated weights are only as good as the auxiliary data used (Branson & Wittenberg, 2014). For details about calibrating the sampling weights, see section 4.7.2 in the appendix.

4.3.2 Description of variables

The variable we use to measure social distance or alienation across racial groups is the *racial radicalism degree*. In this section, we elaborate on questions used, and the aggregation of the questions to compute the radicalism index.

4.3.2.1 The measure of radicalism

The conceptual definition of the degree of racial radicalism or "racism", is the interest that an individual shows in and their identification with their racial group. This group identification (or ingroup bias) can be viewed as "an awareness of similarity, ingroup identity, and shared fate with others who belong to the same category..." (Klandermans, 2014). According to group conflict theory, ingroup bias exists because of conflict of interests between groups that are competing for scarce resources (like land, jobs, etc). Social identity theory, on other hand, maintains that people may discriminate in favour of their group for psychological reasons than because of self-interest. Therefore, our concept of racial radicalism borrows from these two theories. In other words, the degree of radicalism is an indicator of the force with which a person defends the interests, identity, and objectives of their group (Duclos & Taptue, 2015) or their involvement when pursuing the interests of their racial group (Permanyer, 2012).

Radicalism is therefore operationalized by selecting and aggregating the following questions that represent trust among race groups, a sense of identity with others in

one's racial group, and those that are symbolic of the interests of the race groups. To ensure that these questions are oriented in the same direction, we rescaled their categories such that larger values mean more radicalism. That is, we recode the categories from 1 to 10 such that 1 denotes the least amount of racial radicalism and 10 the most radicalism. For example, if there were only two possible responses, then the values were assigned 1 and 10 accordingly, if there were four possible ordinal responses, we assigned them the scores 1, 4, 7 and 10, and so on.

The six questions, which elicit the data we use, with their new codes in brackets, are listed below:

1. To what extent do you agree or disagree with the following statements? People of different racial groups do not really trust or like each other? 1.Strongly agree (10) 2.Agree (7.75) 3.Neither agree nor disagree (5.5) 4.Disagree (3.25) 5.Strongly disagree (1)

2. To what extent do you agree or disagree with the following statements? People of different racial groups will never really trust or like each other? 1.Strongly agree (10) 2.Agree (7.75) 3.Neither agree nor disagree (5.5) 4.Disagree (3.25) 5.Strongly disagree (1)

3. To what extent do you agree or disagree that government should... Redistribute land to black South Africans. 1.Strongly agree (10) 2.Agree (7.75) 3.Neither agree nor disagree (5.5) 4.Disagree (3.25) 5.Strongly disagree (1)

4. To what extent do you agree or disagree that there should be...? Racial quotas in national sports teams. 1.Strongly agree (10) 2.Agree (7.75) 3.Neither agree nor disagree (5.5) 4.Disagree (3.25) 5.Strongly disagree (1)

5. To what extent do you feel attached to the following types of people? Those who speak the same language as you? 1.Very attached (10) 2.Slightly attached (7) 3.Not very attached (4) 4.Not at all attached (1)

6. To what extent do you feel attached to the following types of people? Those who belong to the same race group as you? 1.Very attached (10) 2.Slightly attached (7) 3.Not very attached (4) 4.Not at all attached (1)

As a guiding principle when choosing these questions, we assumed a clear correspondence between the *radicalism degree* and the categories of these ordinal variables. That

is, people with higher degrees of radicalism are supposed to, on average, agree that people of different racial groups do not and will never really trust or like each other. They are also expected to feel attached to those who speak the same language and belong to the same race group, agree to land redistribution, and prefer racial quotas. A White individual, however, is coded 10 (i.e., assumed to have more racial radicalism) if he does not prefer land redistribution. Similarly, a Coloured individual who strongly disagrees with land redistribution is coded 10. The same reverse coding was used for the question (four) on racial quotas in sports. That is, White individuals who strongly disagree with racial quotas in sports, are coded 10. Coloured individuals who strongly disagree with racial quotas are also coded 10. In the robustness checks, we investigate further the effects of the reverse coding of White and Coloured individuals' responses. That is, we compute the index using data from only four questions, excluding these two questions on land redistribution and racial quotas.

It is, however, important to note that the operational radicalism degree, due to data limitations, may not adequately capture the degree of radicalism. Nevertheless, all the variables have a positive effect on *Cronbach's alpha* or *Scale variability coefficient,* which could signal validity of the operational radicalism degree measure[1]. Moreover, these variables provide data on aspects of racial tolerance in the country, and can therefore be used to explain some dimensions of social cohesion.

Another issue of concern is that some of the questions which we select to give us variables relevant for the operationalization of the degree of racial radicalism were rephrased or dropped from the survey rounds over the years. As a result, we had to omit potentially useful data from these questions to have consistent variables across the years. For survey years 2010 to 2012, the questionnaire also includes more questions on race relations. We combine the data from these extra sets of questions with the data from the six original questions to compute another index of the degree of racial radicalism. We then use the second racial radicalism degree distributions for years 2010 - 2012 to examine the robustness of the first distribution based on the original six variables. The extra set of questions are in Appendix 4.7.3.

Before combining the variables, we screen the data to get an overall idea of its quality and make the following restrictions: First, we restrict the sample to individuals who answered at least 75% of the six questions. This is to ensure that only respondents with enough data are included. Second, we drop all individuals without data on race, age,

[1] Initially, we had included eight variables matched across all the years, but questions on discrimination frequency and race relations were dropped due to their negative effect on the *Cronbach's alpha.* In the sensitivity analysis, we investigate the robustness of the findings to the inclusion of these variables.

gender, and self-reported health. The restriction on the non-missing values of the first three variables is to ensure that the raking (see section 4.7.2) runs without errors. The restriction on valid self-reported health status is to ensure similarity of samples for the two variables used to measure alienation. This restriction also ensures that the results from the two sets of Polarization indices are comparable.

We aggregate these variables into a single indicator of the degree of racial radicalism. To do this, we use a variant of Principal Component Analysis (PCA) known as *Polychoric PCA*. It is important to call to mind that PCA, which was popularised by Filmer and Pritchett (2001) in the development economics literature, is a multivariate statistical technique which orthogonally transforms a set of originally correlated variables into a new set of linearly uncorrelated variables called principal components. The principal components, which are a linear weighted combination of the original variables, are orthogonal because they are the eigenvectors of the symmetric covariance matrix. The first principal component has the largest proportion of the total variance, and each succeeding component has the maximal remaining variance.

The standard PCA works best with multivariate normal, continuous data (Kolenikov & Angeles, 2009). Cognizant of this, Filmer and Pritchett (2001) when constructing socio-economic indices, incorporate categorical variables into PCA by breaking them into a set of dummy variables. Kolenikov and Angeles (2009) show that the use of dummy ordinal variables, in general, tends to produce spurious correlations and lowers the proportion of explained variance. Therefore, in order to incorporate the categorical variables into PCA, Kolenikov and Angeles (2009) propose using *Polychoric PCA*. In *Polychoric PCA*, weights are obtained by estimating a Polychoric correlation matrix (see Appendix 4.7.4). Confirming this limitation of standard PCA, Wittenberg and Leibbrandt (2017) provide a convincing argument that the standard PCA tends to give negative scores for assets that are owned only (or mostly) in rural areas. That is, it gives information about the degree of urbanness in the data. Using an approach by A. K. Banerjee (2010) for dealing with multidimensional inequality, they propose using an *Uncentered PCA*. Under the *Uncentered PCA*, the weights are still given by the elements of an eigenvector of a cross-product matrix, but the variables are not demeaned, rather they are divided by their mean to form a matrix A. The non-negative square matrix $A'A$ is then used to construct the weights (Wittenberg & Leibbrandt, 2017).

Based on the limitations of the standard PCA, and recommendations for aggregating ordinal variables into a single index, we use the *Polychoric PCA* (Kolenikov & Angeles, 2009). To ensure that the computed radicalism degree is robust to different

aggregations, we also compute the index based on both *Uncentered PCA* and standard PCA. To ensure inter-temporal comparability of the indices, we pool all the years before running the *Polychoric PCA*. The 2006 index is, however, computed separately because two variables on the identity between racial groups are not available for this year. Given that 2006 has only four variables, results from this year are likely to be biased, and these have therefore been excluded from most of the analysis in the tables. Nevertheless, we compute the index using only four variables for the years to check how different the radicalism distributions would be if only four variables are used. Given the small proportion of the Indian race group in the population, we also check whether their inclusion affects the *PCA* results.

Table 4.7.2a provides the explained variance by the first three components from the Polychoric PCA[2]. The first component has an eigenvalue of 2.203 and accounts for 37% of the variance. There is an eigenvalue difference of 0.67 between the first and second component. Therefore, we retain the first Polychoric principal component (with the largest eigenvalue) as the measure of racial radicalism. We use the other two components (second and third) to assess the robustness of our results, given the small variation accounted for by the first component, 37%. The predicted values are rescaled to a $[0, 10]$ scale using the following normalisation formula: $10(x_{obs} - x_{min})/(x_{max} - x_{min})$. The predicted values from both the Polychoric PCA and Uncentered PCA are already non-negative, so there is no need to rescale them. Nevertheless, we rescale them for completeness and comparability with those from the Standard PCA which had negative values. While the normalisation preserves the order of the numbers, we also re-estimate the main regression using the original or untransformed values, to assess the robustness of the results. The normalised and the original predicted values are positively correlated with the ordinal variables (see Table 4.7.2b). This positive association means more radical individuals have high scores and less radical members have low scores.

Based on the above discussion, one can argue that racial radicalism is driven by, and leads to ingroup bias. In other words, those having a high degree of racial radicalism are "racist" or have "racist attitudes".

[2]The Polychoric correlation matrix is estimated in Stata using the Polychoric programme developed by Kolenikov and Angeles (2009), and Uncentered PCA is estimated using a Stata ado file developed by Martin Wittenberg.

4.4 Descriptive Statistics

Given the importance of racial radicalism in the measurement of social polarization, it is imperative to first examine its profile. Table 4.4.1 provides summary statistics of some individual characteristics across the years. Table 4.4.2 shows patterns of the degree of radicalism across some groups in the selected years.

The main findings, as seen from these tables, are that the degree of radicalism remains relatively constant at an average value of 7.29 over the study period. Although Blacks have higher average values (mean and median), they also have lower inequality (or coefficient of variation) in their degree of radicalism. Lastly, we find that individuals from more wealthy households and more educated people are less radical.

Starting with Table 4.4.1, which provides the summary statistics of individual characteristics, we note that general state of health, as captured by the mean self-reported health, remains relatively unchanged, whereas satisfaction with life increases slightly from 2004 to 2007, then drops between 2009 and 2011. Average years of schooling, which we derive from completed levels of education, appear to increase steadily until 2010. The increase in the education levels seems to be driven by a drop in the share of those with no education and an increase, though modest, in High school completion and Tertiary qualifications. It is important to note that higher levels of educational attainment may negatively affect the extent to which an individual feels involved and identified with their group (Glaeser, 2005), which may in turn lead to lower levels of social polarization.

The Wealth indices show only a slight increase during the period 2005 to 2009, and then a slight fall in 2011. The wealth indices are calculated by Uncentered PCA (see Wittenberg and Leibbrandt (2017)) using household ownership or access to electricity or household goods. The limited wealth index excludes some household goods and whether the dwelling is formal. We expect higher wealth to be associated with lower levels of radicalism, and less social polarization. This hypothesis is based on the predictions of Akerlof and Kranton (2005), who postulate that, as their income rises, people tend to deviate from their identity category.

Looking at race relations, which is derived from responses to the question: *"South Africa used to have apartheid by law between white, black, coloured and Indian/Asian. Since 1994, do you think that race relations in the country have improved, remained the same, or deteriorated?"* We see that, for the entire period, almost 7 out of 10

Table 4.4.1: Summary Statistics, 2003 - 2012

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Black/Africa	0.771	0.763	0.760	0.757	0.761	0.761	0.758	0.759	0.772	0.778
Coloured	0.076	0.093	0.090	0.095	0.091	0.095	0.095	0.094	0.089	0.090
Indian/Asian	0.028	0.029	0.030	0.029	0.029	0.030	0.029	0.030	0.030	0.028
White	0.124	0.116	0.120	0.120	0.119	0.114	0.118	0.118	0.110	0.104
Self-Reported Health	3.69	3.69	3.72	3.66	3.63	3.63	3.62	3.76	3.78	3.88
Life satisfaction	.	2.91	3.15	3.20	3.26	3.08	3.24	2.75	2.65	2.83
Partnered	0.349	0.390	0.358	0.344	0.386	0.360	0.343	0.343	0.340	0.309
Female dummy	0.516	0.519	0.527	0.528	0.522	0.510	0.516	0.521	0.514	0.519
Age	36.20	36.80	36.95	36.80	36.91	36.69	36.59	37.07	37.17	36.92
Years of Schooling	9.22	9.33	9.43	9.57	9.66	9.86	10.11	10.12	9.90	9.74
No Education	0.067	0.051	0.053	0.046	0.043	0.046	0.039	0.030	0.039	0.026
Primary	0.163	0.184	0.180	0.156	0.154	0.141	0.145	0.139	0.147	0.184
High School	0.671	0.676	0.661	0.702	0.709	0.709	0.681	0.718	0.715	0.675
Tertiary	0.099	0.089	0.106	0.097	0.094	0.104	0.135	0.113	0.099	0.115
Wealth Index (limited)	3.03	3.10	2.93	3.15	3.28	3.39	3.53	3.53	3.29	3.42
Wealth index			3.08	3.34	3.30	3.55	3.73	3.61	3.29	3.19
Employed	0.339	0.340	0.288	0.327	0.423	0.344	0.344	0.331	0.324	0.302
Household size	4.69	4.98	5.02	5.08	5.09	5.15	5.04	4.95	4.89	4.96
Household size 16+	3.42	3.61	3.53	3.65	3.72	3.78	3.82	3.71	3.73	3.61
Race relations										
Improved	0.561	0.765	0.717	0.668	0.691	0.648	0.680	0.737	0.645	0.712
Stayed the same	0.305	0.163	0.182	0.217	0.195	0.234	0.243	0.186	0.226	0.179
Got worse	0.134	0.072	0.101	0.115	0.113	0.118	0.077	0.077	0.129	0.109
Radicalism degree										
Mean	7.59	7.28	7.33	.	7.46	7.23	7.22	7.09	7.11	7.33
Median	7.72	7.33	7.41	.	7.72	7.33	7.30	7.18	7.32	7.67
Standard Deviation	1.513	1.528	1.576	.	1.523	1.545	1.543	1.556	1.531	1.490
Coefficient of variation	0.199	0.210	0.215	.	0.204	0.214	0.214	0.220	0.215	0.203

Notes: Self-reported health status and life satisfaction are reported on a five-point ordered scale where 1 means very poor and very dissatisfied and 5 means excellent and very satisfied. Life satisfaction variables for 2011 and 2012 were transformed from a 10-point scale into a five-point scale to make them comparable with the other years. Partnered is a dummy variable for living with a partner, whether married or not. No education is a dummy variable for those with zero years of schooling, Primary for those with between 1 to 7 years, High school those with 8 to 12 years and Tertiary with more than 12 years of education. The wealth index is calculated using Uncentered PCA (Wittenberg & Leibbrandt, 2017) from household ownership or access to things like (piped water, flush-toilet, landline, computer, fridge/freezer, vacuum cleaner, television, Hi-fi/VCR/DVD, radio, microwave, washing machine, and electricity. The limited wealth index does not include the household owning the following; electric stove, dishwasher, tumble dryer, motor car and whether the dwelling is formal. Employed is a dummy for those with any type of employment, either full-time or part-time. Radicalism is the first Polychoric principal component calculated from the six ordinal variables. The index is normalised using the following formula: $10(x_{obs} - x_{min})/(x_{max} - x_{min})$. Higher values of the index indicate a greater degree of radicalism.

Source: Own calculations using weighted SASAS datasets from 2003 to 2012.

respondents think inter-race relations have improved, and only one in ten thinks they have become worse. This improvement in perceptions about inter-race relations suggests declining social distance between racial groups. The average and median degrees of radicalism show some interesting patterns. For example, from 2007 to 2012, they decrease by an amount equivalent to 4.96% and 6.99%, then increase thereafter by about 3.39 and 6.82, respectively. Social polarization or effective antagonism in the Permanyer (2012) index is an increasing function of both population share (identification) and radicalism degree distribution (alienation), and identification has fallen over the study period. We therefore expect social polarization trends to mimic the radicalism degree patterns. That is, a spike in 2007, a decline until 2010 and then an increase in 2011 and 2012.

Table 4.4.2: Racial Radicalism degrees for South Africa, 2003, 2008 and 2012

Race	2003			2008			2012		
	Mean	Median	C.V	Mean	Median	C.V	Mean	Median	C.V
African/Black	7.99	8.09	0.159	7.54	7.72	0.193	7.64	7.83	0.169
Coloured	6.35	6.49	0.248	6.58	6.56	0.222	6.75	6.87	0.239
Indian/Asian	6.81	6.93	0.182	6.75	6.93	0.194	6.4	6.38	0.23
White	6.07	6.2	0.237	5.88	5.79	0.223	5.74	5.79	0.266
Education									
No Education	7.95	7.81	0.152	7.95	8.46	0.161	7.38	7.72	0.167
Primary	7.86	8.05	0.166	7.57	7.72	0.201	7.53	7.72	0.188
High School	7.58	7.72	0.204	7.22	7.32	0.209	7.37	7.69	0.199
Tertiary	6.93	7.09	0.230	6.54	6.56	0.253	6.66	6.70	0.239
Wealth Quantiles									
1	7.93	7.83	0.169	7.58	7.72	0.198	7.80	7.86	0.160
2	7.76	7.72	0.179	7.47	7.70	0.192	7.42	7.70	0.185
3	6.68	6.68	0.238	6.58	6.59	0.224	6.82	6.93	0.246

Notes: Summary statistics of the first Polychoric principal component from the six ordinal variables. The index is normalised using the following formula: $10(x_{obs} - x_{min})/(x_{max} - x_{min})$. Higher values of the index suggest a higher degree of radicalism. C.V is the coefficient of variation, which I use an indicator of radicalism degree inequality.
Source: Own calculations using weighted SASAS datasets from 2003 to 2012.

Table 4.4.2 provides more information about the patterns of racial radicalism by race, education, and wealth quantile group in 2003, 2008, and 2012. Blacks show more racial radicalism while Whites have greater radicalism degree inequality (as measured by the coefficient of variation). In other words, the strength with which Blacks identify with their group, and the extent to which they defend the interest of their group is greater and has less variation. Whites have more variation in their "degree of involvement" with their race group. Coloureds' degree of racial radicalism falls midway between that of Blacks and Whites.

As we expected and consistent with the predictions of Glaeser (2005), we see that those with more education attainment are situated at the lower end of the racial radicalism degree distribution. That is, if we define racial radicalism as hate against other races

which depends on misinformation, then access to more information through education should reduce the extent of radicalism. Table 4.4.2 further shows that individuals in relatively wealthy households have lower degrees of radicalism. This is also not surprising given Akerlof and Kranton (2005)'s predictions in the extended Economics of Identity model. They show that income and identity are substitutes, such that higher income can lead to deviations from the behavioural prescriptions of the social category. That is, if they accept that behaviour within the Black racial group is defending the interest of Blacks, then as income or household wealth rises, we are likely to see a deviation from that behaviour.

In conclusion, these average statistics suggest that an individual's degree of racial radicalism is correlated with race, wealth quantiles, and education. The next step is therefore to use these racial radicalism distributions to spell out the extent of social polarization in the country. Given the above results and the fact that the racial radicalism index is pivotal in the social polarization indices, we further investigate the association between the degree of racial radicalism and a number of key variables through a series of regressions. The objective of these regressions is not to provide an exhaustive analysis of racial radicalism, but rather to gain an insight into potential drivers of racial radicalism.

4.4.1 Determinants of Radicalism

To get a clear picture of the correlates of racial radicalism, we regress the individual degree of radicalism on race and other individual characteristics. The main purpose of these regressions is to ascertain the importance of race. Thus, the aim is not to provide a robust account of the causal effects of radicalism. Rather, it is to highlight some of the potential correlates of radicalism. These regressions may also serve as a backdrop for further understanding of racial tolerance and racist attitudes in the country. We follow approaches by Mocan and Raschke (2014) and Dima and Dima (2016) and estimate a pooled regressions of the following form:

$$R_{it} = \beta_0 + \beta_1 Race_i + \beta_2 X_{it} + \lambda_t + \varepsilon_{it} \tag{4.4.1}$$

where R_{it} represents the radicalism of individual i at year t, $Race$ includes racial dummies with Black as the reference category, and X_{it} includes other controls, like education, age, wealth, employment, life satisfaction, gender, and having a partner. We ex-

clude household income brackets from all the regressions because this variable might be endogenous to racist attitudes (Mocan & Raschke, 2014).

Table 4.4.3 presents the results from the estimation of equation 4.4.1. Column 1 presents the OLS results, Column 2 presents the Logit results with the median as the cut-off point, and columns 3, 4 and 5 report the unconditional quantile effects estimated by Recentered Influence Function (RIF) regressions (see Firpo, Fortin and Lemieux (2007)). All specifications include province-year fixed effects, to account for the fact that we pool datasets from different years and racist attitudes, or that radicalism degrees may be similar for people from the same province. The latter two models (Logit and RIF) are meant to lend force to the findings from the OLS model.

Looking at the OLS results, we note significant effects of race, education, life satisfaction, wealth quantile, and employment on the degree of radicalism. For instance, relative to Blacks, Whites have about 1.51 lower levels of average radicalism. All the race effects are significant at one percent (1%). In line with the literature, we also find that those with no education exhibit, on average, more radicalism. One way to look at these monotonic education effects is to assume that, all things being equal, those with no education suddenly have either primary or high school education or tertiary education. If this occurred, then their average degree of radicalism would fall by 0.17, 0.19, and 0.23, respectively. The education effects are statistically significant at five percent (5%) for both primary and high school and at one percent (1%) for tertiary education. The education effects are consistent with Mocan and Raschke (2014) who report that more educated Germans have weaker xenophobic, anti-semitic and racist feelings. But this could also mean that more educated individuals are, on average, better at hiding their feelings (Glaeser, 2005). It is important to note that education is only significant in the regressions that do not include household income quantiles, which could mean the findings are picking up the income effects. This could be the reason for income being correlated with the degree of radicalism.

Given the general findings in the literature that life satisfaction increases with income, up to a certain point at least (Kahneman & Deaton, 2010), it should also be true that perceptions of personal economic conditions are positively correlated with self-reported life satisfaction. We use the "very satisfied" category as the reference group in our regressions. We find that those who are satisfied with or neutral about their life are, on average, less radical. However, the average degree of radicalism of those who report being either dissatisfied and very dissatisfied with life is not statistically different from the radicalism of those who are very satisfied with life. In line with studies that use perceptions of personal economic circumstances as a predictor of racist at-

titudes, we include a self-reported life satisfaction variable as a proxy for economic circumstances. If satisfaction with life is indeed a good proxy for perceptions of personal economic conditions, we see that those who are not satisfied with their personal economic conditions are as "racist" as those who are very satisfied. The average degree of radicalism is less for people in mid to high wealth quantiles, compared to that of people in the lower quantiles. These wealth effects are monotonic and stronger in statistical significance. That is, compared to those in poorer households (the reference category), people in rich households have lower average degrees of radicalism, and the effect decreases as wealth increases. A possible explanation for this result is that greater wealth can allow some mobility (e.g migrating to more heterogeneous communities) which in turn can foster interaction with people from different racial groups. This finding supports that of Mocan and Raschke (2014) who find that an improvement in an individual's economic well-being tends to mitigate prejudiced feelings.

Age, as a continuous variable, has no impact on the degree to which individuals defend the interests of their racial group. To investigate the age effects further, we re-estimate all regressions by including age dummies for 10-year age intervals, with the group aged 16-24 as the reference category. We find that all the point estimates are positive, and this increases with age. The results are Table 4.7.6 in the Appendix. However, only coefficients for age groups 24 -35 and 75 and older are statistically significant. This suggests that youths and older people, on average, have stronger racist attitudes in comparison to those aged 16-24. We pool together data from various years between 2003 and 2012, and those aged 50 and above would have experienced the apartheid regime. The point estimates for the older group are therefore in line with expectations. These findings are consistent with results from Mocan and Raschke (2016), who report that people who grew up in Nazi Germany are more racist, anti-semitic, and xenophobic.

Having either full-time or part-time employment lowers one's average degree of radicalism, in comparison to those who are not working. An obvious explanation is a competition for resources, in which the unemployed feel they are competing with people from different groups. Another possible explanation for this could be increased contact in the workplace with people from different identity categories, which could reduce any racist feelings (Glaeser, 2005). Having a partner, and being female, have no influence on racial radicalism.

Column 2 presents the results where the dependent variable measures whether the respondent is radical or not. The dependent variable is 1 if the respondent's degree of radicalism is greater than the median degree of radicalism of the pooled sample, and

zero otherwise. We see that race, education, life satisfaction, and wealth tell the same story as in the OLS model. That is, more educated people have a reduced propensity for radicalism, relative to those without education. Those who are neutral about their life satisfaction and those who are satisfied with life have lower average degrees of radicalism than those who are dissatisfied. The average degree of radicalism is no different from the OLS results for those in the middle wealth category, while it is less for those in the high wealth category. The other explanatory variables like age, gender, and marital status are similar to OLS, are not statistically significant. Only the magnitudes of the coefficients change slightly in the Logit model, while the sign and significance of the coefficients remain unchanged. We therefore conclude that the Logit results validate the OLS results.

Column 3 to 5 present the results of the unconditional quantile regressions. The effect of covariates differs across the radicalism distribution, and therefore, compared, to the conditional quantile regressions, it is easier to interpret the estimated coefficients with the RIF regressions (see Fortin et al. (2011b); Porter (2015) for a detailed account of the benefits of RIF regressions). The dependent variable is the RIF which is defined[3] as

$$RIF\left(R;\, q_\tau, F_R\right) = q_\tau + \frac{\tau - 1\left\{R \leq q_\tau\right\}}{f_y\left(q_\tau\right)} \tag{4.4.2}$$

where τ indicates a specific quantile (say the 25th, or 0.25), q_τ is the value of the dependent variable, radicalism degree, R, at that specific quantile. F_R is the cumulative distribution function of R , and $f_y(q_\tau)$ is the density of R at q_τ. The indicator function, $1\left\{R \leq q_\tau\right\}$, identifies whether the value of the radicalism degree, R , for the individual is below q_τ.

For example, consider the 75^{th} quantile $(\tau = 0.75)$, the RIF for this quantile is obtained by first estimating the value of the radicalism degree at the 75^{th} quantile. Then estimating the kernel density at the 75^{th} quantile $f_y(q_{0.75})$, and then generating a dummy variable $1\left\{R \leq q_{0.75}\right\}$ which indicates whether the value of the radicalism degree is at or below the value of the radicalism degree at the 75^{th} quantile. Thus, the resulting RIF is a dummy variable with value $q_{0.75} + \left\{{}^{0.75}/_{f_y(q_{0.75})}\right\}$ for those above the 75^{th} quantile and the values $q_{0.75} - \left\{{}^{0.25}/_{f_y(q_{0.75})}\right\}$ for those at or below the 75^{th} quantile. Once the RIF has been calculated for each individual, it becomes our dependent variable in the OLS model. The RIF- regressions for any quantile is therefore equivalent to running

[3]This RIF discussion follows Borgen (2016) and Porter (2015)

a linear probability model of the probability of the degree of racial radicalism degree exceeding that quantile on race and other explanatory variables (Fortin et al., 2011b).

Table 4.4.3: Determinants of Degree of Radicalism, pooled sample

VARIABLES	(1)	(2)	RIF regressions (3)	(4)	(5)
	OLS	Logit	Quantile_25	Quantile_50	Quantile_75
Coloured	-0.992***	-1.194***	-1.264***	-1.130***	-0.379***
	(0.0600)	(0.0851)	(0.0694)	(0.0530)	(0.0231)
Indian	-1.049***	-1.174***	-1.336***	-1.158***	-0.430***
	(0.0647)	(0.0941)	(0.0897)	(0.0677)	(0.0290)
White	-1.514***	-1.743***	-1.809***	-1.418***	-0.464***
	(0.0656)	(0.105)	(0.0895)	(0.0625)	(0.0264)
Primary	-0.166**	-0.348**	-0.166**	-0.165*	-0.0550
	(0.0796)	(0.141)	(0.0805)	(0.0948)	(0.0506)
High School	-0.187**	-0.365***	-0.127*	-0.161*	-0.0591
	(0.0758)	(0.136)	(0.0767)	(0.0908)	(0.0484)
Tertiary	-0.233***	-0.473***	-0.191	-0.280**	-0.113**
	(0.0887)	(0.157)	(0.118)	(0.112)	(0.0556)
Satisfied	-0.161**	-0.260**	-0.137**	-0.224***	-0.155***
	(0.0690)	(0.102)	(0.0697)	(0.0702)	(0.0372)
Neutral	-0.240***	-0.259**	-0.203***	-0.224***	-0.208***
	(0.0754)	(0.110)	(0.0738)	(0.0764)	(0.0401)
Dissatisfied	-0.0108	-0.0646	-0.0893	-0.142**	-0.126***
	(0.0670)	(0.0988)	(0.0655)	(0.0688)	(0.0369)
Very Dissatisfied	-0.0221	0.0377	-0.108	0.0871	-0.0901*
	(0.0913)	(0.137)	(0.0965)	(0.0911)	(0.0477)
Age	0.00191	0.00110	0.000156	0.00156	0.000566
	(0.00118)	(0.00193)	(0.00143)	(0.00137)	(0.000690)
Middle Wealth	-0.0949**	-0.0628	-0.0212	-0.0293	-0.0484*
	(0.0440)	(0.0668)	(0.0478)	(0.0506)	(0.0266)
High Wealth	-0.300***	-0.390***	-0.312***	-0.332***	-0.149***
	(0.0555)	(0.0801)	(0.0770)	(0.0679)	(0.0320)

Continued on next page:

Table 4.4.4: Continued from previous page

VARIABLES	(1)	(2)	RIF regressions (3)	(4)	(5)
	OLS	Logit	Quantile_25	Quantile_50	Quantile_75
Employed	-0.0914**	-0.0565	-0.0705	-0.0406	-0.0366*
	(0.0370)	(0.0564)	(0.0438)	(0.0415)	(0.0204)
Female	-0.0202	0.00411	0.0412	0.0138	-0.0213
	(0.0330)	(0.0523)	(0.0414)	(0.0396)	(0.0198)
Partnered	-0.0182	-0.0586	-0.0191	-0.0497	-0.00113
	(0.0366)	(0.0575)	(0.0440)	(0.0426)	(0.0212)
Constant	7.918***	1.156***	6.935***	8.071***	8.861***
	(0.108)	(0.182)	(0.114)	(0.122)	(0.0662)
Observations	14,815	14,815	19,308	19,308	19,308
R-squared	0.174		0.153	0.133	0.076

Notes: Dependent variable is the normalised first Polychoric principal component from the six ordinal variables. For the Logit model (column 2), the dependent variable is 1 if an individual's radicalism degree is higher than the pooled sample median and 0 otherwise. For the quantile regressions, the dependent variable is the RIF defined in equation 4.4.2. Black is the base category for racial groups while No education (those with zero years of schooling) is the reference category for the education category. Primary is those with from 1 to 7 years of schooling, High school those with 8 to 12 years of education and Tertiary those with more than 12 years of education. Wealth is the limited wealth index calculated using Uncentered PCA (Wittenberg & Leibbrandt, 2017) from household ownership or access to number of assets. Employed is a dummy for those with any type of employment, either full-time or part-time. Partnered is marital status indicator which is 1 if an individual has a partner. All regressions exclude 2006 because the data for this year does not have two of the ordinal variables. Linearised standard errors in parenthesis. ***, **, * are 1%, 5%, 10% significance levels.
Source: Own calculations from weighted SASAS datasets, 2003 - 2012.

One way of looking at the radicalism degree distribution is to think of it as showing the strength with which an individual safeguards the interests of his racial group. Those at the lower end of the distribution, say at or below $q_{0.25}$, are not overly involved in defending their racial group's interests, while those situated at the top end, say above or at $q_{0.75}$, are deeply involved or identified with their racial group. Similar to the logit results, we see that more educated people tend to exhibit less radicalism compared to those without education. However, at the lower end of the radicalism distribution, $q_{0.25}$, those with primary or high school education have lower levels of radicalism compared to those with no education. At the median or middle of the radicalism distribution, all education dummies are negative and significant at 10%, showing that the more educated have lower levels of radicalism. At the upper percentile, $q_{0.75}$, those with tertiary education are significantly less radical compared to those with no education. This is suggestive of limited education (primary and high school) being a predictor of low or moderate levels of radicalism or racist attitudes.

The same regularity of race effects emerges in all but the upper quantile, $q_{0.75}$. At

the top end, $q_{0.75}$, the point estimates have dropped considerably, compared with the low and middle percentile. For instance, for those at the lower end and middle of the distribution, the Black-White radicalism degree differential is about 1.8, and 1.4, which decreases to 0.46 in the 75th percentile. The same pattern is true for the Black-Coloured differential. To put these differentials into perspective, membership of a racial group does not necessarily lead to a higher degree of involvement in that group. Therefore, the decline of the Black-White differential as one move into or above the 75th percentile suggests that being Black does not guarantee that one will overly defend the interests of Blacks. Rather race is only relevant for lower degrees of racial radicalism. Put differently, the effect of race falls as the degree to which an individual identifies with his racial group rises. Interestingly, the wealth effect tends to decrease as we move from both low and middle percentiles to higher percentiles. This suggests that wealth is more relevant for people who are less radical.

Another noteworthy result is the effect of life satisfaction at the higher percentiles. As we can see, at the lower end of the radicalism distribution, people who are neutral or satisfied with life have significantly lower degrees of radicalism. Moving to the middle of the distribution, those who are dissatisfied with life also have lower degree of radicalism, compared to the very satisfied. At the top end of the radicalism distribution, those who are very dissatisfied with life also have a lower degrees of radicalism. This means that as we move upward along the radicalism distribution (i.e from less racist attitudes to more racist attitudes) dissatisfaction with life becomes relevant. That is, being very dissatisfied with life is a key factor for those who are deeply involved in defending the interests of their racial group. We can also see that being employed is significant at 10% at the top end of the distribution. Thus, if these working people suddenly become unemployed their radicalism distribution would shift to the left (in a negative direction), with a smaller and significant shift for those at the top end, compared to a much larger but insignificant shift for situates at the low end. The effects of other explanatory variables are consistent with both the OLS and logit results. That is, radicalism degree does not vary by age, gender, or marital status (having a partner).

To sum up, in this section we examine the profile and correlates of the degree of radicalism in South Africa. We find that the extent of racial radicalism varies with race, household wealth, level of education, employment status, and to some extent, life satisfaction. However, these variables only explain about 17% of the variation in the radicalism distribution. This could be because of omitted variable bias or the fact that the radicalism degree index does not effectively capture the extent to which people identify with and defend the interest of their racial groups.

Nevertheless, the results appear to be in support of previous studies on the determinants of racist attitudes and social tolerance (Dima & Dima, 2016; Mocan & Raschke, 2016). We also find that poorer people, the less educated and, to a large extent, youths and older people are more likely to have radical racist attitudes. These findings are somewhat consistent with the predictions of Glaeser (2005). In his model of supply of hate by politicians, Glaeser (2005) predicts that education and having contact with the hated groups reduces the costs of acquiring information about the hate-stories propagated by politicians. Therefore, racist attitudes should be mitigated with education and contact with members of other groups. The results are also consistent with Akerlof and Kranton (2005)'s extended model of economics of identity. In their model, income and individual identity are substitutes, meaning relatively wealthy people may deviate from the partisan behaviour of their group. The loss in utility due to this "decline in identity" is compensated for by higher income. In the current context, this suggests more wealthy people are less likely to be radical, while poorer households are likely have greater degrees of radicalism. One notable difference between our results and those of studies like that of Dima and Dima (2016) is that our racial radicalism scores (extent of racist attitudes) do not vary by gender.

4.4.1.1 Sensitivity analysis

In this section, we investigate the robustness of these findings to the different calculations of the degree of radicalism. Firstly, we use the first four ordinal variables to construct the radicalism degree. That is, we omit the last two questions (i.e., questions 5 and 6 on the attached to people of same race or speaking same language) because they were not available in 2006. Second, we use an extended list of 13 ordinal variables, but from only three years, 2010, 2011, and 2012, in the construction of our measure of radicalism. Third, we use the Uncentered PCA and the Standard PCA to calculate the extent of radicalism from the preferred list of 6 ordinal variables. Lastly, we the data from the two questions on land redistribution and racial quotas.

Table 4.7.3 on page 161 presents the OLS results from these sensitivity checks. Column 1 replicates the column 1 in Table 4.4.3 for ease of comparison. Column 2 presents results from the radicalism degree calculation on the first four ordinal variables. Columns 3 and 4 provide results from the three years, with information on the extended list of variables (see Appendix 4.7.3). Column 3 re-estimates the degree of radicalism based on the preferred six variables, to ensure comparability with Column 4 which shows our extended list of 13 variables. Column 5 and 6 show the use of the six variables to calculate the index of the degree of radicalism, but using the Uncentered PCA and

Standard PCA[4]. The last column provides results from the radicalism computed by omitting data on questions with reversed codes for White and Coloured individuals.

The main findings from these regressions are that the results presented in Table 4.7.3 are, by and large, qualitatively similar to the main findings. Therefore, we conclude that the wealth and race effects are somewhat robust to the different calculations of our index of the extent of radicalism.

Looking closely at the Table 4.7.3, the following issues emerge. There is slight increase in the differentials of radicalism across race groups when we use the first four ordinal variables (column 2). Furthermore, relative to those with no education, individuals with education still have a lower average degree of racism. The coefficients of the education dummies continue to fall, as the level of education increases. There is, however, no statistical difference in the average levels of radicalism between the reference category (those reported to be very satisfied with life) and those in the other categories of life satisfaction. Interestingly, being older appears to also positively affect radicalism. This is expected in South Africa, given that older people have experienced the apartheid regime. Those in the upper wealth quantile have lower mean levels of radicalism than those in the lower wealth quantile. This result reinforces earlier findings that an improvement in the economic condition compels people to be less racist. Lastly, we see that having a partner tends to lessen the degree of radicalism.

When we use the extended list of variables (columns 3 and 4), there is a sizeable drop in the race differentials. The Black-White differential falls by an amount equivalent to 70%, from 1.62 to 0.48, while the Black-Coloured differential falls by almost 76%, from 0.906 to 0.218. The other covariates keep the same qualitative effects as the main results. When we use Uncentered PCA and Standard PCA (columns5 and 6), we note that Uncentered PCA and Polychoric PCA results have similar qualitative and quantitative effects across all explanatory variables. The only difference is the positive and significant age effect in the Uncentered PCA results. The Standard PCA results, however, tell a slightly different story. That is, the education coefficients, although not significant, are all positive, which suggests that educated people are more radical. Lastly, in column 7, we examine the sensitivity of the results to omitting questions on land redistribution and racial quotas. The differences of radicalism across race groups declined, though they still keep the same sign. All the other variables remain somewhat unchanged.

[4]For both approaches, we also calculate the radicalism index using the dummy variables based on the original ordinal variables. The results, available upon request, are no different from ones reported in Table 4.4.3 columns 5 and 6.

Apart from the above, the choice of the first component as an indicator of radicalism might also be an issue. While the first component is the natural selection due to its larger eigenvalue, it only explains about 37% of the total variation. The three components, however, account for at least 81% of the total variation. In columns 2 and 3 of Table 4.7.4 in the Appendix, we record our re-estimation of the OLS regressions using the second and the third components. We further check for differences in the results if we use the original untransformed first component derived from the preferred six variables. Column 4 provides an answer to this statement by running the OLS regression with the dependent variable as the untransformed first component.

Despite the minor differences in the quantitative effects of education dummies in the Standard PCA results, we find that the results presented in Tables 4.7.3 and 4.7.4 are, on balance, qualitatively like to the main findings. It is therefore conceivable to conclude that using any of the radicalism degree indices to measure the extent of social polarization would not significantly alter the conclusions. Based on these sensitivity findings, we use the preferred analysis based on the six variables.

4.5 Results

This section gives a general picture of the evolution of social polarization in South Africa from 2003 to 2013. Section 4.5.1 presents the trends for social polarization. We use the radicalism degree distributions to compute the Permanyer (2012) indices of social polarization, and conclude that social distances/gaps between (within) racial groups declined (increased) during the study period.

4.5.1 Racial Radicalism Polarization results

Figure 4.5.1 reports the evolution of indices Permanyer (2012) and Reynal-Querol (2002) showing social polarization in South Africa over the period 2003 - 2012. Figure 4.5.2 presents the decomposition of the Permanyer (2012) index by racial group. That is, it reports the patterns of polarization by each racial group. The lower the polarization score (closer to zero), the narrower the gap between individuals in the racial groups, or the further the society is from a bi-modal distribution in the case of the RQ index.

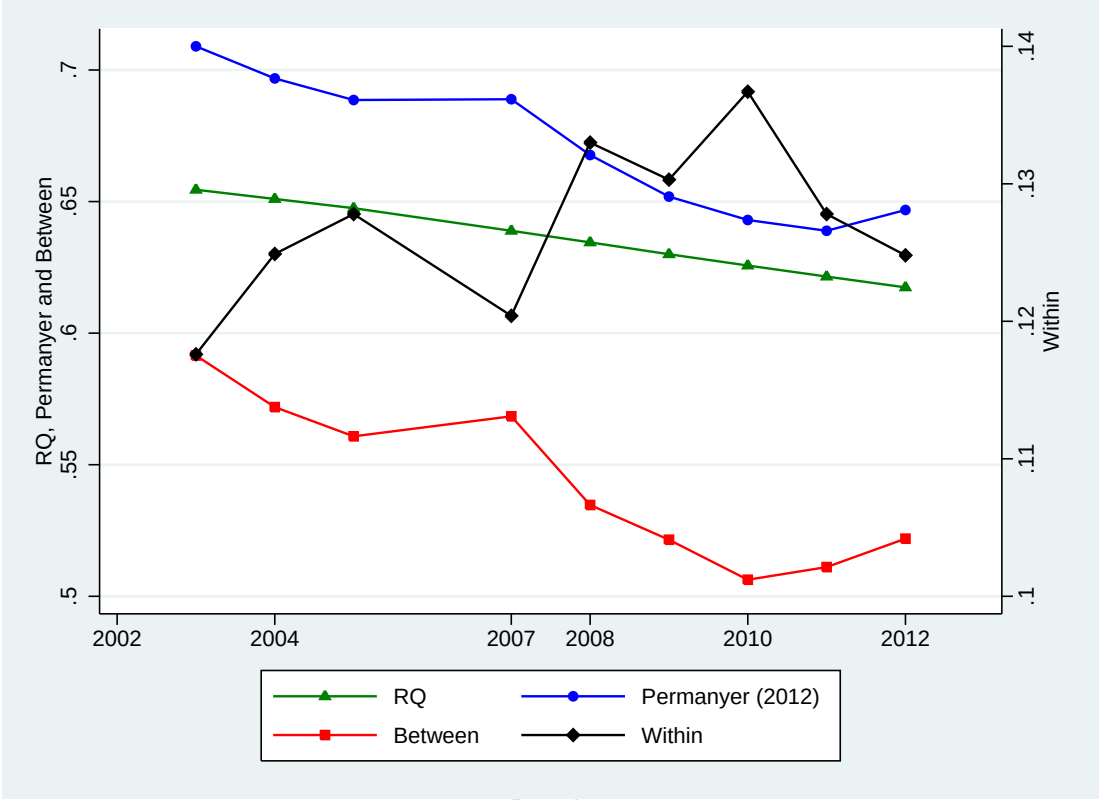
The main findings from these figures are that, besides the spike in 2007, there is an

overall decrease in social gaps between racial groups or individuals in different groups during the period 2003 to 2010, and there is a slight increase from 2010 to 2012. The distance between individuals in the same group tends to increase from 2003 to 2010 and falls from 2010 to 2012. While the change from one year to the next is not significant, the social polarization values for the individual years are statistically significant.

We take a closer look at these figures, starting with figure 4.5.1. The left y-axis measures the RQ, Permanyer (2012) and between-race polarization, while the second y-axis on the right measures the within-racial group polarization (first component of equation 4.2.5). The following four features emerge from this figure: First, the Reynal-Querol (2002) index score, which only uses racial distributions, declines by a value equivalent to 5.67% during the period. As figure 4.7.1 shows, this is not surprising, given that the population share of Blacks increases, whereas that of Whites and Coloureds decreases, and remains fairly stable, respectively. Second, the Permanyer (2012) index score decreases in totality between 2003 and 2012, but with some notable dynamics across the years. This is because Permanyer (2012) uses the degree of radicalism distributions which can vary from one year to another. For instance, the Permanyer (2012) index score increases in 2007, and decreases thereafter until 2011, and increases again in 2012. This suggests the narrowing of gaps and a reduction in hostility, as a measure of the degree of radicalism, between racial groups during the period. However, there appears to be a reversal of this trend in 2012.

The third thing to note from the figure is that the Permanyer (2012) index score is always above the RQ index, while the RQ figures are everywhere above the between-group polarization score. Given that between-group polarization (equation 4.2.3) arises only when there is alienation between groups, we might expect that it will be higher or somewhat closer to the RQ index. Surprisingly, this is not the case. Nonetheless, the gap between the Permanyer and RQ index figures narrows after 2007, until 2011, which is further evidence of the narrowing of gaps between racial groups.

Figure 4.5.1: Social Polarization trends in South Africa, 2003 - 2012



Notes: This figure provides the evolution of social polarization in South Africa during the period from 2003 to 2012. The Permanyer (2012) index score is the sum of between-group and within-group polarization. The Permanyer (2012) index assumes alienation between and within groups, while between-group polarization ignores the within-group alienation and within-group polarization deals with alienation between individuals of the same group. RQ is the Reynal-Querol (2002) index, which is an index of pure social polarization. All the estimates are weighted at the national level using the calibrated survey weights, and the standard errors for the years 2007 to 2012 are adjusted for the sample design used. The Permanyer (2012) index scores are estimated by Distributive Analysis Stata Package (DASP), and the Reynal-Querol (2002) index scores are estimated with the rq Stata code developed by Carlos Gradin.
Source: Own calculations using weighted SASAS 2003 to 2012

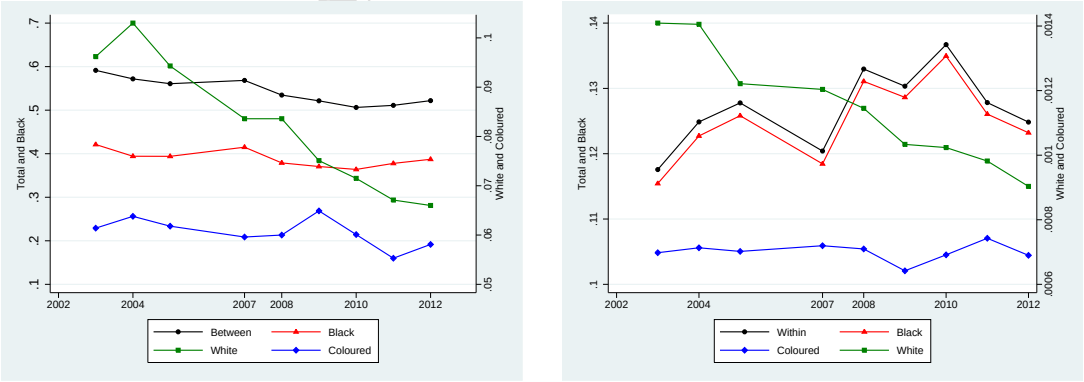
The fourth notable feature is the overall closing of the gap between racial groups until 2010, after which they start to widen. This suggests that animosity between the races has somehow become worse after 2010. Since the identification effect or subpopulation shares are somewhat consistent over the period, this sudden reversal may be due to an increase in radicalism. As expected, we see that alienation between individuals in different groups (between-group polarization) is the main driver of total polarization. That is, between-group polarization accounts for approximately 79% of the variation in total polarization. Lastly, within-group polarization, which focuses on alienation between individuals within a group, has been on the rise. There is a somewhat divergent pattern for between-group polarization and within-group polarization. That is, an increase (decrease) in the distance between individuals from different racial groups happens in tandem with reduced (increased) distance between individuals in the

same racial group. For example, as Black and White groups become more internally homogeneous, the groups become more distant from each other.

We now turn to Figure 4.5.2 which presents between-group polarization, (panel (a)), and within-group polarization, (panel (b)), across the four race groups. Similarly, the figures have two y-axes, where the first y-axis on the left, in both panels (a) and (b), reports the polarization levels of Blacks and South Africa as a whole. The second y-axis (on the right), with much lower scores, shows the polarization levels for Whites and Coloureds. The main contribution of the data shown in this figure is to highlight the differential impact of each racial group on total polarization.

It is clear from the figures that Blacks have the largest share or contribution to the distance between individuals in the different groups (between-group polarization), and the distance between individuals in the same group (within-group polarization). The national patterns of between-group and within-group polarization mimics that of Blacks. Whites' alienation or animosity towards other groups (between-group polarization) and towards other Whites (within-group polarization) decreases during the study period. The results seem to be consistent with the literature on health polarization and social polarization in general (Fusco & Silber, 2014; Permanyer, 2012; **?**).

Figure 4.5.2: Between-race and Within-race Polarization trends in South Africa, 2003-2012



(a) Between (b) Within

Notes: Panel (a) shows the evolution of between-race polarization. Between-group polarization deals with alienation between groups and assumes no alienation or radicalism within groups (see equation **??**). Panel (b) is the within-race polarization, and focuses on alienation or radicalism between individuals of the same group. The estimates are weighted at a national level using the calibrated survey weights, and the standard errors for the years 2007 to 2012 are adjusted for the sample design used.
Source: Own calculations using weighted SASAS datasets from 2003 to 2012.

We conclude this discussion by checking the sensitivity of the above findings to using a different measure of social polarization. That is, we apply the Permanyer and

D'ambrosio (2015) indices to measure social polarization, and check if we reach different conclusions. Figure 4.7.4 (in the appendix) shows that the scores of the *Symmetric* and *Asymmetric* indices indicate the narrowing of gaps between the racial groups. This is similar to the scores of Reynal-Querol (2002) and Permanyer (2012) indices, the scores of the Permanyer and D'ambrosio (2015) indices decrease during the study period. While the Pearson's correlation coefficient between the scores of the *Symmetric*, the Reynal-Querol (2002) and Permanyer (2012) indices is about 0.3, the correlation between *Asymmetric*, the Reynal-Querol (2002) and Permanyer (2012) indices is about 0.5. This means that the *Asymmetric* index of Permanyer and D'ambrosio (2015) is similar to the Reynal-Querol (2002) and Permanyer (2012) indices. The results seem to be consistent with the literature on health polarization and social polarization in general (Fusco & Silber, 2014; Permanyer, 2012; **?**).

4.6 Conclusion

In this chapter, we provide a descriptive examination of the extent of social polarization in South Africa. First, we show that the strength with which an individual defends the interest of their racial group (racial radicalism degree) falls with increases in household wealth and education attainment. We also find less radicalism among employed people and those who are satisfied with life. The racism results, on the whole, are consistent with theoretical predictions of both Glaeser (2005) and Akerlof and Kranton (2005).

Second, we compute the Permanyer (2012) index of social polarization by using the racial radicalism distribution to measure alienation across racial groups. We find that social polarization declines during the study period. This decline is largely due to a decrease in polarization between racial groups. Interestingly, as between-racial group polarization reduces, within-racial group polarization tends to increase. This suggests that, as distances between racial groups are fading away, distances within the races are increasing, or there is an emergence of other social identities within the racial groups. This finding is suggestive of the country being polarized along more than one dimension. It therefore signals a need to also examine the extent of multidimensional polarization.

Higher education, increased household wealth, being employed, and better health status are associated with less animosity between racial groups, and less social polarization in turn. Public policy should therefore target an improvement in education attainment, particularly for those in previously disadvantaged groups. This will in-

crease the probability of employment, better earnings, and improved health status, and reduce alienation levels, which will promote racial integration. Racial integration will most likely increase cohesive tendencies in terms of both economic (for example income) and social characteristics (for example radicalism), which will in turn reduce polarization. De-racialisation policies that abrogate segregation or tracking of students by race within schools, as well as Affirmative Action policies in the workplace need to be implemented in conjunction with education improvement policies.

4.7 Appendix

4.7.1 Axiomatic Characterisations of ER and DER

The axioms used to characterize the discrete polarization measure in Esteban and Ray (1994) are the following:

Condition H If $P(\pi,y) \geq P(\pi,y)$ for two distributions (π,y) and (π,y), then for all $\lambda > 0$, $P(\pi,y) \geq P(\pi,y)$.

Axiom 1 Assume there are three income groups with income levels 0, x, y and population masses p, q, q. Assume that $p > q > 0$ and $0 < x < y$. There exists $\varepsilon > 0$ and $\mu > 0$ (possibly depending on p and x) such that if $|x-y| < \varepsilon$ and $q < \mu p$, then the joining of the two q masses at their mid-point $(x+y)/2$, increases polarization.

Axiom 2 Assume there are three income groups with income levels $0, x, y$ and population masses p, q, r. Assume that $p > r > 0$ and $x > |y-x|$. There exists $\varepsilon > 0$ such that if the population mass $q$is moved to the right (towards) r by an amount not exceeding ε, polarization goes up.

Axiom 3 Assume there are three income groups with income levels $0, x, 2x$ and population masses p, q, p. Any new distribution formed by shifting population mass from the central mass q equally to the two lateral masses p, must increase polarization.

The axioms used to characterize the continuous polarization measure in Duclos et al. (2004) are the following:

Axiom 1 If a distribution is composed of a single basic density, then a squeeze of that density cannot increase polarization.

Axiom 2 If a symmetric distribution is composed of three basic densities with the same root and mutually disjoint supports, then a symmetric squeeze of the side densities cannot reduce polarization.

Axiom 3 Consider a symmetric distribution composed of four basic densities with the same root and mutually disjoint supports. Slide the two middle densities to the sides keeping all supports disjoint. Then polarization must go up.

Axiom 4 If $P(F) \geq P(G)$ and $p > 0$, then $P(pF) \geq P(pG)$, where pF and pG represent identical population scalings of F and G respectively.

4.7.2 Calibrating the sampling weights

In this section, we explain the procedure of calibrating the sampling weights. But, first we highlight the advantages of the new weights we create over the previous weights supplied with the data. The advantage of these new weights we calibrate is that they are benchmarked against the most recent population estimates. That is, StatsSA revises its mid-year population projections annually to reflect the true structure of the population[5], thus our weights will improve the representativeness of each sample. More importantly, the new calibrated weights will provide marginal totals (or subpopulation shares) that are somewhat consistent as a time series. Given that the identification component in the social polarization indicators relies heavily on population weights of the racial groups, the new weights will surely end up with relatively robust polarization trends over time.

We apply an iterative proportional fitting known as *raking* to calibrate the weights (see Battaglia et al. (2013), Wittenberg (2010) and Kolenikov et al. (2014) for details about raking). The procedure is similar to post-stratification in that we divide the samples by province and into 88 race-gender-age groups. The aim is to ensure that weights

[5] A better option would be to benchmark using somewhat consistent population totals from the latest edition of the demographic and epidemiological model developed and maintained by the Actuarial Society of South Africa (ASSA) (Branson & Wittenberg, 2014).

within cells correspond to the recent 2015 mid-year population totals[6]. In the absence of design weights to correct for non-response, for ex-ante weights when raking, we use the benchmarked SASAS weights because they contain information about the sample design and structure of the population. One limitation of using the SASAS weights is that our weights will take on their biases, for example their large range (see table 4.7.8). In the basic raking algorithm, the "margins are adjusted one at the time, with variables repeatedly cycled, until the desired degree of convergence is achieved" (Kolenikov et al., 2014).

For example, consider a hypothetical survey with two strata (urban and rural) from which males and females are selected[7]. In Table 4.7.1 we show that the same numbers of individuals are selected from each stratum. However, males are selected at a rate of 1:4 females in the urban sample and 3:2 females in the rural sample. Assuming that the external population distribution of males to females is actually 3:2, and 80% of the population live in urban areas. If no information is available about the gender distribution within stratum at the population level, calibration can be used to improve the accuracy of estimates. If the sample is 1,000 with marginal distributions 1:1 on stratum and 2:3 on gender, and we need it to represent a population of 2,000, with marginal distributions of 4:1 on stratum and 3:2 on gender. We can calibrate as follows: First, rescale the weights on the one margin, say gender, to those in the population. In this case, males are given a weight of 3 and females 4/3. This then offsets the sample stratum's marginal totals to about 1:1.3. We then rescale this new stratum marginal totals to the population stratum distribution. We continue iterating in this way until each margin converges to the population marginal totals.

Table 4.7.1: Calibration Example

		Gender		Marginal total	
Strata		Male	Female	In sample	Required
Urban		100	400	500	**1600**
Rural		300	200	500	**400**
Marginal total	In sample	400	600	1000	
	Required	**1200**	**800**		**2000**

Source: Adapted from Branson and Wittenberg (2014)

A limitation of our weights is that they are calibrated at an individual level, meaning it is possible for people within the same household to have different weights. Con-

[6]One issue we encounter is that, the SASAS is administered only to people aged 16 and above, thus we needed population total for people age 16 - 19, the first age group. But StatsSA only releases population totals in the age group 15 - 19. Therefore, we use Sprague multipliers released with the mid-year projections to calculate and subtract those aged 15 years to end up with the required aged group, 16 - 19.

[7]This example is adapted from Branson and Wittenberg (2014) and followed closely.

straining the weights to be equal within a household could be solved by using a cross-entropy approach developed by Wittenberg (2010). The cross-entropy approach requires households to have unique identifiers, and the SASAS data does not have unique household identifiers. Even though the raking or weight calibrations bring some efficiency gains, it leads to an increase in the variation of these weights, which in turn leads to greater design effects. This could be due to very small counts in some cells (e.g Indians/Asians 65 years and above in our data). Another limitation of this basic raking algorithm is that it does not place limits on the lowest and highest values of the weights. Raked or calibrated weights are likely, as is the case here, to exhibit considerable variability. One solution is weight trimming such that the largest (smallest) weights are reduced (increased) to reduce their impact on the variance (Izrael, Battaglia & Frankel, 2009; Kolenikov et al., 2014). However, trimmed weights may not add up to intended populations totals, and weight trimming may also introduce a bias, meaning there is a trade-off between latent bias and lower variance (Izrael et al., 2009).

The *raking* was done in two stages. The first calibration is done before the Polychoric Principal Component Analysis (*PPCA*), an approach we use to compute the index of *the degree of racial radicalism*. This is so that we can use the resulting new weights when calculating this index. The second stage of calibration is done after the *PPCA* approach. This is mainly because we dropped all observations with missing values for the *radicalism* index, and this resulted in an underestimation and overestimation of populations and racial group shares in some years. It is, however, vital to note that the calibrated weights are only as good as the auxiliary data used (Branson & Wittenberg, 2014).

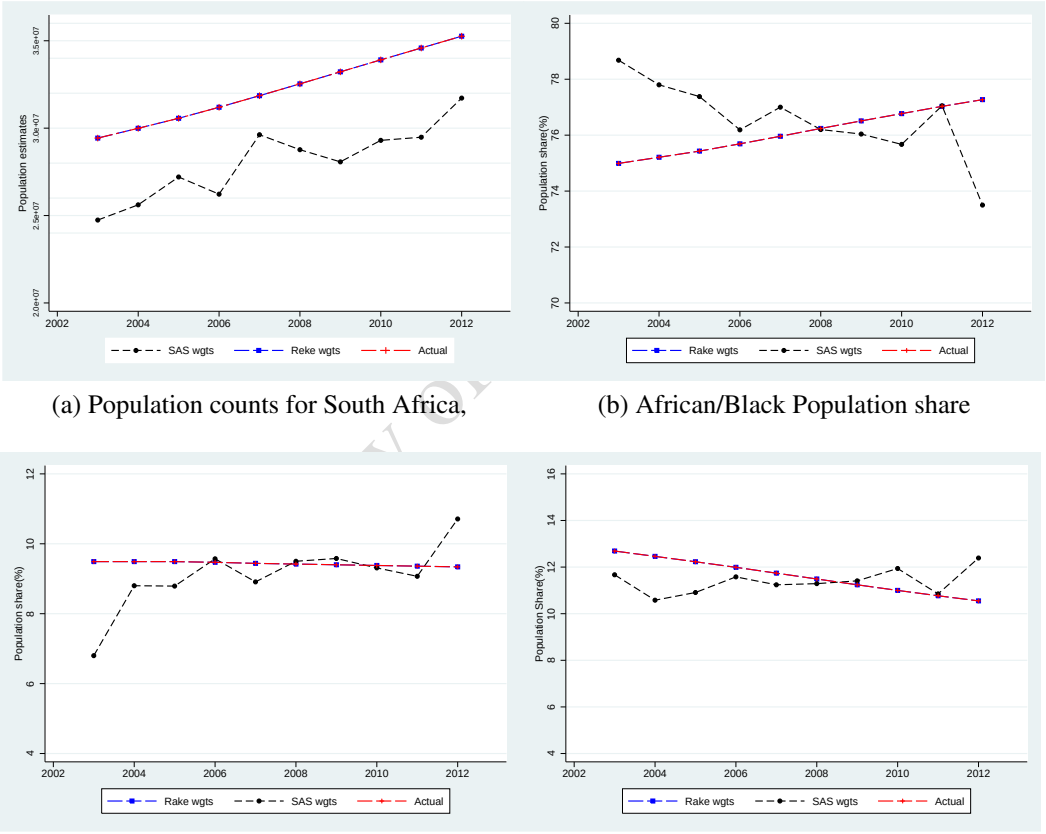
4.7.2.1 Assessing the calibrated weights

In this section, we highlight the differences between the original SASAS weights and the new calibrated weights. As can be seen from table 4.4.1 in the Appendix, which reports summary statistics of these weights, the mean and the spread (standard deviation or coefficient of variation) of the new weights is larger for all the years. This means the original SASAS weights are raised, but they now have a larger variance. Another noteworthy feature is that both the original and the new calibrated weights have a large spread. For instance, for all the years except 2008 and 2011, the ratio of the largest to smallest is above 100 000. This can be worrying as many estimates are overly affected by observations with large weights (Kolenikov et al., 2014). As already noted, weights are often trimmed, but this needs to be done concurrently with calibration to minimize

the latent bias of trimming (Izrael et al., 2009).

We use the untrimmed weights because we are concerned with social polarization which depends on sub-population shares. Social polarization is a function of increasing group identification, which increases with subgroup shares. Therefore, as long as the weights give a true picture of the population shares of racial groups, their variability should not be a problem. A complication arises in the measurement of alienation, that is, we are likely to give ordinal responses from these observations more weight and therefore our estimate of alienation will be biased upwards.

Figure 4.7.1: Comparison of the calibrated weights and the original SASAS weights



(a) Population counts for South Africa,

(b) African/Black Population share

(c) Coloured population Share

(d) White populations share

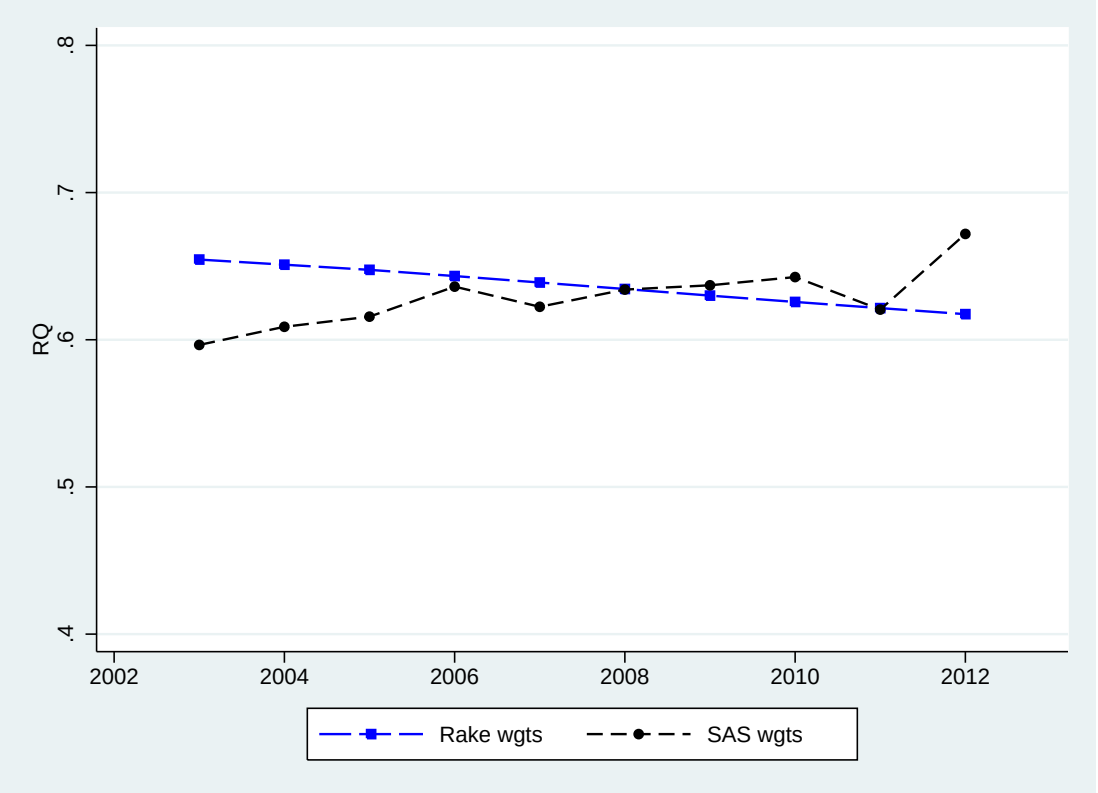
Notes: This figure presents a comparison of population estimates using the original SASAS weights and the new calibrated weights. SAS wgts are estimates based on the original weights supplied with the SASAS datasets, Rake wgts are calibrated using survwgt Stata code from Winter et al. (2015), and Actual are Statistics South Africa mid-year estimates. Panel (a) shows the total population count for the whole of South Africa. Panel (b) to (c) shows the racial population share. The SASAS totals are not consistent, whereas the calibrated (raked) totals form a smooth series over time.

In Figure 4.7.1, we present a population count based on these weights. As expected, the calibrated weights produce a smooth series which are similar to Statistics South Africa's estimates. The only difference is possibly due to converting the new weights

to integers. The original SASAS weights, however, make implausible jumps and dips in some years. For instance, between 2003 and 2012, the population increases steadily, but, according to the SASAS estimates, it increases only up to 2005, then declines in 2006, rises again 2007, and then declines thereafter until 2009.

Looking the racial proportions in Figure 4.7.1 (b) to (c), we note that the proportions of Blacks increases during the study period, while the proportion of Coloureds and of Whites decreases, according to the new calibrated weights and StatsSA's estimates. However, using the SASAS weights, the proportions of Blacks seems to be decreasing and that of Coloureds and of Whites appears to be somewhat constant. Finally, in Figure 4.7.2, we plot the values for the Reynal-Querol (2002) (RQ) index of pure social polarization calculated using both the SASAS weights and the new calibrated weights. As we can see the new calibrated weights produce a smooth downward sloping series, while the series based on the SASAS weights is somewhat constant but with some jumps. Therefore, we conclude that the new calibrated weights are a better option, at least for the present analysis.

Figure 4.7.2: Reynal-Querol (2002) index of pure social polarization



Notes: This figure presents a comparison of population estimates using the original SASAS weights and the new calibrated weights. SAS wgts are estimates based on original weights supplied with the SASAS datasets, and Rake wgts are calibrated using survwgt Stata code of Winter et al. (2015)..

4.7.3 List of questions used to construct radicalism degrees

In parenthesis are the re-coding of the categories to a 1-10 scale such that 1 denotes the lowest racism level and 10 the highest.

Limited list of six questions, 2003 - 2012

1. To what extent do you agree or disagree with the following statements? People of different racial groups do not really trust or like each other? 1.Strongly agree (10) 2.Agree (7.75) 3.Neither agree nor disagree (5.5) 4.Disagree (3.25) 5.Strongly disagree (1)

2. To what extent do you agree or disagree with the following statements? People of different racial groups will never really trust or like each other? 1.Strongly agree (10) 2.Agree (7.75) 3.Neither agree nor disagree (5.5) 4.Disagree (3.25) 5.Strongly disagree (1)

3. To what extent do you agree or disagree that government should... Redistribute land to black South Africans. 1.Strongly agree (10) 2.Agree (7.75) 3.Neither agree nor disagree (5.5) 4.Disagree (3.25) 5.Strongly disagree (1)

4. To what extent do you agree or disagree that there should be...? Racial quotas in national sports teams. 1.Strongly agree (10) 2.Agree (7.75) 3.Neither agree nor disagree (5.5) 4.Disagree (3.25) 5.Strongly disagree (1)

5. To what extent do you feel attached to the following types of people? Those who speak the same language as you? 1.Very attached (10) 2.Slightly attached (7) 3.Not very attached (4) 4.Not at all attached (1)

6. To what extent do you feel attached to the following types of people? Those who belong to the same race group as you? 1.Very attached (10) 2.Slightly attached (7) 3.Not very attached (4) 4. Not at all attached (1)

Extended list of questions, 2010 - 2012

1. South Africa used to have apartheid by law between white, black, coloured and Indian/Asian. Since 1994, do you think that race relations in the country have improved, stayed the same, or gotten worse? 1.Improved (1) 2.Stayed the same (5.5) 3.Got worse (10)

2. How often do you feel racially discriminated against? 1.Always (10) 2.Often (7) 3.Sometimes (4) 5.Not at all (1)

3. And how much do you agree or disagree with the following? Being a member of my race group is an important part of who I am as a person? 1.Strongly agree (10) 2.Agree (7.75) 3.Neither agree nor disagree (5.5) 4.Disagree (3.25) 5.Strongly disagree (1)

4. And how much do you agree or disagree with the following? People of other race groups in South Africa tend to exclude members of my group from positions of power and responsibility? 1.Strongly agree (10) 2.Agree (7.75) 3.Neither agree nor disagree (5.5) 4.Disagree (3.25) 5.Strongly disagree (1)

5. And how much do you agree or disagree with the following? The traditions and values that are important to people of my race are under threat because of the influence of other races in this country? 1.Strongly agree (10) 2.Agree (7.75) 3.Neither agree nor disagree (5.5) 4.Disagree (3.25) 5.Strongly disagree (1)

6. And how much do you agree or disagree with the following? Other race groups in South Africa will never understand what members of my group are like. 1.Strongly agree (10) 2.Agree (7.75) 3.Neither agree nor disagree (5.5) 4.Disagree (3.25) 5.Strongly disagree (1)

4.7.4 Polychoric Correlation

Polychoric correlation between two observed ordinal variables Z_1 and Z_2 with c_1 and c_2 categories is the maximum likelihood estimation of the probabilities that categories c_1 and c_2 are given jointly, weighted by the number of observations (Holgado-Tello, Chacón-Moscoso, Barbero-García & Vila-Abad, 2010; Jöreskog, 2005; Olsson, 1979). Suppose Z_1^* and Z_2^* are bivariate normally distributed latent variables with a correla-

tion ρ that are underlying Z_1 and Z_2. Further, Z_1 and Z_2 are obtained by descretizing these underlying variables according to a set of thresholds $a_i, i = 0, \ldots, -\infty$ and $b_j, j = 0, \ldots, -\infty$; such that $a_0 = b_0 = -\infty$ and $a_{c_1} = b_{c_2} = +\infty$. Then Polychoric correlation ρ can be estimated by maximising the maximum likelihood function of the multinomial distribution:

$$ln\, L = \sum_{i=1}^{c_1} \sum_{j=1}^{c_2} n_{ij} log\ p_{ij} \tag{4.7.1}$$

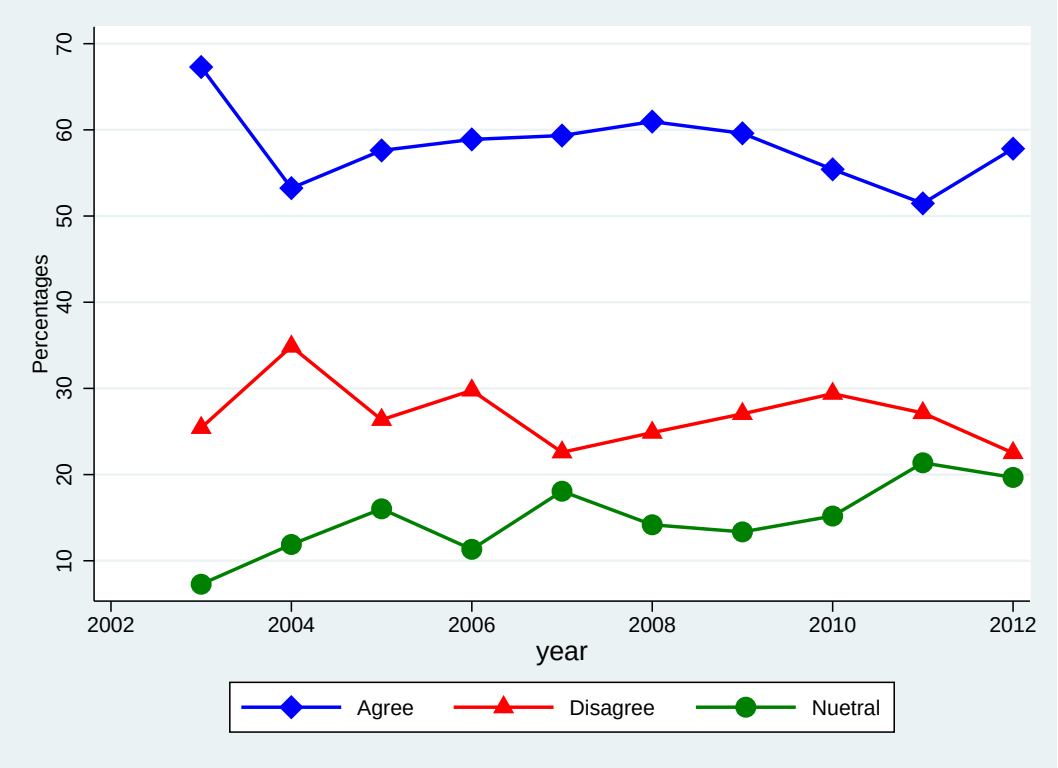
where n_{ij} is the number of cases in category i of Z_1 and in category j of Z_2; and p_{ij} is the probability that an observation falls in cell (i, j):

$$p_{ij} = P[Z_1 = i,\ Z_2 = j] = \int_{-\infty}^{a_i} \int_{-\infty}^{b_j} \frac{1}{2\pi\sqrt{1-\rho^2}} exp^{-\frac{1}{2(-\rho^2)}(x^2 - 2\rho xy + y^2)} \tag{4.7.2}$$

Maximising the likelihood function (Eq. 4.7.1) with parameters ρ, $a_i$and b_j gives the Polychoric correlation between $Z_1$and Z_2. Having estimated the Polychoric correlation, then PCA is applied in the standard manner by solving the Eigen problem.

4.7.5 Additional Tables and Figures

Figure 4.7.3: People of different racial groups will never really trust or like each other?



Notes: This figure provides percentage distribution of responses to the statement: People of different racial groups will never really trust or like each other? The possible answers were 1.Strongly agree 2.Agree 3.Neither agree nor disagree 4.Disagree 5.Strongly disagree. We combine the first and last two categories to end with just three categories. All estimates are estimated to 2015 population totals using calibrated weights. .
Source: Own calculations using weighted SASAS datasets from 2003 to 2012.

Table 4.7.2: Polychoric Principal Component Analysis Results

(a) Explained variance by the first three components

Components	Eigenvalue	Difference	Proportion	Cumulative proportion
Component 1	2.203	0.672	0.367	0.367
Component 2	1.531	0.385	0.255	0.622
Component 3	1.146	0.599	0.191	0.813

(b) Polychoric correlation matrix, pooled sample

	Radicalism	Radicalism	not_trust	never_trust	same_lang	same_race	redis_land	race_qouta
Radicalism	1							
Radicalism_std	1	1						
not_trust	0.598	0.598	1					
never_trust	0.571	0.571	0.696	1				
same_lang	0.663	0.663	0.133	0.065	1			
same_race	0.638	0.638	0.114	0.072	0.728	1		
redis_land	0.621	0.621	0.141	0.113	0.232	0.217	1	
race_qouta	0.592	0.592	0.134	0.128	0.193	0.156	0.451	1

Notes: Panel (a) shows the Polychoric principal components analysis results. We retain the first component as the measure of distance between racial groups. Panel (b) provides the weighted Polychoric correlations between the original ordinal variables and the index of radicalism degree (first component). Radicalism is the untransformed first Polychoric principal component, while Radicalism_std is the first component normalised using the following formula: $10(x_{obs} - x_{min})/(x_{max} - x_{min})$. The positive correlations (column 1 and 2) in Panel (b) between each of the ordinal variables and the degree of radicalism index confirms, to some extent, the validity of our measure. The ordinal variables are rescaled them from 1 to 10 such that 1 denotes the lowest racial radicalism degree and 10 the highest radicalism degree. The ordinal variables are defined in Appendix 4.7.3.
Source: Own calculations using weighted SASAS datasets from 2003 to 2012.

Table 4.7.3: Sensitivity analysis of the Radicalism degree results

VARIABLES	(1) Original	(2) 4vars	(3) 6vars_lim	(4) 13vars	(5) Upca	(6) Spca	(7) 4vars_rev
Coloured	-0.992***	-1.167***	-0.906***	-0.218**	-1.140***	1.201***	-0.444***
	(0.0600)	(0.0752)	(0.0921)	(0.0849)	(0.0642)	(0.106)	(0.0598)
Indian	-1.049***	-1.283***	-1.096***	-0.305***	-1.218***	0.668***	-0.450***
	(0.0647)	(0.0891)	(0.0994)	(0.103)	(0.0684)	(0.117)	(0.0790)
White	-1.514***	-1.627***	-1.662***	-0.480***	-1.722***	1.545***	-0.597***
	(0.0656)	(0.0786)	(0.101)	(0.115)	(0.0670)	(0.116)	(0.0786)
Primary	-0.166**	-0.182*	-0.207	-0.120	-0.179**	0.195	-0.131
	(0.0796)	(0.109)	(0.136)	(0.155)	(0.0836)	(0.163)	(0.0918)
High School	-0.187**	-0.214**	-0.170	-0.124	-0.195**	0.226	-0.191**
	(0.0758)	(0.106)	(0.126)	(0.148)	(0.0800)	(0.155)	(0.0892)
Tertiary	-0.233***	-0.287**	-0.157	-0.185	-0.255***	0.202	-0.238**
	(0.0887)	(0.122)	(0.145)	(0.174)	(0.0931)	(0.177)	(0.106)
Satisfied	-0.161**	-0.109	-0.0875	0.0584	-0.167**	0.678***	-0.0934
	(0.0690)	(0.0974)	(0.0914)	(0.104)	(0.0740)	(0.116)	(0.0789)
Neutral	-0.240***	-0.126	-0.102	0.0576	-0.224***	0.956***	-0.206**
	(0.0754)	(0.101)	(0.107)	(0.118)	(0.0796)	(0.130)	(0.0866)
Dissatisfied	-0.0108	0.0864	0.0757	0.239**	0.00716	0.523***	0.00214
	(0.0670)	(0.0937)	(0.101)	(0.111)	(0.0716)	(0.115)	(0.0770)
Very Dissatisfied	-0.0221	0.00213	0.365***	0.635***	-0.0133	0.0378	-0.0652
	(0.0913)	(0.124)	(0.129)	(0.153)	(0.0958)	(0.148)	(0.107)
Age	0.00191	0.00288*	0.00197	0.00391*	0.00227*	0.000737	0.00141
	(0.00118)	(0.00159)	(0.00178)	(0.00203)	(0.00124)	(0.00214)	(0.00136)
Middle Wealth	-0.0949**	-0.0906	-0.132**	-0.199***	-0.0950**	0.0632	-0.0867*
	(0.0440)	(0.0594)	(0.0647)	(0.0689)	(0.0464)	(0.0812)	(0.0495)
High Wealth	-0.300***	-0.263***	-0.251***	-0.194**	-0.301***	0.451***	-0.240***
	(0.0555)	(0.0698)	(0.0852)	(0.0867)	(0.0575)	(0.102)	(0.0620)
Employed	-0.0914**	-0.0542	-0.0428	-0.0517	-0.0852**	0.223***	-0.0867**
	(0.0370)	(0.0479)	(0.0577)	(0.0611)	(0.0386)	(0.0623)	(0.0416)
Female	-0.0202	-0.00493	-0.00299	-0.0167	-0.0140	0.134**	-0.0388
	(0.0330)	(0.0435)	(0.0535)	(0.0570)	(0.0343)	(0.0605)	(0.0385)
Partnered	-0.0182	-0.0832*	-0.00694	-0.0359	-0.0367	-0.0561	-0.00666
	(0.0366)	(0.0473)	(0.0555)	(0.0592)	(0.0380)	(0.0664)	(0.0432)
Constant	7.918***	7.042***	7.635***	6.131***	7.672***	3.717***	8.006***
	(0.108)	(0.152)	(0.176)	(0.197)	(0.115)	(0.208)	(0.126)
Observations	14,815	14,815	6,639	6,235	14,815	14,815	14,815
R-squared	0.174	0.125	0.169	0.038	0.197	0.085	0.036

Notes: The dependent variable in all regressions is the normalised first principal component. In column 1 it is calculated from the six ordinal variables, in column 2 it is from the four ordinal variables, while results columns 3 and 4 it is from the extended list of variables in 2010, 2011 and 2012. In columns 5 and 6 the dependent variable is from the Uncentered PCA and Standard PCA and in column 7, it is from the four variables which exclude the data from questions 3 and 4. Black is the base category for racial group while No education (zero years of schooling) is the reference category for the education category. Primary is between 1 to 7 years of schooling, High school 8 to 12 years, and Tertiary more than 12 years of education. Wealth is the limited wealth index calculated using Uncentered PCA (Wittenberg & Leibbrandt, 2017) from household ownership of or access to assets. Employed is a dummy for those with any type of employment. Partnered is the marital status indicator, which is 1 if an individual has a partner. All regressions exclude 2006 because the data from that year does not have two of the ordinal variables. Linearised standard errors in parenthesis. ***, **, * are at 1%, 5%, 10% significance levels.
Source: Own calculations from weighted SASAS datasets, 2003 - 2012.

Table 4.7.4: Sensitivity analysis of the Radicalism degree results

	(1)	(2)	(3)	(4)
VARIABLES	1st comp	2nd comp	3rd comp	Unnormalised
Coloured	-0.992***	0.0514	-0.988***	-2.172***
	(0.0600)	(0.0577)	(0.0601)	(0.131)
Indian	-1.049***	-0.000614	-1.077***	-2.298***
	(0.0647)	(0.0755)	(0.0715)	(0.142)
White	-1.514***	0.340***	-1.591***	-3.317***
	(0.0656)	(0.0652)	(0.0722)	(0.144)
Primary	-0.166**	-0.0126	-0.0763	-0.363**
	(0.0796)	(0.0899)	(0.0707)	(0.174)
High School	-0.187**	-0.0551	-0.0200	-0.410**
	(0.0758)	(0.0882)	(0.0715)	(0.166)
Tertiary	-0.233***	-0.0937	-0.0381	-0.511***
	(0.0887)	(0.106)	(0.0889)	(0.194)
Satisfied	-0.161**	0.102	-0.109*	-0.354**
	(0.0690)	(0.0748)	(0.0619)	(0.151)
Neutral	-0.240***	0.152*	-0.0399	-0.526***
	(0.0754)	(0.0779)	(0.0708)	(0.165)
Dissatisfied	-0.0108	0.136*	0.00948	-0.0236
	(0.0670)	(0.0745)	(0.0621)	(0.147)
Very Dissatisfied	-0.0221	-0.000366	0.0766	-0.0483
	(0.0913)	(0.101)	(0.0813)	(0.200)
Age	0.00191	0.00110	0.00123	0.00418
	(0.00118)	(0.00130)	(0.00119)	(0.00258)
Middle Wealth	-0.0949**	0.00150	-0.0171	-0.208**
	(0.0440)	(0.0481)	(0.0388)	(0.0965)
High Wealth	-0.300***	0.0614	-0.107**	-0.657***
	(0.0555)	(0.0555)	(0.0513)	(0.121)

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Table 4.7.5: Continued from previous page

	(1)	(2)	(3)	(4)
VARIABLES	1st comp	2nd comp	3rd comp	Unnormalised
Employed	-0.0914**	0.0424	-0.00169	-0.200**
	(0.0370)	(0.0377)	(0.0339)	(0.0810)
Female	-0.0202	0.00586	0.0315	-0.0442
	(0.0330)	(0.0358)	(0.0318)	(0.0723)
Partnered	-0.0182	-0.0790**	-0.0415	-0.0399
	(0.0366)	(0.0386)	(0.0348)	(0.0803)
Constant	7.918***	4.189***	4.785***	19.78***
	(0.108)	(0.125)	(0.106)	(0.237)
Observations	14,815	14,815	14,815	14,815
R-squared	0.174	0.007	0.167	0.174

Notes: The dependent variable is the Polychoric principal component calculated from six ordinal variables. For column 1 the dependent variable is the normalised first component, and in columns 2 and 3 it is the normalised second and third components, while in column 4 it is the unnormalised first component. Black is the base category for racial group, while No education (zero years of schooling) is the reference category for the education category. Primary is between 1 to 7 years of schooling, High school 8 to 12 years and Tertiary more than 12 years of education. Wealth is the limited wealth index calculated using Uncentered PCA (Wittenberg & Leibbrandt, 2017) from household ownership of or access to assets. Employed is a dummy for those with any type of employment. Partnered is the marital status indicator, which is 1 if an individual has a partner. All regressions exclude 2006 because because the data from this does not have two of the ordinal variables. Linearised standard errors in parenthesis. ***, **, * are 1%, 5%, 10% significance levels.

Source: Own calculations from weighted SASAS datasets, 2003 - 2012.

Table 4.7.6: Sensitivity analysis of the Radicalism degree results

			RIF regressions		
	(1)	(2)	(3)	(4)	(5)
VARIABLES	OLS	Logit	Quantile0.25	Quantile0.5	Quantile0.75
Coloured	-0.992***	-1.195***	-1.264***	-1.129***	-0.380***
	(0.0599)	(0.0850)	(0.0694)	(0.0530)	(0.0231)
Indian	-1.049***	-1.172***	-1.334***	-1.155***	-0.431***
	(0.0647)	(0.0941)	(0.0895)	(0.0677)	(0.0289)
White	-1.509***	-1.733***	-1.806***	-1.409***	-0.466***
	(0.0658)	(0.104)	(0.0890)	(0.0624)	(0.0265)
Primary	-0.167**	-0.350**	-0.167**	-0.172*	-0.0510
	(0.0794)	(0.141)	(0.0811)	(0.0952)	(0.0506)
High School	-0.194**	-0.380***	-0.128*	-0.172*	-0.0565
	(0.0760)	(0.136)	(0.0769)	(0.0907)	(0.0483)
Tertiary	-0.244***	-0.499***	-0.192	-0.294***	-0.110**
	(0.0891)	(0.157)	(0.119)	(0.112)	(0.0558)
Satisfied	-0.160**	-0.258**	-0.137**	-0.223***	-0.154***
	(0.0690)	(0.102)	(0.0698)	(0.0703)	(0.0372)
Neutral	-0.239***	-0.258**	-0.204***	-0.222***	-0.207***
	(0.0754)	(0.110)	(0.0737)	(0.0764)	(0.0401)
Dissatisfied	-0.00969	-0.0631	-0.0893	-0.141**	-0.125***
	(0.0670)	(0.0983)	(0.0654)	(0.0689)	(0.0369)
Very Dissatisfied	-0.0210	0.0403	-0.107	0.0873	-0.0899*
	(0.0912)	(0.137)	(0.0965)	(0.0912)	(0.0477)
2.Aged 25-34	0.0904*	0.117	-0.0144	0.0448	0.0181
	(0.0488)	(0.0746)	(0.0660)	(0.0610)	(0.0305)
3.Aged 35-44	0.0859	0.127	0.0884	0.0986	-0.00927
	(0.0541)	(0.0853)	(0.0638)	(0.0655)	(0.0329)
4.Aged 45-54	0.0433	0.0243	-0.0713	0.0453	0.0150
	(0.0592)	(0.0945)	(0.0768)	(0.0737)	(0.0364)
5.Aged 55-64	0.104	-0.0124	0.0329	0.0795	0.0319
	(0.0638)	(0.110)	(0.0763)	(0.0749)	(0.0381)
6.Aged 65-74	0.0790	0.0675	-0.0259	-0.000636	0.0150
	(0.0803)	(0.127)	(0.0936)	(0.0922)	(0.0446)
7.Aged 75-99	0.234**	0.318*	0.112	0.214*	0.0847
	(0.117)	(0.191)	(0.163)	(0.124)	(0.0659)

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Table 4.7.7: Continued from previous page

			RIF regressions		
	(1)	(2)	(3)	(4)	(5)
VARIABLES	OLS	Logit	Quantile0.25	Quantile0.5	Quantile0.75
Middle Wealth	-0.0937**	-0.0597	-0.0239	-0.0295	-0.0482*
	(0.0439)	(0.0666)	(0.0479)	(0.0506)	(0.0267)
High Wealth	-0.293***	-0.377***	-0.313***	-0.328***	-0.149***
	(0.0555)	(0.0803)	(0.0789)	(0.0686)	(0.0323)
Employed	-0.102***	-0.0757	-0.0725	-0.0529	-0.0349
	(0.0387)	(0.0597)	(0.0465)	(0.0438)	(0.0213)
Female	-0.0220	5.05e-05	0.0407	0.0123	-0.0212
	(0.0330)	(0.0525)	(0.0412)	(0.0396)	(0.0197)
Partnered	-0.0195	-0.0602	-0.0234	-0.0569	0.00247
	(0.0380)	(0.0593)	(0.0450)	(0.0443)	(0.0221)
Constant	7.933***	1.148***	6.937***	8.095***	8.867***
	(0.0991)	(0.168)	(0.101)	(0.111)	(0.0604)
Observations	14,815	14,815	19,308	19,308	19,308
R-squared	0.175		0.154	0.134	0.076

Notes: The dependent variable is the Polychoric principal component, calculated from six ordinal variables. For column 1 the dependent variable is the normalised first component, and in columns 2 and 3 it the normalised second and third components, while in column 4 it is the unnormalised first component. Black is the base category for racial group while No education (zero years of schooling) is the reference category for the education category. Primary is between 1 to 7 years of schooling, High school 8 to 12 years and Tertiary more than 12 years of education. Wealth is the limited wealth index calculated using Uncentered PCA (Wittenberg & Leibbrandt, 2017) from household ownership of or access to assets. Employed is a dummy for those with any type of employment. Partnered is the marital status indicator, which is 1 if an individual has a partner. All regressions exclude 2006 because the data from this year does not have two of the ordinal variables. Linearised standard errors in parenthesis. ***, **, * are 1%, 5%, 10% significance levels.

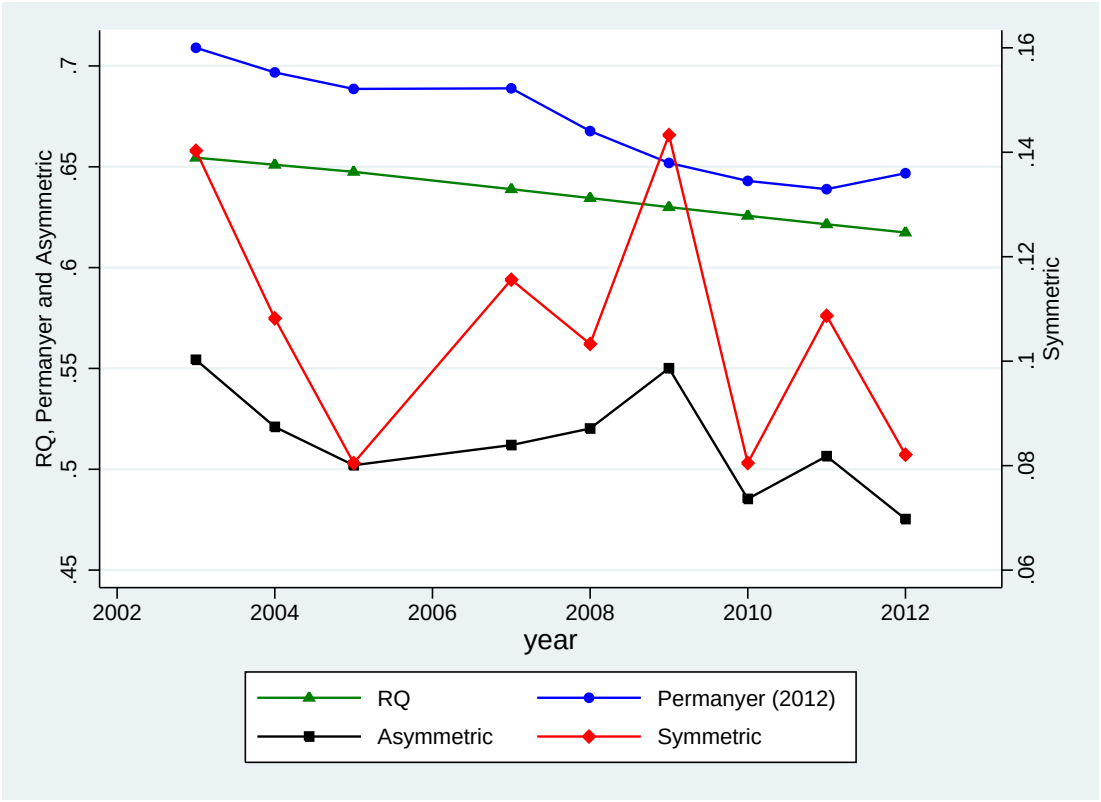
Source: Own calculations from weighted SASAS datasets, 2003 - 2012.

Table 4.7.8: Summary Statistics of sampling weights

	Mean		Std. Dev.		C.V.		Minimum		Maximum	
	SAS wgts	Rake wgts	SAS wgts	Rake wgts	SAS wgts	Rake wgts	SAS wgts	Rake wgts	SAS wgts	Rake wgts
2003	12402	12975	21440	22727	1.729	1.752	131	140	301552	384075
2004	10523	11062	14557	15597	1.383	1.410	125	144	178543	215142
2005	11006	11140	18745	19972	1.703	1.793	53	65	406623	374276
2006	10687	12712	15058	19756	1.409	1.554	195	118	223984	270248
2007	10101	10272	10802	10834	1.069	1.055	276	290	214846	181523
2008	9567	9844	9325	9969	0.975	1.013	359	266	86761	90167
2009	9833	10146	10919	11455	1.111	1.129	127	149	115293	112462
2010	10484	10758	10181	11050	0.971	1.027	145	103	79015	112563
2011	11146	11757	9613	10399	0.862	0.885	210	199	107262	75068
2012	14244	14444	13609	14298	0.955	0.990	309	248	128506	142690

Notes: The table presents summary statistics of the original SASAS weights and the new calibrated weights. SAS wgts are original weights supplied with the SASAS datasets, and Rake wgts are weights calibrated using the survwgt Stata code of Winter et al. (2015).

Figure 4.7.4: Health polarization in South Africa, 2003 - 2012



Notes: The figure presents the patterns of social polarization in South Africa. RQ is the Reynal-Querol (2002) index of pure social polarization. The Permanyer (2012) index uses radicalism degree to measure alienation. Asymmetric and Symmetric are Permanyer and D'ambrosio (2015) indices of health polarization. Asymmetric means that the alienation felt by the unprivileged towards the privileged is not reciprocated, while symmetric indicates symmetric alienation. All estimates are weighted at a national level using the calibrated weights

Source: Own calculations from weighted SASAS datasets, 2003 - 2012

Chapter 5

Summary and Concluding Remarks

This thesis investigates the extent of clustering of incomes in the South Africa income distribution. More specifically, we investigate the extent to which incomes cluster at specific ranges of the income distribution. We further examine the impact of different income sources on the clustering of incomes. We conclude with a measurement of social distances across racial groups in the post apartheid era. The thesis is therefore at the intersection of different strands of literature addressing income polarization, bi-polarization, stratification and social polarization. Our main goal is therefore to understand the evolution of (economic and social) distances and relative fortunes across groups in post-apartheid South Africa. We use data from a survey conducted at the end of Apartheid, and data from two post-Apartheid surveys.

Since the dawn of democracy in early 1990s, South African government made a public commitment to overcome the economic legacies of apartheid. The government enacted an ambitious suite of reforms to redress the injustice of centuries of colonialism and apartheid. Over the two decades into democracy, the country has been successful on a number of outcomes. For instance, the country achieved a steady GDP growth rate, improved access to social grants and basic services, and has seen an improvement in the Human Development Index. Despite these gradual improvements, the data reveals that, unemployment hovers around 25%, poverty, though it has declined, is still entrenched among Blacks, and the country remains one of the most unequal societies in the world. This suggests that the long term roots of the inequities have not been adequately understood and addressed. There is therefore a need to investigate how the different dimensions of welfare (that is, polarization and stratification) compare in the post-Apartheid period, and further evaluate how the distribution of different income sources have impacted the level of polarization and stratification.

These investigations are undertaken in three distinct, but related, analytical chapters. Using data collected by surveys between 1993 and 2014-2015, we find that, while there was a movement from the bottom income classes to the middles classes, there was also an increase in the extent of clustering of incomes. This movement of people from lower

to middle income classes, which happened between 1993 and 2008, created poles in the income distribution. That is, there is higher income polarization and income bi-polarization in 2008. We actually find near perfect bi-polarity between the rich and the poor in the South Africa distribution of income in 2008. Previous studies have found that income inequality also increased during this period. The simultaneous increase in polarization and inequality suggests that the government's de-racialisation policies designed to accelerate the economic integration have favoured a select few.

From 2008 to 2014-2015 income polarization declined, partly, due to a significant movement of people from the bottom income class to the middle classes. On the whole, income polarization and bi-polarization declined in the post apartheid era. These finding suggest that the distances between groups have declined during the period between 1993 and 2015. We confirm this by showing that income disparities between groups defined by region (urban-rural) and race have declined. Meanwhile, the income disparities within the groups increased. In line with the income inequality literature, we also find that social grants are central to reducing income differences. More generally, our decompositions reveal that the distribution of government transfers contributes negatively to income polarization, while the distribution of labour earnings tend to increase polarization. These findings are consistent with those from Bonnefond and Clément (2012) and Deutsch et al. (2013) who investigated the effects of different income sources on income polarization, and inequality.

One of the limitations of the above analysis is that we could not identify where the poles are located and what the characteristics are of the poles (or the characteristics of people at the poles). In an effort to gain a deeper understanding of the poles, we investigated the relative fortunes of different racial groups, and the hierarchical ordering of race along the income distribution. Given the high, though declining, contribution of the between racial groups polarization to the overall degree of income polarization, we conjecture that the local poles may be the mean or median incomes of the racial groups. Therefore, the lower (higher) the degree of overlapping (stratification) of incomes of the different races suggests higher income polarization.

Using the same datasets, we first show that the incomes of Blacks, particularly those at lower income percentiles, are catching up to those of their White counterparts. The incomes of Coloureds have, however, been slow to keep up. Convergence of incomes (or lack of it) across groups is a clear signal of overlapping (stratification) of income distributions across the groups. Therefore, the growth of income convergence suggests a decline in the stratification of incomes across the racial groups. We confirm this reduction in stratification by showing that, even though the incomes of Whites are

stratified (that is, their incomes overlap less with incomes of other races), the degree of stratification lessened in the post-apartheid era. Despite the growth in the overlapping of income distribution, the incomes of Whites continue to rank above the 90^{th} percentile in the income distributions of other races.

During the six years from 2008 to 2014, the income distribution of Blacks is characterised by two strata, one rich and one poor. This distributional characteristic increases the Blacks overlapping of income distributions of other racial groups, thereby increasing their assimilation into the economy. To figure out the effect of the different income sources on stratification, we use rank-preserving income exchange simulations. The simulations show that the the distribution of government transfers has a positive effect on overlapping of incomes of Blacks with those of Whites. This implies the expansion of state transfers contributed to reduction of economic distances. The distributions of labour income, of capital income, and of remittances tend to increase stratification of the incomes of Whites. The implication is that policies such as the Employment Equity and Black Economic Empowerment have not had the desired effect. We also find evidence is support of the view that these policies only benefited a select few.

All things considered, our evidence suggests clustering of incomes around local means of the racial groups incomes. Further, the pace of economic assimilation of the previously disadvantaged racial groups into the mainstream economy is slow. Additionally, our results confirm that race is still the defining stratum even two decades after the end of apartheid. Cognizant of these results, we shift focus to examining the distance across racial groups in terms of social characteristics. More precisely, we use data from 10 waves (from 2003 to 2012) of the South African Social Attitudes Survey (SASAS) to investigate the evolution of social polarization in the country. To measure alienation among the racial groups, we use the extent of an individual's interest in and identification with his subgroup. We call this involvement with one's group the degree of racial radicalism.

Owing to the importance of racial radicalism in our indicators of social polarization, first we examine how the scores of the index of radicalism correlate with a number of variables. The regression results reveal that the degree of racial radicalism decreases with more household wealth, higher education attainment and employment. These results are robust to different calculations of the scores of the radicalism degree index, and are also consistent with predictions of the economics of identity models. With regard to social polarization, we find that social polarization declines during the study period. Most importantly, as between-group polarization declines, we find that within-group polarization tends to rise, which indicates an inverse relationship between internal ho-

mogeneity and external heterogeneity.

The three essays in this thesis address the normatively undesirable issue of distance between groups in South Africa. From a positive economics analysis, the social and economic distances between relevant and salient groups have negative effects on other social objectives. Therefore, one limitation of our analysis is that we do not provide a discussion on how polarization and stratification correlate with outcomes like unemployment, poverty, economic freedom and political inclusion. Nevertheless, the thesis finds that distances between the incomes of different groups mimic distances between individuals. That is, patterns of polarization and stratification are similar to those of vertical inequality.

These insights have several implications for policy. First, there is a need to increase education attainment of previously disadvantaged groups. This stems from our finding that labour market earnings do not only increase income disparities, they also tend to create local poles in the distribution. Since education is the surest way to improve labour market earning, then public policy should equalise education opportunities across groups.

We further show that government transfers tend to lower the stratification of income of White individuals and increase the overlapping of the income distribution of Blacks. This suggests scaling up the initial policy which expanded the government transfers. While government transfers are an immediate option to move people out of poverty, they may also reduce the likelihood of labour force participation, thereby slowing the pace of labour market integration. Thus, a preferred long-term policy is to empower individuals from the disadvantaged groups. For instance, a targeted policy that provides tertiary education bursaries together with paid internships and placements is more likely to improve school-to-work transition.

Moreover, the results point to the existence of two strata in the national distribution, one poor and the other rich. This is particularly true among the incomes of Blacks. This observation is seen by some as an indication that democracy only benefits a select few. From a political economy perspective, this suggests a factional state that redistributes income and wealth from one faction to the other.

Another important finding from the thesis is that the three dimensions studied appear to evolve in tandem with one another. For instance, the higher polarization of incomes, the greater the stratification of incomes, especially those of White individuals, and the greater the degree social polarization. Thus, the country appears to divided along

racial lines. From a policy perspective, it means the underlying root causes of the three concepts are similar. Therefore, a policy that addresses the economic advantage of Whites, also provides a platform for other racial groups to integrate into the labour market. At the same, it improves social cohesion in the country.

Further research is still needed to better understand the mechanisms by which polarization and stratification impact the degree to which an individual's partisan and social identities converge. The thesis has not dealt with polarization and stratification of assets and wealth. Therefore, one issue worthy of investigation is how the distribution of capital incomes (like dividends, property earnings, and private pensions) might affect the degree of polarization or stratification of incomes among the race groups.

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