



Black living standards in South Africa before democracy: New evidence from heights

Bokang Mpeta, Johan Fourie and Kris Inwood

ERSA working paper 670

February 2017

Economic Research Southern Africa (ERSA) is a research programme funded by the National Treasury of South Africa.

The views expressed are those of the author(s) and do not necessarily represent those of the funder, ERSA or the author's affiliated institution(s). ERSA shall not be liable to any person for inaccurate information or opinions contained herein.

Black living standards in South Africa before democracy: New evidence from heights*

Bokang Mpeta,[†] Johan Fourie[‡] and Kris Inwood[§]

February 22, 2017

Abstract

Very little income or wage data was systematically recorded on the living standards of South Africa's black majority during much of the twentieth century. Between 1911 and 1996, for example, only fragmentary evidence of black living standards remain in mining reports and manufacturing censuses, often at a too generalised level or of too short time-span to render any meaningful unbiased, long-run interpretations of living standards. This paper uses three new datasets to document, for the first time, the stature of black South Africans over the course of the twentieth century. The data allow us to disaggregate by ethnicity within the black population group, revealing levels of inequality within race group that has been neglected in the literature.

Keywords: apartheid, living standards, South Africa, heights, anthropometric, twentieth century

1 INTRODUCTION

The history of living standards in South Africa is a complex and incomplete picture. We know much more about the pre-1994 living standards of white South Africans – the descendants of European immigrants since the 17th century

*This project is funded by the Elite Project Fund of the Faculty of Economic and Management Sciences at Stellenbosch University, the National Research Foundation's Thuthuka-grant (87966) and Competitive Programme for Rated Researchers-grant (98921). We would like to thank Emmanuel Akyeampong, Gareth Austin, Joerg Baten, Rulof Burger, Michiel de Haas, Ewout Frankema, Holly Hanson, Martine Mariotti, Alexander Moradi, Johannes Norling, Nathan Nunn, Dieter von Fintel, Marisa von Fintel, Dmitri van den Bersselaar and participants at conferences and seminars at the following institutions: European Social History Conference (Valencia), Graduate Institute (Geneva), Workshop on African History and Economics (Harvard), African Economic History Workshop (Sussex), and the departmental seminars at Stellenbosch University and Mount Holyoke College.

[†]E-mail: bokangmpeta@sun.ac.za. Department of Economics, Stellenbosch University, South Africa.

[‡]E-mail: johanf@sun.ac.za. Department of Economics, Stellenbosch University, South Africa.

[§]Department of Economics and Department of History, University of Guelph, Canada.

– than of black South Africans, the indigenous, Bantu-speaking population that had inhabited most of modern-day South Africa before the arrival of Europeans and have since formed the majority of the population. The reason for this dearth of knowledge is the lack of source material: whereas meticulous records were kept on white living standards from the beginning of settlement – including 18th, 19th and 20th century wages (Du Plessis and Du Plessis 2012; De Zwart 2011; Mariotti 2012), 18th century income and wealth (Fourie 2013; Fourie and Von Fintel 2010; Fourie and Von Fintel 2011) – the colonial and apartheid-era records often neglected to record the wages or incomes of black South Africans at the individual level. A different approach is thus necessary to provide a more complete picture of the evolution of South Africa’s living standards before the advent of democracy.

We take this alternative route by considering three unique data sources that record the biological measure of height, or human stature. The relationship between growth, nutrition and income allows us to infer information on living standards by considering adult height. In order for optimum growth to take place, nutrition, medical conditions, and living conditions must be at their optimum (Komlos, 2003; Komlos and Baten, 1998). This is highly correlated with income and other measures of welfare (Steckel, 1995; 2009). As such, average height has been shown to rise with socioeconomic class (Steckel, 1983) which can be explained by the fact that factors such as quality of nutrition and access to medical care improve with socioeconomic class (Komlos and Lauderdale, 2007). It must be noted, however, that historically the relationship between socioeconomic status and average height is by no means linear; it is often confounded by factors such as high food prices, and unsanitary or congested living conditions due to industrialization, for example. Nevertheless, by analysing the mean height of a sample of black South African males over the 20th century, we can shed light on the standard of living of a subsection of the population that has remained hidden for too long.

Our results respond to important questions in the South African economic history that have not yet sufficiently been addressed: Were poor black living standards a result of apartheid-era policies, or did this worsen even before South Africa’s most infamous era? When did the divergence between white and black living standards occur? Finally, and most difficult, can we explain the level and trend within the black population over the twentieth century?

Answers to these questions will also help our understanding of the causes of current-day inequality (Wilson 2011), an antidote to a large literature that attempts to measure and explain post-apartheid inequality (due to the availability of better surveys) with limited recourse to the past (Leibbrandt, Finn and Woolard 2012). We already know, for example, that the difference in heights between black and white males born towards the end of apartheid was at least 7cm, some of the highest within-country differences in the world. But what we don’t know is when this gap emerges? Inwood and Masakure (2013), using World War 1 recruits, document the large differences between white and coloured South Africans at the start of the twentieth century. But, as far as we are aware, the historical heights of black South Africans remain unstudied.

Our results come from three very unique data sources. Firstly, we consider a sample of black Southern African males born between 1895 and 1927 who enlisted in the South African military between 1940 and 1945. Secondly, we consider a group of black males whose skeletons are protected in the Raymond A. Dart Collection of Human Skeletons in the School of Anatomical Sciences at Wits University (Dayal et al. 2009). Thirdly, we add the 2008 National Income Dynamics Study (NIDS) survey data to measure the heights of individuals born after 1960. Each of these samples requires careful analysis of the likely incentives to be included in the sample, and the effect this might have on sample selection and inference.

Our results show that black living standards showed little improvement over the 20th century, in contrast not only to the heights of most other world populations, but also to other population groups within the same country. Whereas the differences between black and white South Africans born in the 1980s were 9cm, the difference at the start of the century was already a sizeable 6.5cm. But this single measure masks considerable change over the twentieth century and surprising within-group inequality. We find that the events of the 20th century had varying effects on different ethnic groups within the black population group. In particular, the Sotho experiences the most change (at first negative and later positive) in living standards, while the Xhosa appear to remain largely constant throughout the century. As far as we are aware, we are the first to report on such living standard disparities within the black population. The mining boom of the post-gold standard era seems to have had particularly large effects on black male heights. Although a small sample size would undermine a full persuasive causal analysis of the reasons for these shifts and shocks, our results provide the first quantitative indications of the adverse effects of the repressive and discriminatory labour policies during the first three decades, and the oppressive apartheid policies of the second half of the twentieth century.

2 A BRIEF ECONOMIC HISTORY OF BLACK LIVING STANDARDS

In the late eighteenth century, Southern Africa was populated by a large number of Bantu chiefdoms spread out mainly across the North Eastern part of South Africa. By the 1830s, following the wars of calamity known as the *Mfecane*, the chiefdoms had fanned and then clustered throughout southern Africa, leaving the eastern half of South Africa with a few strong, dominant kingdoms such as the Zulu, Ndebele and a number of Tswana chiefdoms (Wright, 2010). Because these kingdoms consolidated their territory in fertile but rugged terrain, some parts of the interior were left largely depopulated, creating the opportunity for bands of white settlers to occupy.

By the mid-1830s, thus, white settler families (known as *Voortrekkers*) were moving from the eastern border of the Cape Colony into what later became the two Boer Republics of the Orange Free State and Transvaal and the British

colony of Natal. A number of factors influenced this process: the end of slavery in 1834, the influx of British nationals in the 1820s and discontent with the British government that had governed the Cape since 1806 were all plausible push factors for the Voortrekkers' north-easterly journey (Legassick and Ross, 2010). But the relatively 'open' terrain must have been a strong incentive too, especially for those land speculators in debt in the Colony.

These white settlers encountered a number of Bantu chiefdoms, weakened by the effects of the *mfecane*, on the way – for example the Ndebele kingdom, whom they defeated, expelling a formidable force from the region in 1837 (Etherington et al., 2010). The military power and technology in the hands of the Voortrekkers who crossed into lands that had been or were still occupied by various Bantu societies left these kingdoms largely unable to defend themselves. In the Transvaal, for example, land that was already occupied by Bantu societies was appropriated by the white settlers, meaning that the original occupants of the land then had to pay rent while the Boers benefited from fertile, well irrigated land which they now 'owned' (Etherington et al., 2010). Appropriation and expulsion meant that, at a general level, black farmers were pushed into more marginal areas, or forced into a peasant lifestyle as weakly-compensated farm labourers. For some individuals the situation was much worse: there is ample historical evidence of Pedi and Tswana children being taken captive for indentured labour, and instances where Bantu women were forced into working the land without compensation (Etherington et al., 2010).

However, whilst the general impression is of a deterioration of black living standards, not all interaction between the various Bantu chiefdoms and whites were only hostile. Throughout the nineteenth century, there are examples of mutual benefit, of Boer-Bantu cooperation, which allowed parties on both sides to thrive (Etherington et al., 2010; Trapido, 2011). An example of immediate mutual benefit is the discovery of diamonds around 1870 which transformed the economy of Southern Africa on a far-reaching scale. Men of all races flocked to Kimberley to become diggers in the diamond mine. The demand for labour meant high salaries with which young, black men could purchase guns and ammunition, agricultural equipment and other sundries which brought them influence and status back in their kingdoms. Discrimination soon followed. Black men were not allowed to own claims, and were subjugated to menial labourers. A system of migrant labour was soon established to ensure that black wages were kept constant. The discovery of gold two decades later on the Witwatersrand further entrenched this labour system (Wilson 1972). This is reflected in the wage gap between blacks and whites towards the end of the nineteenth century: white miners earned eight times as much as black miners (John Hobson in Trapido, 2011, p.98).

This wage gap was institutionalised through repressive and discriminatory labour practices installed at the start of the twentieth century (Terreblanche 2002). Such laws most famously included a 'colour bar', instituted in the 1910s and modified in the 1920s, which essentially reserved skilled and semi-skilled for white workers. Suppressing black wages while encouraging the growth of white wages through whatever means possible was one way to address the 'poor

white problem' which had become acute in the 1920s and, following the Great Depression, in the early 1930s (Fourie 2007; Natrass and Seekings 2011; Wilson, 2011).

The economy of South Africa has for a long time been dependant on an abundance of cheap or coerced labour (Wilson, 2011). One of the ways through which this was encouraged was by driving down the bargaining power of non-white workers by removing their alternative means of earning a living. For most, this alternative was agriculture. Several natural disasters (locust attacks, severe drought, rinderpest and wheat blight) swept the country during the 1890s, and all but decimated subsistence agriculture, particularly for blacks. This made migrant labour crucial for survival and further drove down black bargaining power (Marks, 2011, p.129-133). The legislation that remained, however, was the most serious peril. The 1913 Land Act – which prohibited, amongst other things, the ownership of land by blacks – had devastating effects on the prospects of black farmers (Freund, 2011), forcing many into the job market.

First-hand accounts provide a useful perspective on the impact of such legislation. After the passing of the Native Land Act in July 1913, Sol Plaatje (2007, p.149) undertook a journey around the country (by train and bicycle) to investigate the effects of the Act. He wrote extensively about the impact of the Act. In the Cape province, for example, Plaatje learned that the prohibitions of the Act drove many back into black farmers to “overcrowded locations”. Poor sanitation in these areas resulted in a loss of welfare and likely many health problems. Grazing ground was limited, which led to the loss of cattle, which had been an important source of nutrition, but also a crucial store of value for blacks.

These effects were not only felt in the Cape, and were not only the impressions of black intellectuals. Plaatje (2007, p.69) also met an ‘affable’ white policeman in the Transvaal province (where the Act was implemented more strictly), and asked him about the Act’s likely impact:

"I knew [them] to be fairly comfortable, if not rich, and they enjoyed the possession of their stock, living in many instances just like Dutchmen. Many of these are now being forced to leave their homes. Cycling along this road you will meet several of them in search of new homes, and if ever there was a fool’s errand, it is that of a Black trying to find a new home for his stock and family just now.”¹

When South Africa left the gold standard in December 1932, the economy experienced some recovery after several years of decline. Mining boomed, lifting output growth by more than 5% per annum. Fedderke and Simkins (2012) divide the first four decades of the Union government in two: from 1914 to 1932 when the South African was adversely affected by local policies and international shocks, and from 1933 to 1945, when the rise in the gold price and the Second World War stimulus ‘permitted a sustained, rapid rate of growth’, from which many black workers benefited too. Apart from agriculture, mining was a leading

¹We have altered some of the original derogatory language.

employer of black labour, and the enlistment of large numbers of white men in the Second World War created an increasing demand for female and black labour, sometimes even in semi-skilled or skilled positions.

But the victory of the National Party in 1948 and the imposition of even more repressive policies changed the fortunes of black South Africans again. Already in anticipation of the apartheid regulation, former president of the African National Congress, Alfred B. Xuma (in Gish, 2000, p.158) noted:

“To the African, it means political enslavement, economic strangulation, and destruction of the national personality. It is exploitation and repression. To submit to it is to assist South Africa to commit suicide. It is to betray future generations – white and black. It is to abandon all human values.”

The 1951 Bantu Authorities Act (followed by the 1959 Promotion of Black Self-Government Act), to name just one apartheid-era law, had devastating consequences for blacks living in the new homelands. Chief Albert Luthuli (2006, p.49) addressed the effects of both in his autobiography:

“Before I was chief I was in a sense a migrant labourer myself; but when I became a villager the plight of my people hit me hard – and Groutville is by no means the poorest of African communities. Others are condemned to land that will support almost nothing, so that a far higher proportion of workers must spend their lives away from home, in cities where African unemployment is rife and increasing. The government reaction to this problem of growing unemployment is typical: send the unemployed back to the already overcrowded sub-economic reserves, which they left because of poverty.”

The lack of access to land had the expected outcomes on nutrition and living standards. William ‘Bloke’ Modisane (1986: 99) described the increased poverty in black communities:

“A man who lives below the poverty datum line is expected to provide his starving children with milk, butter, eggs, vegetable and fruit; he is criticised, and this by way of accusation, for cutting down on those foods which are considered essential to the health of his children. These critics are deliberately blind to the fat fact staring them in the eye that when poverty holds dominion over a family the essentials of life are the first things to be cut down upon; for what else is there to be cut down upon but food? A house to live in, fires for heating, these are the things which cannot go; thus milk can be sacrificed, butter becomes a luxury, eggs a dish for kings, and these essentials for nourishment and life are the first to be cut down upon.”

The conditions were equally poor in cities. On a tour of Coronation Hospital in Sophiatown with a visiting British journalist, Modisane (1986: 100-101) noted:

We were immediately challenged by the blast-furnace screaming of children in various advanced stages of malnutrition; children with dome-like heads, top-heavy wobbling gnomes balancing precariously on reedy legs; others with grotesquely ballooned stomachs flanked by a tattoo of ribs... children who would only return to the same conditions on leaving that had brought them into the hospital in the first place. That colony of children faced death because they were victims of starvation, children sacrificed at the altar of greed and comfort of white South Africa.

These personal observations are backed up by the scant empirical evidence available. Suffice to say, for much of the era of apartheid, there were large differences in the proportions of state funding that were allocated to education, health and pensions for different racial groups, which directly affected the relative living standards of the respective racial groups (Nattrass and Seekings, 2011). It is only of little consolation that, towards the 1970s and 1980s, even before the transition to democracy, there had been a decrease in some of the racial inequality in state spending on things such as education (Bromberger, 1982; Van der Berg 2014). However, the gap remained stark: state pension funds would only be equalised in 1993, for example.

Due to the limited quantitative individual-level evidence of incomes and wealth of black South Africans before democracy, it is difficult to construct a clear picture of the evolution of living standards over the course of the 20th century. Nattrass and Seekings (2015: 28) agree: “It is not possible to identify precise levels and trends in poverty prior to the 1990s because the apartheid state made little or no effort to measure poverty among the black majority of the population, showing serious interest only in the living standards and conditions of white citizens”. A directly comparable measure such as height can help in this regard.

3 THE SAMPLES

Height or stature has a long tradition as an indicator of human welfare and the biological standard of living (Fogel et al. 1983; Steckel 1983). Adult height is generally considered to be determined by two factors, the genetic inheritance of the individual and early-life conditions, including access to nutrition and a favourable disease environment. While genetic variation explains most of an individual’s height, it tends to be less important at the group or country-level as deviations from the mean cancel each other out (Baten and Blum 2012). A considerable body of literature now shows that it is environmental and socio-economic conditions that explain most of the variation in height across societies, not genetics (Steckel 1995; Alter 2004; Deaton 2008). In a recent analysis of individuals born between 1951 and 1992 in 39 developing countries, Akachi and Canning (2015) find, for example, that a 1cm gain in cohort height is associated with a 6% increase in income per capita and 1.25 year increase in life expectancy.

We use three data sets to investigate black living standards in the twentieth century. The first is a data set of 8159 black military recruits in the Second World War, a subset of the population of black males born between 1895 and 1927 in and around South Africa. The second is a smaller data set of 500 observations compiled from cadaver records with birth years between 1896 and 1980. The final data set is a sample of 2885 black men born between 1958 and 1990 from the first wave of the National Income and Dynamics Study (NIDS). Table 1 provides the summary statistics for the three samples.

Although the average height across the samples seem relatively similar – increasing from 167.1cm to 168.8cm over the century – each of the three samples presents us with selection issues. Teasing out the incentives behind the choice of men to enlist in the military service is important so that inferences to the rest of the black male population and comparisons to other samples can be made with confidence. Similar selection issues apply to men included in the cadaver records. Being a representative sample, the NIDS data is far more reflective of the actual black male population, but even here the sample size may give inexact answers at the detailed level. These selection issues are discussed below.

All three samples were restricted to those between the ages of 18 and 50. Adult height can change outside of these ages: men younger than 23 may still experience a growth spurt, while men over the age of 50 may start to shrink (Moradi and Baten, 2005). For the purposes of comparison with other adult populations groups, height should only be analysed between these ages where height is stable. Although the rule has been applied less stringently to this sample, it is unlikely that there would still be a change in the heights of the 18-22 year olds in the sample so significant as to render our results meaningless. A robustness check with recruits older than 22 yield similar results, although, because of a smaller sample, with less significance (larger confidence intervals).

3.1 *World War 2 sample*

The sample of 8159 black males was compiled by transcribing a sample of attestation records of the South African military from 1940-1945. These records are available in the South African National Defence Force archives in Pretoria. Due to attitudes around race at the time, it is likely that most of these men were recruited as non-combatants, either as medical aids, drivers, builders, or telephone operators, to mention a few, and would have been armed at least with a *knobkerrie* (a club with a large knob at one end) and/or *assegai* (a spear-type weapon) for self-protection (Mohlamme, 1995). The assumption that the men in the sample were not recruited for combat is further supported by the fact that there is no truncation in the sample heights. Figure 1a shows that the men had a normal distribution of heights once observations that were outliers or clear transcription errors were accounted for.

It is plausible that unemployed men were recruited to the army, a selection that would bias our sample downward as men of a lower socioeconomic class (and hence, lower average welfare) are more likely to be unemployed. Yet the records do indicate previous job type. Of concern should also be the narrow

distribution. As can be seen in Table 1, the standard deviation of the WW2 sample is more than 6.4 compared to the 7.7 average for the other two samples. This suggests that there may have been a preference for men of a certain height, and thus implicit truncation at either end of the distribution. As long as this truncation is not skewed either way, which it does not appear to be, this should not affect our results.

3.2 *Cadaver sample*

Our second sample consists of 500 human skeletons of black men that forms part of the Raymond A. Dart Collection of Human Skeletons at the University of the Witwatersrand in Johannesburg. The Dart Collection comprises 2605 skeletons from regional Southern Africa. 76% of the skeletons are of black Southern Africans, and 71% are male (Dayal et al. 2009). While most males died between the ages of 20 and 70 – the reason for death is often included – we limit the sample, as with the other data sources, to only men older than 18 and younger than 50.

Most of the bodies in the collection derive from unclaimed bodies in regional South African hospitals, and the documentation that were found with them – including ethnicity and place-of-birth which we use in our analysis (Dayal et al. 2009). The collection in general do not reflect the demographics of South Africa, and there is thus no reason to suspect that our subsample does either. Nevertheless, although this sample is significantly smaller than the other two samples while also stretching over a longer time span, Figure 1b seems to show no evidence of truncation at either side of the distribution. In addition, the average and the standard deviation appear to be very similar to that of the NIDS sample, which is based on a nationally representative sample.

3.3 *NIDS sample*

Our final sample comes from the first round of the National Income Dynamics Study (NIDS), a nationally representative survey undertaken in 2008 (Woolard, Leibbrandt & De Villiers 2010). Here we include only black males born after 1958 and before 1990 given the upper and lower age restrictions we impose above. There appear to be several individuals that are outliers at the bottom of the distribution, men that are implausibly short. We therefore remove all outliers that are four standard deviations from the mean. Figure 1c plots the distribution of heights in the NIDS sample. Adding the three samples in Figure 1d shows the distribution of all 11557 observations.

4 BLACK LIVING STANDARDS IN THE TWENTIETH CENTURY

Combining the three data sets into one series, Figure 2 plots a locally smoothed polynomial of heights across the twentieth century. The grey area indicates the

95% confidence interval. As far as we know, this is the first representation of black living standards based on micro-level evidence for the entire period.

Black males born during the late nineteenth century were on average 168 cm tall. Over the course of the next three decades, the heights of black males would fall by 2cm, to 166cm. This suggests that a strong deterioration in living standards, especially after 1910, the year South Africa became a union. The two decades after 1910 – the period of sharpest decline in the series – was a period which saw increasingly more repressive and discriminatory legislation against black workers introduced. The 1913 Land Act, which limited the sale of land to black men outside the ‘native reserves’, combined with labour regulations in the form of the ‘colour bar’, promulgated by the Mines and Works Act of 1911 and amended in 1912 and 1926, limited the ability of black men to find skilled or semi-skilled work, and repressed black workers’ incomes.

Figure 2 shows a sharp turnaround after 1932, when black heights increase by around 3cm in 15 years. One likely explanation for this turnaround is South Africa’s decision to leave the gold standard in December of 1932 (indicated by the vertical line in Figure 2), boosting mining production, a major source of employment for black men. This increase in heights seems to have come to an abrupt halt around 1948 when the National Party won the elections and introduced its policy of apartheid (indicated by another vertical line). Unfortunately this is also the period with the least number of observations in our dataset, which complicates identifying the exact turning point (reflected in the wide confidence intervals). However, what is clear is that after 1948, black male heights remain at around the same level – 169cm – until the end of the apartheid period.

The question arises whether the trends observed are simply an outcome of sample selection. Our biggest concern is that the time-period with the fewest number of observations (consider, for example, the width of the confidence bands) are also the period with the most rapid change; during the 1930s and 1940s, we rely entirely on the 500 observations in the cadaver sample. We are satisfied that sample selection does not explain our results, for three reasons: First, our summary statistics across all three samples, presented above, are comparable. Second, the cadaver sample is likely to be biased downward as unclaimed bodies would tend to be poorer individuals – thus the heights observed here, if biased, are more likely lower bound on the population’s actual height. An unobserved downward bias would run counter to our argument of a significant increase in heights over this period. Third, even if the cadaver sample is completely removed from the analysis, the trends remain the same: a rapid decline in heights until 1930, and a higher but largely stagnant trend from 1960 onwards. If one has to connect the endpoint of the WWII sample with the starting point of the NIDS sample, the overall trend would look very similar to Figure 2.

An additional worry might be that these trends, particularly within each sample, do not simply reflect a shift in labour demand. Conceivably the early decline, for example, is simply a reflection of a shift in military recruitment, from skilled into unskilled labour (assuming that skill level is correlated with

socioeconomic status). To test this, we only consider black males who worked in one industry: mining. Both the WW2 data and the NIDS data report occupation or industry. We remove all individuals not formerly employed as ‘miners’ or employed within ‘mining and quarrying’.

Unfortunately occupational information is not available in the Dart Collection archive. We instead make use of information on the cause of death. We assume all deaths related to ‘lung’, ‘pneumonia’ or ‘respiratory’ diseases were mine workers. While this may seem an extreme assumption, we believe, based on historical and medical evidence, the correlation between these diseases and employment in mines to be high. Figure 3 shows the evolution of heights of black mine workers (all male) across the twentieth century.

The pattern of Figure 3 largely resembles the pattern of the full sample in Figure 2, although the initial rapid decline is less obvious and the confidence intervals are wider (given the smaller number of observations of 1260 – 11% of the full sample). Importantly, the steep rise in black male heights during the 1930s and 1940s, which we ascribe to the impact of the mining boom, is still evident.

If it is not sample selection that drives the results, what can explain the steep rise in the 1930s and 1940s? Figure 4 provides some support for the argument that the gold mining industry contributed to the improvement in welfare of black men. It overlays the growth in the remuneration to the gold mining industry over the heights of black men at year-of-birth. A strong correlation is observed: gold mining remuneration expanded significantly during the 1930s and 1940s, both in the number of employed workers and their (real) wages. This was as a result of South Africa’s decision to leave the gold standard in 1932. And because mining was such an important component of South Africa’s Gross Domestic Product (15.6% in 1930 up to 21.3% in 1933), real GDP per capita increased by an annualised 5.1% during the 1930s compared to 2.2% the previous decade.²

Rising mining profits did not only give rise to more jobs and somewhat higher wages for black workers, but also to greater tax revenue at the local municipality level. A part of this additional revenue was used to finance, in 1934, the construction of a new suburb – the south-western township (Soweto), to improve the living conditions of mine workers. We posit that increases in income for mineworkers would have been key in improving health and nutritional outcomes for the children of those mineworkers and this helps to explain the improvement in heights in the 1930s.

We note that these are mere correlations; it is almost impossible to causally link mining remuneration with an increase in birth height. We would argue, though, that the trend in remuneration is, in the least, supportive of our hypothesis that heights increased significantly during the 1930s and 1940s because of an expanding mining sector.

²Mining data is obtained from South African Government (1970). GDP per capita is obtained from Alvaredo (2016).

5 WITHIN-GROUP DYNAMICS

These general trends obscure the dynamics within the black population, a topic that has received very little attention in South African economic history. All three data sets identify either the ethnicity or the language group of each individual. The World War 2 and WITS samples required extensive cleaning, and some interpretation by the authors. There are also several individuals where either the ethnicity is left blank, or is simply indicated as ‘Black’ or ‘African’. We are forced to exclude these observations from the analysis. In the end, we classify nine black ethnic groups per contemporary classifications of those ethnicities – Ndebele, Pedi, Sotho, Swazi, Tsonga, Tswana, Venda, Xhosa and Zulu. Table 2 provides a descriptive summary of the nine ethnic groups.

Mean height across ethnicity already provide some indication of inter-group differences. While Sotho men are on average 166.8cm tall, Tsonga men are almost two centimetres taller. The picture is slightly different when we only consider differences in the NIDS sample, now weighted to give a fairer reflection of the population. Ndebele and Xhosa men are now the shortest, at 167cm, while Sotho men are now significantly taller at 169cm. The heights of Tsonga men have also fallen, from being the tallest in the sample to amongst the shortest, at 167.5cm. Swazi men are the tallest in the weighted NIDS sample, at 171cm.

These differences may be attributed to, amongst others, an imprecise allocation of observations by ethnicity across the century. For example, Sotho men may be more prevalent during the first half of the century, while Swazi men may only appear towards the latter half.³ For that reason, Figure 4 provides the temporal changes for the three largest groups, the Xhosa, Sotho and Zulu.

Figure 5 clearly shows different temporal changes of heights across the three ethnicities. Xhosa male heights remain flat for the entire period of analysis. For the first three decades, Xhosa men in our sample are taller than Sotho or Zulu men. The height of Sotho men fall precipitously during the first three decades. Two likely explanations are possible. First, Sotho men were increasingly moving to the urban areas around the mines of Johannesburg where employment was increasingly limited to poorly remunerated, unskilled occupations. Second, and perhaps more importantly, the beginning of the period is a time of great famine in Basotuland which had long-lasting effects. Eldredge (2002: 80) explains:

“The 1890s saw a particularly disastrous chain of events. Locusts destroyed crops in 1892, 1893, 1895 and 1898. The country [Basotuland] suffered a prolonged drought from 1894 through 1898. The Rinderpest cattle epizootic entered the country in 1896, and internal migrations caused by the drought accelerated the spread of the disease among the cattle. At the end of the century, the Basotho lost 80 percent of their cattle during the Rinderpest. Famine was severe by 1898, when once again a civil war broke out.”

³It should be noted, though, that all three data sources include observations from all nine ethnicities. See Appendix for a breakdown by data source.

Although there was some reprieve during the Anglo-Boer War as Basotho horses were in high demand by the British, disaster struck again in 1903, when food was imported into Basutoland for the first time. “Lesotho, once the grain basket of the Cape Colony and the Orange Free State, was no longer self-sufficient in food production” (Eldredge 2002: 81).

The ranking between the three ethnicities of Figure 5 changes after 1932, when the heights of Zulu men but especially Sotho men increase rapidly. This is not surprising; of the three groups, Sotho men would have been most likely to work in and around the mines and thus benefit from the increased labour opportunities available during the 1930s and 1940s. Zulu heights continue to increase until 1960, where after they plateau. Although few Sotho men are observed during the early apartheid period, their heights seem to change little following the rapid increase of the 1930s and early 1940s.

6 BLACK LIVING STANDARDS IN COMPARISON

Black living standards also did not evolve in isolation. We next compare the trend in black male heights with white male heights. We use four sources of white male heights. The first is data set that itself consists of four sources: a series of World War 1 attestation forms, collected by Kris Inwood and Oliver Masakure (2013), a series of attestations of the Cape Mounted Police, attestations of the South African Constabulary (Fourie, Grundlingh & Mariotti 2015) and attestations of sixteen smaller forces that enlisted throughout South Africa during the early twentieth century. The full data set is discussed and analysed by Fourie, Inwood and Mariotti (2016). It should be noted that there were height requirements for enrolment in these forces, which means that the height average is probably higher than the actual population. We also do not weight observations by ethnicity, language or race.

The second, third and fourth sources are the same as for the black male heights, although the sample sizes – apart from World War 2 – is significantly smaller. We also note that the military heights of the white soldiers who enlisted in World War 2 are probably biased upwards because of height requirements, although as we argue elsewhere, because of technological change, height requirements probably became less relevant over the course of the twentieth century (Fourie, Inwood and Mariotti 2014). There should also be no biases between whites and blacks in the cadaver and NIDS datasets. The summary statistics are provided in Table 3.

Figure 6 compares white and black male heights over the twentieth century. Three things should be noted. First, the difference between white and black male heights is persistently large. Even though the confidence intervals are at some stages quite large, owing to the few observations available to us, the two lines never overlap. Second, the gap increases over time. The average height difference for the first decade of the twentieth century is 6.5cm. By the 1980s,

the difference has increase to 8.9cm. The largest increase in the gap seems to follow immediately after the introduction of apartheid policies in the 1950s. Note that if sample selection plays an important role, the gap during the first half of the twentieth century should be largest, given that these samples were selected differently; white men were selected into the army on height while black men were not. Yet, despite this potential selection, the gap still grows larger over the period. Third, the 1930s and 1940s sees a prodigious increase in both black and white male heights, confirming the economy-wide impact of the mining and Second World War boom. A more nuanced causal inference is, however, difficult given the few observations and explanatory variables for this dynamic period.

One frequent question is whether the differences in black and white heights can only be ascribed to nutritional and environmental or socio-economic factors, or whether genetic inheritance also plays a role. One possible answer is to look for societies where genetic inheritance is similar, but there are large within-group differences that can only be attributed to socio-economic factors. Korea is one example. Pak (2004) shows that while South and North Koreans born during the 1940s were of similar height, the adult heights of North Koreans have stagnated while the heights of South Koreans have increased by 6cm, the same gap between black and white at the start of the twentieth century.

Because of data availability, the analysis so far has been restricted to the heights of black and white males. We have no observations in the World War 2 sample of female heights, and only a few in the cadaver sample. We instead use only the NIDS sample to compare, in Figure 7, black male and female heights, and then those two trends with white male and female heights.

The lines look flat, but reveal two important trends. First, both black male and female heights seem to increase for those born until the mid-1970s, and then stagnate or even decline. It is not surprising that these trends are closely correlated, again, with South Africa's poor economic performance between 1975 and 1990, and the well-documented social unrest that of this period. Second, white males and females exhibit no increase in heights over the period, a somewhat surprising result given how the apartheid system had been designed to benefit these groups exclusively. This either suggests that white females had already reached their full height potential earlier during the century, with additional material gains not translating into height increases, or that their increase in incomes were counterbalanced by a change in diet and environmental conditions as they urbanised.

The availability of black female heights for the second half of the twentieth century also allows comparisons with similar stratified survey data for other African countries. The Demographic and Health Survey was conducted across many African countries. In Table 3, we compare black and white South African females against their counterparts in 28 African countries. We obtain the estimates for the other African countries from Akachi and Canning (2015).

Black South African females are shorter on average than half the sample, evidence that early-life conditions for those born during the height of apartheid were even worse off relative to African countries after colonialism. Although there are strong regional groupings – for example the clustering of Sahel coun-

tries at the top of the list which is most likely explained by access to proteins, notably milk and beef, during early childhood – environment is not deterministic: Zimbabwe is in the top ten while Nigeria falls below South Africa. White South African females are the tallest in Africa.

In our final analysis, we return to male heights to compare South African blacks and whites to the heights of males from a sample of 74 non-African countries. Here we obtain the estimates for the other countries from Grasgruber, Sebera, Hrazdřira and Kalina (2016).

Table 4 highlights the disparity in heights within South Africa. White South African men are in the top half of the table, although it has to be noted that during the twentieth century they had lost the lead they had had at the start of the twentieth century as other countries caught up and surpassed them. Black South African men are close to the bottom of the list, with mostly South-east Asian countries, where proteins such as milk and beef are not part of the regular diet, ranking lower.

7 CONCLUSIONS

Owing to the lack of adequate micro-level evidence, the living standards of black South Africans before democracy remain poorly understood. This paper begins to rectify this gap. We use three data sources on the heights of black South African men to show the persistently poor living standards across the twentieth century.

We find evidence to suggest that the first three decades of the century were particularly bad, perhaps due to the increasingly repressive labour policies in urban areas and continued expropriation of land, especially of the Basotho. The two decades following South Africa’s departure from the gold standard, a higher international gold price and the demand for manufactured goods from South Africa due to the Second World War seem to have benefited black South Africans significantly. Unfortunately this progress was halted by a return to stagnation after 1948, which coincided with the introduction of further repressive and discriminatory policies that would become known as apartheid policy. Chief Luthuli (2006: 233) summarised the overall impact of these laws on black South Africans:

“The past thirty years have seen the greatest number of Laws restricting our right and progress until today we have reached a stage where we have almost no rights at all: no adequate land for our occupation, our only asset, cattle, dwindling, no security of homes, no decent and remunerative employment, more restrictions to freedom of movement through passes, curfew regulations, influx control measures; in short we have witnessed in these years an intensification of our subjection to ensure and protect white supremacy.”

Although our results support such anecdotal evidence of the repression of black living standards, the peculiar samples we use might introduce sample selection biases which we have to account for. Furthermore, the samples provide little supplementary individual-level factors that could be used as explanatory

variables. The best we can do is to show that the same trend exists if one only considers mine labourers.

The average trend in black heights masks important within-ethnic trends. Such inequalities within the black population have, as far as we know, not been adequately examined or explained. Our analysis of heights show that, while the heights of Xhosa men remained relatively unaffected over the twentieth century, those of Sotho men declined and then increased significantly during the 1930s and 1940s. The decline, we posit, might be explained by the expropriation of land, and the increase by greater access to employment, even of semi-skilled and skilled positions.

These results allow us to compare black South African heights to those of white South Africans, and to the rest of the world. Unsurprisingly, living standards for black South Africans are poor across all measures, even in comparison to other African countries following colonisation. The roots of this poor record, we show, are not limited to South Africa's apartheid era, but lie deep in the history of segregation, exploitation and appropriation that characterised nineteenth- and early twentieth century South Africa.

References

- [1] Akachi Y, Canning D. Inferring the economic standard of living and health from cohort height: evidence from modern populations in developing countries. *Economics & Human Biology*. 2015 Dec 31;19:114-28.
- [2] Alter G. Height, frailty, and the standard of living: Modelling the effects of diet and disease on declining mortality and increasing height. *Population Studies*. 2004 Nov 1;58(3):265-79.
- [3] Baten J, Blum M. Growing tall but unequal: new findings and new background evidence on anthropometric welfare in 156 countries, 1810–1989. *Economic History of Developing Regions*. 2012 Jun 1;27(sup1):S66-85.
- [4] Baten J, Komlos J. Height and the Standard of Living. *The Journal of Economic History*. 1998 Sep 1;58(03):866-70.
- [5] Bromberger N. Government policies affecting the distribution of income, 1940-1980. Schrire, Robert (Ed.). 1982:165-203.
- [6] Dayal MR, Kegley AD, Štrkalj G, Bidmos MA, Kuykendall KL. The history and composition of the Raymond A. Dart Collection of human skeletons at the University of the Witwatersrand, Johannesburg, South Africa. *American Journal of Physical Anthropology*. 2009 Oct 1;140(2):324-35.
- [7] Deaton A. Height, health, and inequality: the distribution of adult heights in India. *The American economic review*. 2008 May;98(2):468.
- [8] De Zwart P. South African Living Standards in Global Perspective, 1835-1910. *Economic History of Developing Regions*. 2011 Jan 1;26(1):49-74.

- [9] Du Plessis S, Du Plessis S. Happy in the service of the Company: the purchasing power of VOC salaries at the Cape in the 18th century. *Economic History of Developing Regions*. 2012 Jun 1;27(1):125-49.
- [10] Eldredge EA. A South African kingdom: the pursuit of security in nineteenth-century Lesotho. Cambridge University Press; 2002 Jun 6.
- [11] Fedderke J, Simkins C. Economic growth in South Africa. *Economic History of Developing Regions*. 2012 Jun 1;27(1):176-208.
- [12] Fogel RW, Engerman SL, Floud R, Friedman G, Margo RA, Sokoloff K, Steckel RH, Trussell TJ, Villaflor G, Wachter KW. Secular changes in American and British stature and nutrition. *The Journal of interdisciplinary history*. 1983 Oct 1;14(2):445-81..
- [13] Fourie J. The remarkable wealth of the Dutch Cape Colony: measurements from eighteenth-century probate inventories. *The Economic History Review*. 2013 May 1;66(2):419-48.
- [14] Fourie J, Grundlingh A, Mariotti M. “Poor South Africa! Will no nice English people ever come out here?”—The South African Constabulary of the Second South African War. Stellenbosch Working Paper series. 2015.
- [15] Fourie J, Inwood K, Mariotti M. Can historical changes in military technology explain the industrial growth puzzle?. Mimeo., London School of Economics; 2014.
- [16] Fourie J, von Fintel D. The dynamics of inequality in a newly settled, pre-industrial society: the case of the Cape Colony. *Cliometrica*. 2010 Oct 1;4(3):229-67.
- [17] Fourie J. The South African poor White problem in the early twentieth century: Lessons for poverty today. *Management Decision*. 2007 Sep 11;45(8):1270-96.
- [18] Freund B. South Africa: the Union years, 1910–1948—political and economic foundations. *The Cambridge History of South Africa*. 2011;2:1885-994.
- [19] Gish S. *Alfred B. Xuma*. 1st ed. New York: New York University Press; 2000:158.
- [20] Grasgruber P, Sebera M, Hrazdára E, Cacek J, Kalina T. Major correlates of male height: A study of 105 countries. *Economics & Human Biology*. 2016 May 31;21:172-95.
- [21] Inwood K, Masakure O. Poverty and physical well-being among the coloured population in South Africa. *Economic History of Developing Regions*. 2013 Dec 1;28(2):56-82.

- [22] Komlos J. Access to food and the biological standard of living: perspectives on the nutritional status of native Americans. *The American Economic Review*. 2003 Mar 1;93(1):252-5.
- [23] Komlos J, Lauderdale BE. The mysterious trend in American heights in the 20th century. *Annals of human biology*. 2007 Jan 1;34(2):206-15.
- [24] Luthuli A. *Let My People Go*. 1st ed. Cape Town: Tafelberg; 2006:49.
- [25] Mariotti M. Labour markets during apartheid in South Africa1. *The Economic History Review*. 2012 Aug 1;65(3):1100-22.
- [26] Marks S. Class, Culture and Consciousness in South Africa, 1880-1899. In: Ross R, Mager A, Nasson B, ed. *The Cambridge History Of South Africa, Volume 2: 1885-1994*. 1st ed. New York: Cambridge University Press; 2011:102-156.
- [27] Modisane B. *Blame Me On History*. 1st ed. Craighall: Ad. Donker; 1986.
- [28] Mohlamme JS. *Soldiers Without Reward: Africans in South Africa's Wars*. publisher not identified; 1995 Jun.
- [29] Moradi A, Baten J. Inequality in Sub-Saharan Africa: new data and new insights from anthropometric estimates. *World development*. 2005 Aug 31;33(8):1233-65.
- [30] Natrass N, Seekings J. The economy and poverty in the twentieth century. *The Cambridge History of South Africa*. 2011;2:1885-994.
- [31] Seekings J, Natrass N. *Policy, politics and poverty in South Africa*. Springer; 2015 Jul 21.
- [32] Leibbrandt M, Finn A, Woolard I. Describing and decomposing post-apartheid income inequality in South Africa. *Development Southern Africa*. 2012 Mar 1;29(1):19-34.
- [33] Legassick M, Ross R. From slave economy to settler capitalism: The Cape Colony and its extensions, 1800–1854. *The Cambridge History of South Africa*. 2010;1:253-318.
- [34] Pak S. The biological standard of living in the two Koreas. *Economics & Human Biology*. 2004 Dec 31;2(3):511-21.
- [35] Plaatje S. *Native Life In South Africa*. 3rd ed. Northlands [South Africa]: Picador Africa; 2007.
- [36] South African Government, 1970. *Report 09-10-01. Gross Domestic Product at Factor Cost, 1910-1968*. Stellenbosch University Library: Government Reports.\

- [37] Steckel RH. Height and per capita income. *Historical Methods: A Journal of Quantitative and Interdisciplinary History*. 1983 Jan 1;16(1):1-7.
- [38] Steckel RH. Heights and human welfare: Recent developments and new directions. *Explorations in Economic History*. 2009 Jan 31;46(1):1-23.
- [39] Steckel RH. Stature and the Standard of Living. *Journal of economic literature*. 1995 Dec 1;33(4):1903-40.
- [40] Terreblanche SJ. *A history of inequality in South Africa, 1652-2002*. University of Kwazulu Natal Press; 2002.
- [41] Trapido S. Imperialism, Settler Identities, and Colonial Capitalism: The Hundred-year Origins of the 1899 South African War. In: Ross R, Mager A, Nasson B, ed. *The Cambridge History Of South Africa, Volume 2: 1885-1994*. 1st ed. New York: Cambridge University Press; 2011:66-101.
- [42] Van der Berg S. The transition from apartheid: Social spending shifts preceded political reform. *Economic History of Developing Regions*. 2014 Jul 3;29(2):234-44.
- [43] Wilson F. *Labour in the South African gold mines 1911-1969*. Cambridge University Press; 2011 Mar 3.
- [44] Wilson F. Historical roots of inequality in South Africa. *Economic History of Developing Regions*. 2011 Jun 1;26(1):1-5.
- [45] Wright J. Thinking beyond ‘tribal traditions’: Reflections on the precolonial archive. *South African Historical Journal*. 2010 Jun 1;62(2):268-86.
- [46] Woolard I, Leibbrandt M, De Villiers L. The South African national income dynamics study: design and methodological issues. *Studies in Economics and Econometrics*. 2010 Jan 1;34(3):7-24.

Table 1: Summary statistics of three samples

	Observations	Mean	Std. Dev.	Min	Max
WW2	8 159	167.1	6.4	142	199
WITS	500	167.6	7.7	139	188
NIDS	2 885	168.8	7.6	131	200

Table 2: Summary statistics for black male heights by ethnicity, 1895-1990

	Full sample (unweighted)		NIDS (weighted)		Full sample	
	Observations	Mean	Observations	Mean	Lower-bound	Upper-bound
Ndebele	167	167.33	28	167.49	166.40	168.27
Pedi	1207	167.86	272	169.68	167.50	168.22
Sotho	1292	166.76	345	169.00	166.39	167.14
Swazi	332	168.33	94	171.19	167.57	169.09
Tsonga	348	168.71	102	167.51	167.96	169.47
Tswana	982	167.26	391	170.23	166.83	167.69
Venda	246	167.84	55	170.15	166.93	168.75
Xhosa	1140	167.54	531	167.17	167.13	167.95
Zulu	1585	167.84	957	168.98	167.48	168.20

Table 3: Summary statistics of white male heights, by source (1880-1990)

	Observations	Mean	Std. Dev.	Min	Max
WW1	6306	173.74	6.38	139.7	198.1
WW2	7695	174.37	6.63	144.8	209.6
WITS	27	175.04	7.36	157.0	188.0
NIDS	159	178.23	7.13	153.0	198.5

Table 3: Female heights for a selection of 28 African countries

Country	Survey year	Obs	Initial birth year	Last birth year	Mean height	SD of height
South Africa (white)	2008	193	1956	1990	165.62	6.74
Senegal	2010–11	4389	1960	1991	163.09	6.76
Burkina Faso	2010	6797	1960	1990	161.83	5.9
Mali	2006	11440	1956	1986	161.31	6.66
Niger	2006	3680	1956	1986	160.78	6
Namibia	2006–07	7762	1957	1987	160.58	7.03
Cameroon	2011	6038	1961	1991	160.42	6.66
Zimbabwe	2010–11	6914	1960	1991	160.13	6.24
Egypt	2008	15990	1958	1988	159.47	5.93
Kenya	2008–9	6892	1958	1989	159.33	7.4
Ghana	2008	3838	1958	1988	159.27	6.58
Cote d'Ivoire	2011-12	3827	1962	1992	159.07	6.26
Benin	2006	14030	1956	1986	159.05	6.59
Uganda	2006	2254	1956	1986	158.98	6.53
Swaziland	2006–7	3890	1956	1987	158.92	6.31
Congo, Rep	2005	5431	1955	1985	158.86	8.11
Guinea	2005	3962	1955	1985	158.81	6.42
South Africa (black)	2008	2885	1956	1990	158.59	7.12
Morocco	2003–4	13988	1953	1984	158.54	5.92
Zambia	2007	5600	1957	1987	158.18	6.55
Nigeria	2008	26356	1958	1988	158.17	7.26
Lesotho	2009	3002	1960	1989	157.29	6.38
Congo, Dem Rep	2007	4731	1957	1987	157.19	7.93
Liberia	2007	5872	1957	1987	157.12	6.3
Ethiopia	2011	12280	1961	1991	157.03	6.59
Rwanda	2010	5401	1960	1991	156.85	6.49
Malawi	2010	5927	1960	1990	156.36	6.41
Mozambique	2011	10572	1961	1991	156.3	6.25
Madagascar	2008–09	6722	1959	1989	154	5.98

Table 4: Heights of black and white male South Africans compared to rest of world

Rank	Country	Height	Rank	Country	Height	Rank	Country	Height
				United				
1	Netherlands	183.8	26	Kingdom	177.7	51	Japan	172.1
2	Bosnia & Herzegovina	182.2	27	Belarus	177.5	52	Armenia	171.9
3	Iceland	181.8	28	Hungary	177.5	53	Morocco	171.7
4	Sweden	181.4	29	Macedonia	177.4	54	Kyrgyzstan	171.3
				South Africa				
5	Lithuania	181.3	30	(white)	177.3	55	Uzbekistan	171.1
				Russian				
6	Czech Republic	181.3	31	Federation	177.3	56	Turkmenistan	170.9
7	Estonia	180.9	32	Spain	177.3	57	Jordan	170.9
8	Denmark	180.6	33	Ukraine	176.6	58	Egypt	170.3
9	Croatia	180.5	34	Italy	176.5	59	Tajikistan	170.1
							South Africa	
10	Germany	180.2	35	Romania	176.0	60	(black)	168.9
11	Latvia	180.1	36	Georgia	175.8	61	Mongolia	168.2
12	Norway	179.9	37	Kazakhstan	175.6	62	Pakistan	167.8
13	Slovenia	179.8	38	Bulgaria	175.3	63	Thailand	167.6
14	Austria	179.6	39	Moldova	174.8	64	Malaysia	167.5
15	Belgium	179.5	40	Algeria	174.6	65	Sri Lanka	165.6
16	Australia	179.4	41	Cyprus	174.6	66	India	165.2
17	Slovakia	179.3	42	Israel	174.5	67	Viet Nam	164.4
18	USA	178.9	43	South Korea	174.3	68	Indonesia	163.9
19	Finland	178.6	44	Tunisia	174.2	69	Philippines	163.8
20	Poland	178.5	45	Albania	174.0	70	Laos	163.6
21	Ireland	178.5	46	Portugal	173.9	71	Yemen	163.1
22	Switzerland	178.2	47	Turkey	173.6	72	Nepal	163.0
23	Greece	178.1	48	Iran	173.4	73	Bangladesh	162.7
24	New Zealand	177.8	49	Azerbaijan	172.9	74	Cambodia	162.4
25	France	177.8	50	China	172.1			

Figure 1a:

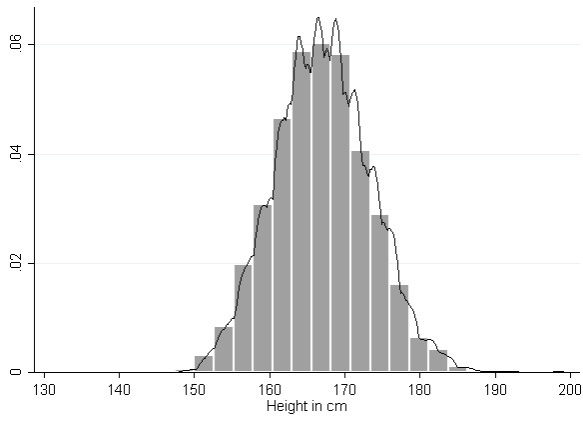


Figure 1b:

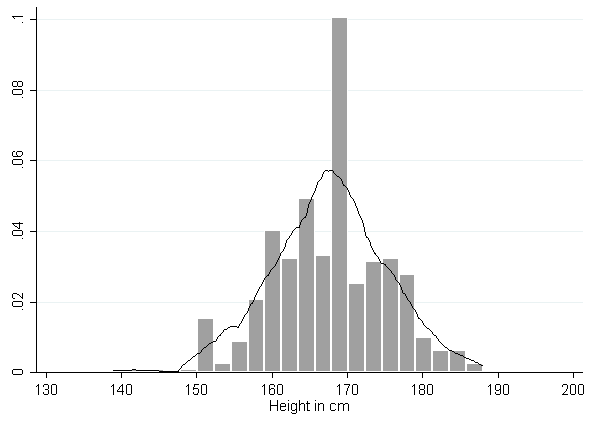


Figure 1c:

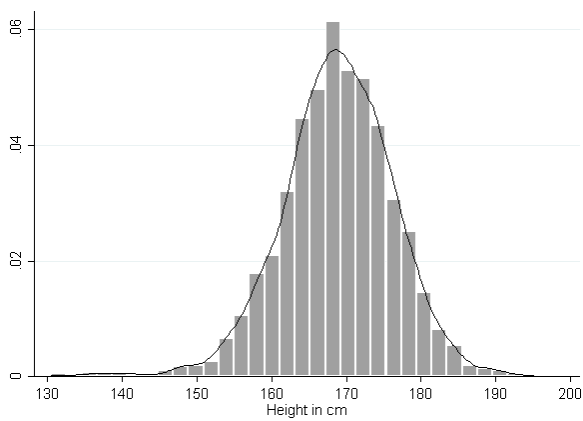


Figure 1d:

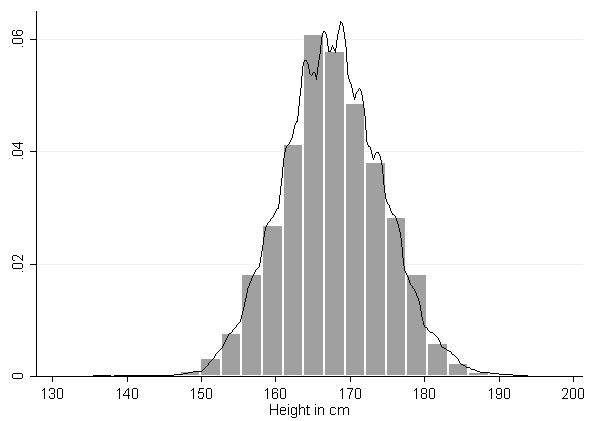


Figure 2: Black male heights, 1895-1990

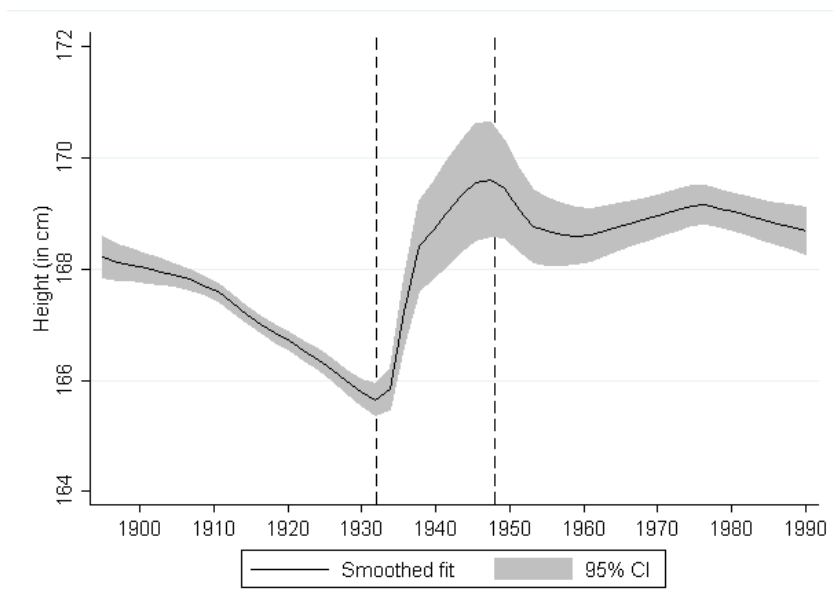


Figure 3: Black male heights of mine-workers, 1895-1990

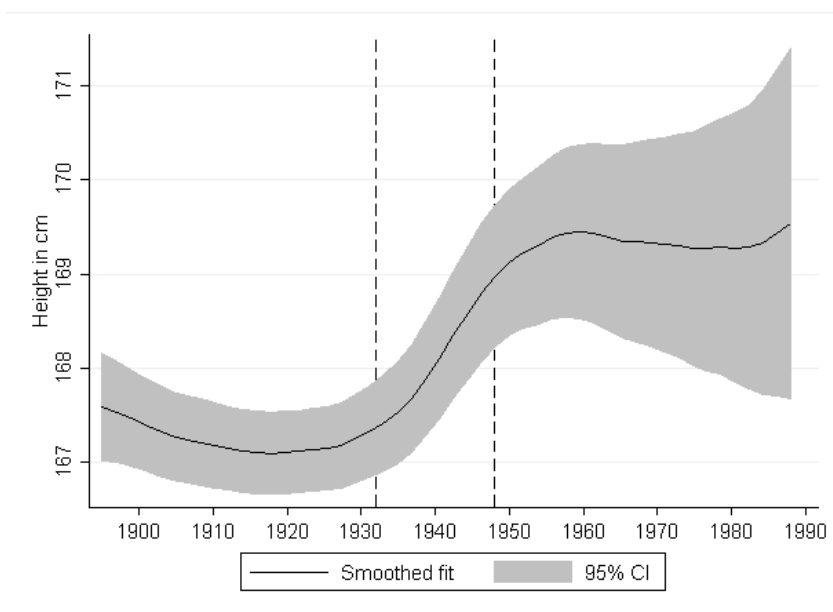


Figure 4: Black male heights and growth in gold mining remuneration

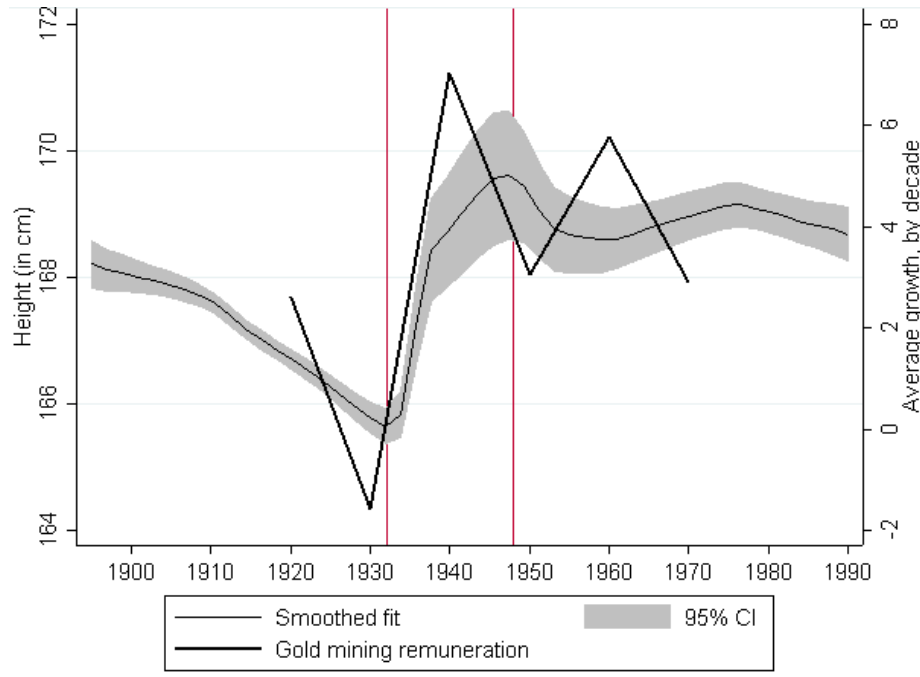


Figure 5: Black male heights by ethnicity, 1895-1990

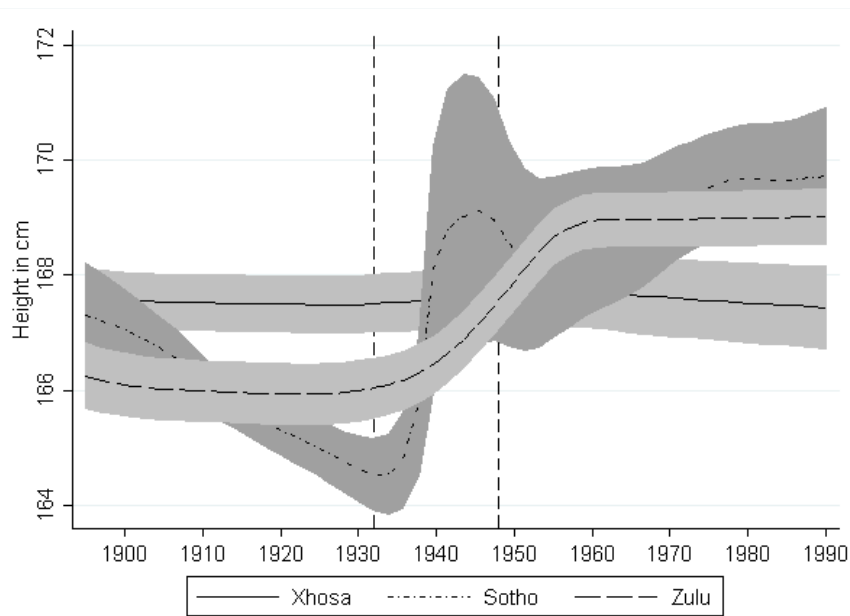


Figure 6: Black and white heights over the twentieth century

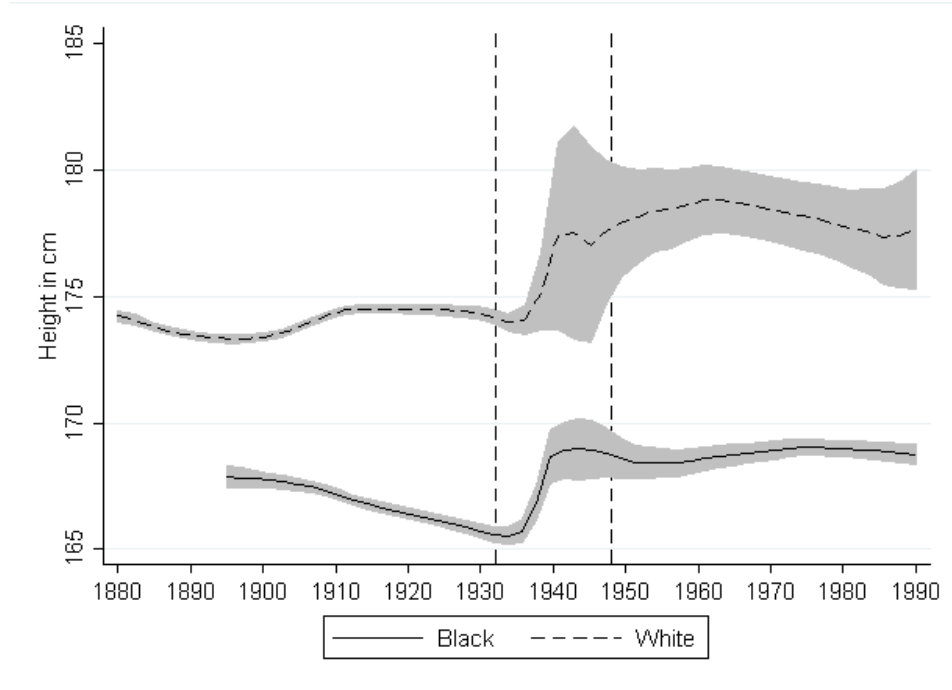
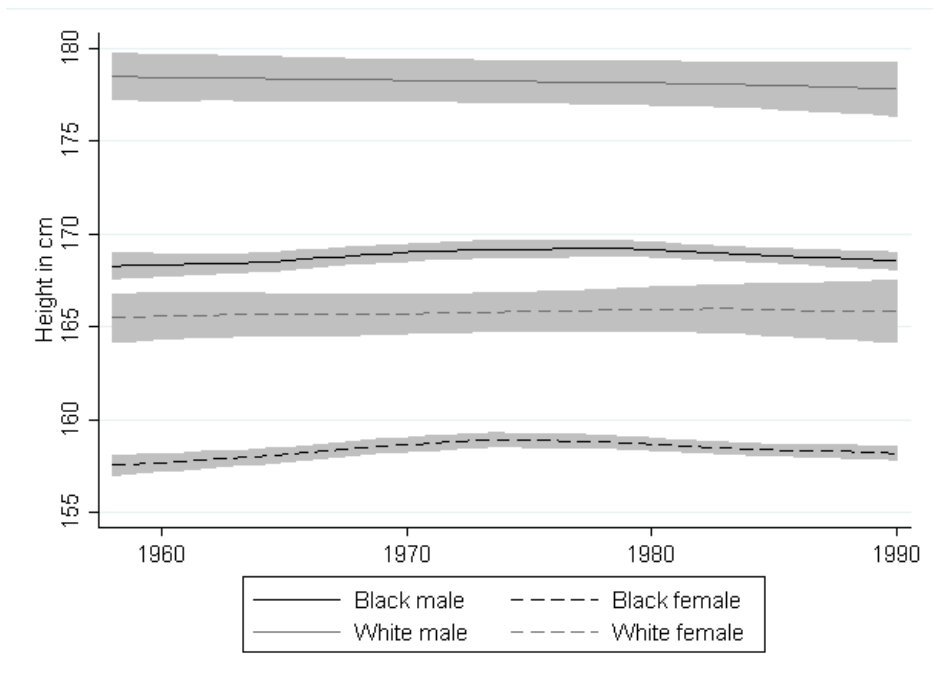


Figure 7: Comparisons of black male and female heights with white male and female heights, birth year 1956-1990



Appendix

Table A1: Number of observations by source and ethnicity

	WW2	WITS	NIDS	Total
Ndebele	130	9	28	167
Pedi	930	5	272	1207
Sotho	890	57	345	1292
Swazi	229	9	94	332
Tsonga	227	19	102	348
Tswana	576	15	391	982
Venda	180	11	55	246
Xhosa	568	41	531	1140
Zulu	527	101	957	1585
Total	4257	267	2775	7299