



Father's Employment and Sons' Stature: The Long Running Effects of a Positive Regional Employment Shock in South Africa's Mining Industry

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Father's Employment and Sons' Stature: The Long Running Effects of a Positive Regional Employment Shock in South Africa's Mining Industry*

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Abstract

I exploit the unexpected increase in employment in 1975, 76 and 77 in the South African homelands to compare the long term adult outcomes of children whose fathers benefitted from the employment increase to those who did not. Using a standard difference in difference approach I find that the shock affected males who were either newborn or in utero at the time, providing support to the fetal origins hypothesis and showing the importance of mother's nutrition. The income increases did not raise household incomes above the poverty datum line, explaining why older individuals were not affected. This study provides previously unmeasured individual level information on the quality of life in the homelands during apartheid, an era when African living standards were neglected but unmeasured because of a lack of data collection.

Key words: Apartheid; living standards; stunting; difference-in-difference; fetal origins hypothesis

JEL Classification: I31 N37

1 Introduction

A large literature uses the long term impacts of in utero and early childhood environmental conditions on adult outcomes such as health, cognitive ability and longevity to measure living standards (Komlos 1987, Barker 1992, Costa 1993, Steckel 1995, Almond 2006, Frijters et al. 2010, Hatton et al. 2010,

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and Almond and Currie 2011). Food intake, public health provision and the disease environment all play a role (Almond et al. 2007, and Gørgens et al. 2012). It is also now well known that exposure to increased family incomes in early childhood years can lead to increased nutritional intake for children (Jensen 2000, Duflo 2003, and Banerjee et al. 2010). The implication is that family income increases can improve early childhood environmental conditions which can result in positive adult outcomes such as increased stature, longevity and improved health. However, many studies that characterize improvements in living standards rely on time variation between cohorts during periods of economic growth and slumps. As Banerjee et al. (2010) note, these studies cannot necessarily distinguish between the role that improvements in nutritional intake play versus the role played by the increase in the provision of public services such as health care that might occur during boom periods when incomes increase. This paper fills the gap by exploiting the sudden rise in incomes in regions of South Africa that had previously suffered from long term malnutrition because of poverty, regions where changes in the provision of public services did not occur.

Furthermore, most studies rely on data from subsamples of the population that may be subject to sample selection bias as noted by Bodenhorn, Guinanne and Mroz (2013). The paper avoids that pitfall by using the 2008 wave of the National Income Dynamics Study (NIDS) to determine the impact of an unexpected shock to the labor supply of the South African mining industry between 1975 and 1978 on living standards in the South African homelands.¹

In 1974 the South African mining sector experienced an unanticipated decline of its massive foreign labor supply and responded by increasing recruitment activities in the former homelands resulting in an unexpected and sudden increase in the incomes of many African men living in those homelands. In April 1974 President Hastings Banda of Malawi suspended all recruiting operations of the South African Chamber of Mines in that country pending the outcome of an inquiry into the causes of a plane crash that killed 77 Malawian miners. The decision to halt Malawian labor supply affected 70,000 gold miners that the South African Chamber of Mines had to replace. Then in 1976, the new government in Mozambique, the Liberation Front of Mozambique (FRELIMO), discouraged the migration of workers from Southern Mozambique to apartheid South Africa. The number of foreign workers in the mining industry fell from 297,000 in December 1973 to 189,000 at the end of 1977 as shown in table 1A (South African Institute of Race Relations 1974, 1977, and 1978). To fill the worker short fall, employment of domestic recruits increased from 95,000 to 193,000 over the same period (see table 1B). Three out of the ten former homelands experienced large increases in mining sector employment both in absolute value and as a proportion of the population. For approximately 24 % of households in the affected areas this signified an increase in family incomes of at least R14.22 per month when the average yearly income in Transkei (one of the affected homelands) had

¹There were 10 homeland areas, one homeland for each ethnic group. Four homelands had been granted political independence by the South African government by the end of apartheid, although this was never formally recognised by the international community.

been between R40 and R120 in 1953, the latest date for which there is data for all homelands (Tomlinson Commission 1955).² ³

South Africa's former homeland regions were home to approximately 20 million African South Africans until they were reincorporated into South Africa in 1994. Their physical land mass constituted slightly more than 13 percent of the total South African land mass and yet they housed approximately 50 percent of the African population. Homelands were situated in rural areas of South Africa with either low rainfall, poor soil quality or both. Homelands were overcrowded and unable to support the agricultural activities on which most inhabitants depended. Jobs were scarce and unemployment was rife.

While we know that the level of poverty in the homelands was high (Simkins 1984, Hirsch 1986, Wilson and Ramphele 1989), the long term physical consequences of poverty in the homelands are not well known due to the lack of data collected during apartheid. Wilson and Ramphele (1989) provide substantial anecdotal evidence on life in the homelands in their collection of work from the Second Carnegie Inquiry into Poverty and Development in Southern Africa, however numerical data from the period is scarce. The 1970 census, the last census to enumerate almost the entire country prior to the end of apartheid in 1994, excluded people living in Venda, one of the independent homelands.⁴ Furthermore, the census had one questionnaire for Coloureds, Asians and Whites and a different one for Africans.⁵ The African questionnaire contained only a limited subset of the questions in the Coloured, Asian and White survey. Subsequent censuses excluded the independent homelands and also ultimately the non-independent homelands. Since 1994, censuses and household surveys represent the entire population but do not explicitly record whether an individual was born in a former homeland or not. Due to the high levels of geographic mobility in South Africa from rural to urban areas in the post apartheid period, a large number of people who would have grown up in the homelands no longer live there and their origins have been untraceable until now.

The NIDS data improve on other post-apartheid survey data by documenting where and when a person was born. In addition, the data contain a number of well being measures such as height, education and health. We now have information on individual characteristics in the homelands which we know can be used to determine the standard of living in these areas (Nicholas and Steckel 1991, Komlos 1993, Steckel 1995, and Steckel 2008).

Both the nature of the shock and the South African political environment at the time help to interpret the results. Firstly, the shock itself was completely unexpected and not the result of any changes in South African racial policy. In 1975, Leys discussed the nature of recruitment of foreign workers not-

²One Rand was worth around one US dollar at this time.

³Butler, Rotberg and Adams (1978 p 125) note that incomes for Bophuthatswana and Kwa-Zulu, two of the other affected homelands, in 1973 were between R40 and R165.

⁴The other three: Bophuthatswana, Ciskei and Transkei were not yet independent at this time.

⁵The racial terminology in this paper is consistent with that used by the current South African government. African make up 80 % of the population, Whites 10 %, Coloureds 6 % and Indians 4 % (Feinstein 2005).

ing that there was only minimal discussion by the Chamber of Mines of what independence in Mozambique might bring and the paper came out before the full extent of the Malawian withdrawal was understood. Secondly, the selection of the homelands that would contribute to mining was for the most part independent of conditions in the homelands. For historical reasons the Chamber of Mines recruited predominantly from specific homelands meaning that some homelands experienced a larger shock to employment than others. There is therefore a convenient comparison group to determine the quality of the living standards in areas affected and unaffected by the shock. Since, mining industry recruitment was higher in more densely populated regions (Wilson 1972, 70), one concern is that living standards may have been lower in the homelands that experienced the labor demand shock than in other homelands. Any changes in outcomes, in that case, would be for the worst off individuals who may not necessarily represent the general homeland population. However, given the high levels of poverty in all homeland regions, I believe that the poorest homelands still provide some information on living standards in the homelands in general. Furthermore, Leys (1975) notes that South African government policy was that each homeland would send the majority of its workers to one specific industry. The choice of industry each homeland contributed to was independent of the stature or strength of the inhabitants. The selection of the most crowded homelands to fill the labor shortfall had more to do with access to larger amounts of workers than any attempt to benefit those who might be worst off. Thirdly, there was unlikely to have been much, if any, migration into areas subject to the shock from other areas by people looking to take advantage of the increase in labor demand in those areas. The policy regarding the mobility of the African population was extremely restrictive. Pass Laws made it very difficult for people to move from one region to another (Feinstein 2005, 64). Related to that, because of the immobility of the population it is very unlikely that financial gains in one homeland would spread to another given their geographical distance. Therefore, the positive impacts in each homeland would have stayed within that homeland.

Using a standard difference in difference analysis, I find that men who were born in the affected regions in 1975 and 76 are between one and one and a half centimeters taller than other African men. Table 2 shows that on average African men living both within and outside of a homeland were approximately 8 centimeters shorter than Whites. The implication is that living standards for Africans during apartheid were indeed very poor compared to those of Whites and that the income increase was not large enough to compensate for the extreme levels of poverty prior to the shock. I do not find any impact on men born slightly before the shock nor slightly after, lending support to the hypothesis that fetal conditions and mother's nutrition are most important for long run physical development (Barker 1995, Almond 2006). The evidence is also consistent with the findings in Duflo (2003) where increases in male incomes are not necessarily passed on to children in the household. Although household incomes may have increased by a large amount relative to average incomes, they were still below the income level of the poverty datum line and thus unable to

contribute to large scale improvements in living standards.

2 Mining industry employment and the shock to domestic labor demand

By 1973, foreign workers made up 75 % of the gold mining workforce in South Africa (South African Institute of Race Relations, 1973). The majority of these workers came from Malawi and Mozambique with Lesotho sending the third largest contingent of workers. While Tanzania and Zambia restricted their citizens from working in the mines already in the 1960s, two events occurred in the mid-1970s that drastically reduced the supply of foreign workers to the gold mining industry. In April 1974 Malawi's president, Hastings Banda, reduced the flow of workers to South Africa pending the outcome of an inquiry into the causes of a plane crash that killed 77 workers. The number of Malawian workers decreased by 14 000 between 1973 and 1974 and another 72 000 by the end of 1975 (see table 1A). Following that, in 1976, after Mozambican independence, the supply of workers from that country to South Africa declined substantially, by 24 000 between 1975 and 1976 and another 33 000 by April of 1977. As a consequence, the size of the mining labor force declined by 53 000 workers between 1973 and 1974 and another 28 000 by 1975.

The domestic labor recruitment arm of the South African Chamber of Mines, the Native Recruitment Corporation (NRC, renamed The Employment Bureau of Africa, or TEBA, in 1977), responded to the decrease in the supply of foreign workers by expanding its recruitment in the Eastern Cape and setting up new recruiting stations in other former homelands. The majority of the new workers came from Transkei, Ciskei, Bophuthatswana and Kwa-Zulu with the first major increase in 1975, followed by increases in recruitment in 1976 and 1977 before stabilizing again in 1978 (Crush 1986, Crush et al. 1991, see table 1B of this paper). The number of South Africans employed in the industry increased from 76 523 in 1974 to 228 109 by 1978, an increase of almost 200 % (South African Institute of Race Relations Annual Reports, 1969 – 1979).

This is a substantial increase in the number of workers recruited domestically and leads to two questions. Firstly, why were the mines not in the habit of hiring predominantly domestic workers from the outset and secondly, why was there such a large number of available domestic workers at the time of the shock to foreign supply? The mining industry succeeded almost at its inception to convince the colonial government to implement legislation that would ultimately force African males to seek employment in the industry and to do so at low wages. By means of taxes, restrictions on geographic mobility and on residential location they hoped Africans would have no other recourse to income than a mining job (Wilson 1972, 2).

By the 1920s the industry also managed very successfully to establish a recruiting procedure that allowed it to act as a monopsonist thereby keeping wages low (Jeeves 1985, 121). The NRC and the Witwatersrand Native Labour

Association (the foreign recruiting arm of the NRC, henceforth WNLA) were ultimately the sole recruiters for the entire industry. This ensured that all mines would pay equal wages, that mines would not compete with each other for labor and therefore that wages would not be subject to competitive increases. Furthermore, African workers were unable to increase their wages through job promotion because higher skill level occupations were reserved for white workers through the Mines and Works Acts of 1911 and 1926. The industry defended its low wage policy by claiming that domestic laborers had families based in the homelands who could support themselves through subsistence farming. There was therefore no need to pay a man a wage large enough to maintain his family, unlike that required for white workers who had families to support. What this meant for the workers is that wages were kept unattractively low. Through these actions the industry ensured a cheap source of labor but alienated the local labor supply. The industry's poor safety record further contributed to mining's unattractiveness (Leys 1975). Other than the Eastern Cape which historically had sent a large number of recruits to the industry, South African workers increasingly rejected the mining sector.⁶

When mining was unable to satisfy labor demand locally early in the twentieth century it expanded its catchment area to other countries/colonies in southern Africa where the British and Portuguese colonial authorities were accommodating (Prothero 1974). The proportion of foreign workers in the South African mining industry rarely fell below 50 percent between 1886 and 1973. Foreign workers accepted the low wages that domestic workers would not because population densities in southern African countries were lower than in South Africa and the remaining community could survive through subsistence agriculture without the migrant's wages.

For the first half of the twentieth century African workers had a much better paid employment alternative in the rapidly growing manufacturing sector. The sector was able to absorb the growing African labor supply due to its high unskilled labor requirements. Therefore, by the early 1970s, domestic Africans had been excluded from the mining industry and the NRC did not actively recruit other than in the Eastern Cape. Yet, economic circumstances in the South African economy and in the homelands had deteriorated during the apartheid years so that when the employment crisis came to the mining industry in 1974, the homelands were characterized by high rates of unemployment, overcrowding, and poverty.

While the size of the African population increased, the growth rate of the preferred employer, manufacturing, began to decline from the late 1960s and it was unable to absorb the increases in the unskilled labor supply. The industry became more capital intensive in order to substitute away from African labor because of government imposed restrictions on African mobility (Nattrass and

⁶The Cape Government had targeted the Eastern Cape as a labor source for the mining industry in the early 1900s. The government allowed a competitive recruiting market which ultimately the NRC was able to dominate in the 1920s ensuring a large supply of workers from that region. The NRC battled to exert the same monopsonistic control in other regions of the country (Jeeves 1985, 120 and 139).

Seekings 2005, 518). Relatively few industries were situated close to the majority of the homelands and attempts by the government to encourage industry to relocate to homeland borders were ineffective and homeland unemployment continued to grow (Feinstein 2005, 156). In addition, during the 1960s many Africans living in the rural areas of the country were forced to relocate to the homeland areas as the agricultural sector mechanized and they too lost their jobs (Horrell 1973, 17, Simkins 1984, Crush 1986, Feinstein 2005, 194).

Because of these events, population density in the homelands increased rapidly. For example, by 1972 the population density of Transkei was 122 people per square mile, with forced population resettlement this was expected to increase to 212 people per square mile (Horrell 1973, 39).⁷ The land quality of many homelands was poor, and several of them were geographically fragmented with poor infrastructure between them, (Figure 1 presents a map of South Africa during apartheid with the homelands shaded in.) (see also Horrell 1973, 6).^{8 9}

A consequence of rapid population growth in the homelands was a decrease in the size of land holdings within these areas. Wilson and Ramphela (1989, 39) note that over the period 1946-81 the average size of land holdings in parts of the Ciskei fell from 1.72 ha to 0.43 ha. Such small landholdings were completely inadequate for a family to meet its own maize requirements even in high rainfall areas (pg43). At the same time, in a region where people depended on access to land, landlessness increased from 10 per cent to 43 per cent of all families. This problem was found to be equally severe in areas of the Transkei, Kwa-Zulu, Venda and Gazankulu (pg 40). Simkins (1984) notes that by 1980 80 % of the households situated in the homelands were living below the urban minimum living level.

The dire physical consequences of these levels of poverty are well documented in several sources (Butler, Rotberg and Adams 1978, 221, Food and Agricultural Organisation of the United Nations (FAO) 1982, 88-93, Bradshaw 1987, Wilson and Ramphela 1989, 100 – 120). The FAO notes that in 1971 about one million African children were believed to be suffering from malnutrition. Wilson and Ramphela believe that in 1975 between 15 000 and 27 000 African children under the age of 5 died from malnutrition. In addition, approximately a third of all African children below the age of 14 years were underweight and stunted with the situation worst in the homelands. The FAO and Wilson and Ramphela describe the levels of stunting across South African homelands and it is evident that the levels are extreme with approximately half of the children in the Eastern

⁷In comparison in the non-reserve areas the population density was 35 people per square mile (Horrell 1973 p 39)

⁸Wilson and Ramphela (1989) note that official numbers likely underreport actual population density in the homelands (pg 37). They also note that on white farms surrounding the homelands population density was much lower.

⁹The South African government originally created the homelands in the 1913 Land Act. The Act allocated 7.6 percent of South Africa's land mass in the form of reserves to the African population which at the time accounted for 67 percent of the population of almost six million people (Feinstein, 2005). The government allocated each African ethnic group in South Africa to a reserve so that the 10 homelands ultimately served 10 ethnic groups (most homelands consisted of a majority ethnic group and minorities from other groups (Horrell 1973 p38)).

Cape below normal height for their age group. As the FAO and also Wilson and Ramphela note, malnutrition leads to other diseases and also affects mortality and morbidity. Homeland inhabitants suffered from preventable diseases such as gastroenteritis, cholera, typhoid, dysentery, measles, and tuberculosis and often died from these diseases. Pneumonia is estimated to have been responsible for between 50 and 60 % of infant deaths in the 1970s. While data on childhood mortality for the homelands is sparse, Bradshaw (1987) notes that from 1981 - 1985 infant mortality rates in the homelands ranged between 36 per thousand births in Bophuthatswana to 130 per thousand births in Transkei although she notes that there is a large range of uncertainty. In comparison the white mortality rate was 12 per 1000 births. The FAO notes that the prevalence of these diseases was increasing in the homelands at a time when they were in decline worldwide and notes that the severity of these diseases is worse when sufferers are undernourished. By the time the increase in the demand for workers from the homelands came, starting in the second half of 1974, income earning opportunities for working age males were limited and workers were eager to meet the new demand from the mines to help their families back home.

Was the positive shock to mining labor demand large enough to deal with the extremely poor living conditions in the homelands? While mining wages were low relative to the amount of money needed to feed and house a family, a job on a mine still signified an increase in income. In 1972 the monthly wage in the mining industry was R21. The monthly wage increased to R29 in 1973. Following labor disputes throughout 1973, the wage increased to R46 in 1974, R79 in 1975, R92 in 1976, R102 in 1977, R123 in 1978 and R141 in 1979 (SAIRR Annual Surveys). For a household that sent an unemployed member to the mines in 1975 the increase in monthly income for the household would have been R14.22 (if we assume that a worker used only official channels, Wilson (1972, 57) says that workers remitted around 18 % of their wages through official channels) and one less household member to feed.¹⁰ Horrell (1969, 140) says that often up to half of a worker's wage was given to the homeland household, driving the increase in income up to R40 in 1975. Even if the mine workers remitted only a portion of their wages to the homeland household, the increase in household income would have been substantial relative to what the household was earning before but it is not clear whether it was enough to improve living standards given the low income base. Wilson and Ramphela found that in 1985 when the average monthly mining wage was R327, workers remitted between R15 and R38 per month back home on average (pg 56 and 63). It is probable that workers also brought cash and other gifts when their contract ended and they returned home for a period. At the same time, the minimum monthly living level in 1985 was R350.¹¹

¹⁰Francis Wilson notes in personal conversation (October 2011) that while 18 % of the wage may have been sent through formal channels, most certainly the worker also brought a portion of his wage home with him when on leave from the mines which occurred approximately every six to nine months.

¹¹The minimum monthly living level is the amount a household needs to meet its basic food, clothing, energy, housing, transport, education and health requirements. The supplementary

Estimating the size of the income shock and the possible effects on living standards in the former homelands is complicated by the lack of data on earnings and subsistence earnings. The best estimates depend on assumptions about a family's income that cannot be verified but must seem reasonable. As table 1A shows, the number of workers from Transkei increased from 47 139 in 1973 to 104 181 in 1978 in a region of 2.3 million people as estimated in 1982.¹² That is an increase of almost 60 000 people. A conservative estimate is that half the population were children at the time and half were women, then that is 60 000 men out of approximately 500 000 men (if we assume that the population in 1975 was around 2 million). If we further estimate that only half of the men might have been young enough and fit enough to work in mining, that reduces the pool of potential workers to 250 000. These are likely to have been young men, more likely to have had small children or to be older siblings of small children. If each worker came from a household with a small child, this *ad hoc* calculation suggests that about 24 % of people born at the time of the shock in the region of the shock were likely to have been affected by a change in a family member's employment status in Transkei. The corresponding increases were 31 per cent in Bophuthatswana, 17 percent in Qwa Qwa, 5 per cent on average for the homelands in the north east of the country and 3 per cent in Kwa-Zulu. Approximately a quarter of the households in Eastern Cape homelands experienced what would have amounted to a large increase in income. If we further assume knock on effects in the local economy, the proportion of the population affected may be even larger. For a population suffering from malnutrition, these income increases may well have had substantial effects.

The expectation is that increases in household incomes should lead to improvements in the well-being of small children and those that are in utero at the time of the shock. However, the manner of household resource allocation for these households is not known and it remains to be seen what the effects of increased household income are on younger household members.

A number of changes occurred in South Africa during the mid-1970s that may affect the results. There were wage increases throughout the country in a number of sectors including manufacturing and the construction industries, a fact that needs to be taken into account when evaluating the impact of the mining labor demand shock as living standards would have improved following these wage increases for a broad section of the African population. Transkei became independent in 1978 and it is possible that it experienced a massive employment increase because of this. Leibbrandt (2011) notes however that the Transkei civil service was small relative to the number of workers employed in the mining industry. Furthermore, the FAO notes that upon independence of a homeland, Africans in that homeland lost their South African citizenship and any rights to claim benefits, limited as they were (92). For example, unemployed workers no longer had access to the unemployment insurance fund. If anything

living level is the amount needed to cover all those things as well as recreation, personal care, pension, unemployment insurance, and medical and funeral contributions.

¹²As mentioned earlier, data collection in the former homelands was poor and this figure is an estimate from Mauder (1982).

then, both the wage increases and increases in local employment should also lead to height increases for children born at this time providing further evidence that living standards in the homelands were poor and that any increases in nutritional intake resulted in increased stature.

3 Data and Summary Statistics

The first wave of the National Income Dynamics Study (NIDS), run by the Southern Africa Labour and Development Research Unit (SALDRU) at the University of Cape Town, is the first comprehensive South African survey to ask respondents retrospective questions on month and year of birth, birth location, as well as to record measures of health and height. Wave 1 of the study (done in 2008) became available in July of 2009. The adult sample consists of 16,885 adults of all race groups over the age of 15 and includes information such as age, fertility outcomes, parents' characteristics, employment data, income and expenditure data, education, health, and height measurements. Height measurements were taken by the enumerators of the survey. Enumerators were instructed to take two height measurements and a third if the first two differed by more than two centimeters thereby reducing the incidence of measurement error.

The treatment group consists of people who were born just before and during the shock years in those homelands that experienced the largest absolute increase in recruitment as well as the having the largest proportion of the population employed in mining. These are the individuals most likely to show a response to changes in living standards, primarily through stature, according to the fetal origins hypothesis (Barker 1992). In order to create the treatment variable I need to know where an individual was born. The original NIDS adult data contains information on the province and district council where a person was born only if she has moved away from her region of birth at some stage. However 9, 543 individuals have never moved from their area of birth and there is no record of where they were living at the time of the survey. I therefore supplement the adult data with the derived household data file which records the province and the district council where the household in the survey was situated at the time of the survey. After taking account of missing data or cases where the respondent did not know the answer there are 10, 433 Africans, 4, 098 males and 6, 335 females.¹³ I restrict the sample to people born in districts that contained homelands and exclude all Africans born outside of these districts as it is not clear that they would constitute a valid control group. Africans living in urban areas were subject to fewer restrictions on movement and employment than those from the homelands. I also restrict the sample to men born before and during the shock and exclude any men born after employment stabilized in 1978 as South African economic conditions became more volatile and other factors could affect their heights. The sample consists of 1, 235 observations.

¹³The rest of the sample consists of other race groups not affected by the shock or homeland policy.

The homelands that were most affected by the employment shock are Transkei, Ciskei, Bophuthatswana and Kwa-Zulu although the proportion of the population recruited from Kwa-Zulu increased from approximately 0.2 % in 1974 to 1% in 1976.¹⁴ These regions now fall within the provinces of the Eastern Cape (Transkei and Ciskei with one former piece of Transkei now in Kwa-Zulu Natal but which I have labeled Eastern Cape for this study), the Northern Cape and North-Western Province (Bophuthatswana), and Kwa-Zulu Natal (figure 2 shows the post 1994 provinces). There is no clear continuation between former homeland boundaries and current district councils; however, the overlap can be matched up from maps. I assign a person to the treatment group depending on the district council in which he was born. If the district council overlaps with parts of one of the affected former homelands the value of the variable is one, it is zero if the district council does not include parts of the affected former homelands. There are 53 district councils in total, 28 of which overlap with former homeland areas, 6 contain land from Ciskei and Transkei and 4 contain land from Bophuthatswana, excluding the area around Thaba ‘Nchu as it is not possible to distinguish those respondents from respondents born in the nearby city of Bloemfontein. A further 9 contain land from Kwa-Zulu.

The literature on heights and nutrition suggests that nutrition matters at early ages, particularly at the fetal stage of development (Almond 2006, Faber and Wenhold 2007, Case and Paxson 2008, Banerjee et al. 2010, Almond and Currie 2011, Gørgens et al. 2012). I have therefore focused on men who were born at the time of the employment shock. Note that not all individuals in the treatment group would have been treated since it is not possible to determine whether an individual lived with a person employed in mining or not.

Ultimately there are between 40 and 61 individuals in the treatment group, depending on which years are treated as shock years. The small size of the treatment group affects the power of any hypothesis tests that will be done on the regressions in the subsequent section. I find that the power is 19 %, that is, there is an 81 % chance of making a Type II error of failing to reject the null when the null is false. The implication is that in such a small treatment group I am unlikely to find significant results even when there is a positive increase in height. Nevertheless, there are a number of robustness checks that can be done to determine the stability of the coefficients.

Table 3 contains the summary statistics. The average height of men born before the shock in all regions from 1941 to 1974 is 168.47 centimeters. The average height of men born during the shock in the regions with the greatest employment increase is 169.77 centimeters. With respect to education, on average the highest level achieved of men born before 1975 is just less than grade seven, while men exposed to the shock have just over grade seven. The result appears to be driven by younger males rather than stemming from exposure to the treatment since education levels are higher for all men born from 1975 and 1976.

The four health measures in the table are based on the respondent’s an-

¹⁴Population estimates taken from Butler, Rotberg and Adams (1977, pg. 4)

swers to several health questions. For general health, answers range between one for poor health and five for excellent health.¹⁵ The specific health variable is constructed from 23 questions regarding the respondent’s current health complaints, an answer of 1 indicates they suffered from that complaint in the last 30 days while 2 indicates no symptoms. The measure in this paper is the sum of the responses to the 23 questions so that a higher number indicates fewer complaints than a lower number. Similarly, the long term health variable was constructed from 7 questions on long term illness including tuberculosis, high blood pressure, diabetes, stroke, asthma, heart problems and cancer. Higher values indicate fewer illnesses. The measure of emotional health is again a composite from 10 questions regarding the respondent’s state of mind in the last week, responses range from one for symptoms that were experienced throughout the previous week to four when the respondent rarely experienced the symptoms. The mean values for general health, specific ailments, and long term illnesses are slightly higher than those for the control group while emotional health seems to be slightly worse for males in the treatment group. While education and health outcomes are commonly included as indicators of early childhood living standards (Banerjee et al. 2010), the lack of adequate provision of these services in the homelands would contaminate the effects of nutritional intake on these outcomes. Therefore educational attainment and health status as measures of early childhood homeland living conditions will not be used in this study.

4 Analysis

The hypothesis is that people born just prior to and during the shock in the regions that experienced a large employment increase should be taller than those born long before the shock or in regions that experienced less of an increase. Treated and untreated homelands are comparable since, as argued above, poverty levels in all homelands would have been high enough to cause a deficiency in nutrition.¹⁶ The implication is that prior to the shock outcomes in all homelands were similar. I therefore adopt a standard difference in difference approach:

$$Y_i = \alpha + \beta birthdistrict_i + \gamma yearofbirth_i + \delta birthdistrict_i * yearofbirth_i + \Gamma X_i + \varepsilon_i \quad (1)$$

where Y_i is height. $birthdistrict_i$ is a dummy variable equal to one if a person was born in the homelands affected by the employment change, and zero otherwise, $yearofbirth_i$ is a dummy variable equal to one if a person was born either prior to or during the shock, and equal to zero otherwise. $birthdistrict_i * yearofbirth_i$ is an interaction term equal to one if a person was born in the

¹⁵In the questionnaire, responses range from one for excellent health to five for poor health. I have turned these around to be compatible with the measures of specific illness and long term illness.

¹⁶An investigation of whether the outcome variables in each type of homeland differed amongst the populations born before the shock shows that there is no difference in outcomes of untreated people in any homelands (results not shown).

affected region either prior to or during the shock. X_i is a vector of control variables including age and birth years which take account of any cohort specific changes, a person's birth district and language group to take account of any physical differences by ethnic group, and father's occupation since any changes in height should be related to whether or not the father worked in the mining sector. ε_i is a random error term. If the shock has a positive impact on outcome variable Y_i then we expect δ to be positive, denoting that individuals born just prior to or during the shock in the treated regions experienced an increase in nutritional intake and that this resulted in taller adults.

Ideally, the specification would include a record of siblings' and parents' heights as well as parental education levels. However, since the individuals in the data are adults at the time of the survey, there is no way to know who their siblings are unless they reside in the same household. To the extent that individuals live with their parents, such height information may be available. However, not all parents are still living with their children and including parental heights may result in some amount of selection bias, not to mention the reduction of an already small sample.

Parental income and education are known to be important determinants of height. In this data there is no record of parental income while the respondent was a child. Also, many respondents do not know the level of their parents' education. Furthermore, it is unclear under the apartheid system of education exactly what role a person's education should play in the height outcomes of their children especially if they grew up in a homeland. Information on father's occupation is available, however, the job categories in the data are at an extremely aggregated level so that it is not possible to determine the actual occupation an individual's father held and certainly not whether an individual's father worked in the mining sector. Nevertheless, I do include the broad categories in the regressions since father's occupation should be directly related to child's height if the father worked in the mining sector. This inclusion would reduce the sample somewhat since many respondents do not know their father's occupation; I include a categorical variable for whether an individual knows his father's occupation. Out of the 1235 in the sample, 655 do not report their father's job, 132 say their fathers did elementary work which would have consisted of unskilled mining labour. Because of the low number of respondents for this variable I do not create an interaction of father's job and originating from an affected region. No other socio-economic determinants of the outcome variables are included in the regressions.

The decision of where the workers who would fill the gap created by the lack of foreign workers would come from was based on the South African government's industrial policy and was not determined by any of the potential outcome variables and in that sense the choice of treatment group is independent of the outcome variable. Crush et al. (1991) show that the first wave of employment increases occurred in 1975 in Transkei, Ciskei, Bophuthatswana and Kwa-Zulu. Subsequent and larger increases occurred in 1976 and 1977 and by 1978 recruitment had stabilized with very few increases from then onwards

and a series of layoffs starting in the mid 1980s.¹⁷ Although small employment increases began already in 1974 following the withdrawal of Malawian workers, the biggest increases in the four homelands of interest were in 1976 and 1977 following the withdrawal of Mozambican workers. To the extent that changes in homeland employment opportunities may have been anticipated, as noted previously, the proportion of the populations affected was small (around 24 % of households who might have had eligible males). It is hard to conceive that these households would have correctly anticipated the extent of the hiring boom and in response would have adjusted their expectations towards higher incomes and that any effects I pick up are unrelated to the income shock. For this reason, I consider the income shock to be exogenous despite the fact that the Chamber of Mines tentatively began to anticipate changes in the composition of its labor force already in 1974.

In looking for the effect of the employment shock I consider a number of options. Ideally, I would like to examine the effect on each homeland individually. In addition, I would like to look at the effect of the increase on individual birth years. Due to the small number of observations in the treatment group in each birth-year-homeland cell, I cannot look both at individual homelands and at individual years. Either I need to combine a number of birth years for each individual homeland or I need to combine a number of homelands for each year so that the treatment group consists of sufficient observations for the analysis to be meaningful.

I begin in table 4 by comparing the heights of all males born during and up to six years prior to the employment increase from all homelands to those born seven or more years prior to the employment increase. The idea is that since all homelands experienced some increase in employment it is possible that all of them experienced an increase in living standards. The treatment group consists of all males born in all homelands from 1970 – 1976. Columns 1, 3, and 5 report the coefficients on height for individual birth years. Columns 2, 4 and 6 present a coefficient for a dummy variable that is equal to 1 for all males born between 1970 and 1976. The regressions reported in columns 1 and 2 control only for birth year and age, in columns 3 and 4 I include birth district dummy variables and in columns 5 and 6 I include father’s occupation. The coefficient for individual birth years is positive for all years except 1970 and 1975. When the birth years are combined into one dummy variable, the coefficient is also positive and suggests that males born either just before the shock or during the shock are around three millimetres taller than those born earlier. The coefficients on birth year are insignificant. Given the size of the treatment group in this regression (342 observations), the impact of the shock on height across all homelands is not positive.

The following analysis therefore divides the homelands into those that experienced a large increase in employment where a large proportion of the population was employed relative to the other homelands and those with smaller increases

¹⁷Employment in the other homelands also increased but only slightly and the proportions affected are much lower than in the four homelands listed above (Crush et al. 1991, and table 2 of this paper).

and a smaller proportion affected. The two homelands with the largest increases in employment relative to their population size are the Transkei and Ciskei as shown in table 1B. The next largest increase in employment took place in Bophuthatswana. KwaZulu also experienced a large increase in absolute numbers, however as a proportion of the total population of the homeland the increase was relatively small. I do include Kwa-Zulu in some of the subsequent analysis if the number of observations in the treatment group would be too low to yield meaningful regression results without it.

In table 5 I begin with an investigation of the impact of the employment increase on males in the Eastern Cape (Transkei and Ciskei) and I include birth years from 1970 – 1976 to capture the effect of the employment increase on children aged from zero to six years old, those being the ages most likely to show long run benefits of increased nutritional intake (Faber and Wenhold 2007).¹⁸ The regression in column one includes a dummy variable equal to one for birth years from 1970 to 1976. The coefficient on height is positive yet insignificant and there are 83 observations in the treatment group. The following columns display the results of the same regression, however with the removal of an additional birth year moving from left to right so that in column six the treated years are from 1974 – 1976 with a treatment group of 32 observations. I do not include fewer than three birth years because of the resulting small sample size for the treatment group. The coefficients in all five regressions are positive, ranging from an effect of 1.2 centimetres to 1.7 centimetres, however none of the coefficients are significant. The persistence of the coefficient suggests that there may well have been an increase in height which hypothesis testing does not pick up due to the low power of the sample.

Table 6 repeats the regressions in table 5 but includes 1977 as an additional birth year that may have been affected. While the increase in employment was not new by 1977, I allow for a length of time before the shock becomes anticipated and household decision making adjusts. For the Eastern Cape homelands, the coefficient remains positive and insignificant with the impact on heights ranging from 1.2 centimetres to 2.1 centimetres. There are six regressions considering birth years from 1970-1977. Controls in both tables include year of birth, birth district and father’s occupation. As in table 5, the coefficient is positive and stable across the regressions and I conclude that there is an increase in height for newborns and those in utero at the time of the shock.

In tables 7 and 8, I add Bophuthatswana as a treatment group and repeat the regressions shown in tables 5 and 6. The coefficients for the Eastern Cape remain around between one and two centimetres but continue to be insignificant (table 7). The coefficient for Bophuthatswana is less stable depending on which birth years are included and the effect on heights ranges between a decrease of 1.3 centimetres and an increase of 2 centimetres. The effect of the employment increase appears to be stronger for the Eastern Cape than for Bophuthatswana. This is born out also by the coefficients in table 8 which repeats the regressions

¹⁸Individuals born in the Ciskei cannot be separated from those born in the Transkei because modern district councils contain elements of both former homelands.

in table 7 but includes 1977 as a treated birth year.

For the analysis in table 9 I split the birth years into individual years. Because this reduces the number of observations in the treatment group to levels too low to find meaningful results I combine the treated homelands into one treatment group. This necessitates the inclusion of KwaZulu as a treated homeland as the number of observations in the treatment group would be below 30 if I include only the two Eastern Cape homelands and Bophuthatswana. The first three regressions include 1977 as a birth year. The coefficients on the year of birth are somewhat volatile suggesting that for males born before the shock there is no clear effect. Only for males born during the three years of employment increases is there a positive coefficient with the effect on height being between 0.1 centimetres for those born during 1975 and 4.2 centimetres for those born during 1976. In all regressions I control for year of birth. Including controls for father's occupation and age does not change the findings. In columns 4 and 5 I exclude 1977 as a birth year. There is minimal effect on the size of the coefficients. The coefficients suggest that there was a positive impact of the employment shock on males born during the period of higher employment.

One problem with splitting the birth years into separate variables is that it is not clear that those children born in December 1975 should be so different to those children born in January 1976. However children born in January 1975 could be quite different to those born in December 1975. Table 10 therefore reports the results of a regression of height on a treatment group consisting of males born in 1975 or 1976 from the Eastern Cape homelands and Bophuthatswana. I have combined the regions due to the low sample size. The coefficient on height for the treated group is between 0.9 centimetres and 1.7 centimetres. Again, the coefficients are not significant although this may be due to limitations with the number of observations in the treatment group as well as the fact that only around 24 % of the treatment group may have been exposed to the employment increase. Column 1 presents the results of the most basic regression, controlling for whether the person was born in the treated region during the treated years but does not control for individual district of birth or year of birth. Columns 2 to 7 present the results of regressions that check the robustness of the results. I include varyingly, year of birth, district of birth, father's occupation, home language and age. The coefficient size remains robust to the inclusion of various controls suggesting that, indeed, the employment increase led to increased heights.

Table 11 repeats the regressions from table 10 including 1977 as a treated birth year. The Eastern Cape and Bophuthatswana remain the treated regions. The inclusion of males born in 1977 reduces the coefficient on height to between a decrease of 0.5 centimetres and an increase of 0.5 centimetres, essentially it would appear that there is no effect on height in this case and that by 1977 the increase in local employment has a limited effect.

While it is not possible to test directly for the impact on each homeland for each year, the regression results indicate that if there was any effect of the employment shock on long run stature at all, it was mostly on males from the Eastern Cape born during the shock years. Males who were in utero or new

borns during the shock years are approximately 1 centimetre taller than those in other homelands. There does not seem to be any effect on the heights of males who were young children at the time of the shock.¹⁹

Table 12 tests for this more explicitly. The literature on the value of nutrition for stature notes that increased nutrition in early childhood and in teenage years can have an effect on stature (Steckel 1995, Faber and Wenhold 2007, Case and Paxson 2008, Hatton and Martin 2010, Gørgens et al. 2012). I test whether there is an effect of being in the treated region on males who were toddlers, young children or teenagers at the time of the shock. I also look for the impact of the shock on those born just after the shock. Control variables include year of birth, birth district and father's occupation. Column 1 shows that males who were toddlers at the time of the shock, that is born 1 to 2 years before the shock (1973 and 1974), were not affected by the shock. Column 2 tests whether males aged between two and five years at the time of the shock were affected by the shock and again I find no effect. Column 3 provides a robustness check and includes both toddlers and young children, the results remain unchanged. Column 4 tests for the effect of the shock on teenagers and I find no significant effect although the coefficient is positive. Finally, in column 5 I find no effect of the shock on males born one to five years after the shock in the treated regions, meaning that the impact of the shock on heights had worn off by 1978 as employment in the mining industry began to stabilize. This could be because households could have adjusted their expectations in line with their increased incomes. Household composition may have changed if unemployed adults moved into a household where there was a migrant worker or if households restructured to make sure grandparents were available to take care of children or even if fertility increased as a result of higher incomes. While we have no information on household size NIDS does have fertility and childhood mortality figures. Figure 3 shows fertility for women from the Eastern Cape homelands and fertility for women from other homelands over the period 1965 – 1990. Fertility is on an increasing trend in all homelands and therefore even though mining incomes are increasing, their impact on living standards as measured by height could be muted. These results are consistent with the findings in Banerjee et al. (2010) who find an in utero effect of a negative income shock but no effect on small children or teenagers. The results might also suggest that increases in male incomes in the household are not passed on to existing children, a result consistent with Duflo (2003) and rather that increases in income manifest themselves as increases in nutrition for expectant and new mothers.

One concern may be that households would have changed their fertility decisions to take advantage of the income shock, that is, knowing that incomes would increase they decided to have a child in the shock years so that the child would benefit from the increase in incomes. In that sense the shock would be expected, however the results would still provide a valid evaluation of living standards in the former homelands. Again, however, this assumption requires

¹⁹The results are robust to adjusting the control group to those born between 1965 and 1975 to try to eliminate shrinkage in older men.

us to believe that all households would have anticipated being affected by the shock when ultimately only a maximum of 24 % were affected and it is more likely that the income shock was not planned for. Nevertheless, an examination of the rate of fertility shows a slight decrease in the shock years most likely due to the increased absence of males and a return to pre shock fertility levels by 1978.

Selective mortality might confound the results if we expect that it is the weaker and hence shorter children who die as a result of malnutrition. A positive income shock might reduce mortality related to malnutrition but may also ultimately have no effect on average heights even if stronger individuals become taller. If anything, selective mortality would bias the coefficients against finding an improvement in living standards. Figure 4 plots childhood mortality rates of children under the age of 10 for the Eastern Cape and other homelands. There does not appear to be an immediate decrease in mortality following the shock, mortality rates begin to decline by the mid 1980s but this result is not driven by children born during the mining industry employment increase.

5 Conclusion

This study utilizes recent cross sectional data to provide valuable evidence on living conditions in the former homelands of South Africa during apartheid. Although these regions were characterized by extreme poverty, it has not been possible to study the impact of poverty on individual adult outcomes until now with the National Income Dynamics Study. The sudden and large increase in employment in some of South Africa's former homelands provides an opportunity to test the importance of early childhood nutrition for long term adult outcomes. A standard difference in difference analysis shows that living standards in the homelands were so poor that they barely improved after a large positive employment shock in these regions. Only African men born when employment increased in their region of birth are around one centimetre taller than men not born around the time of the shock. This finding is despite the small sample and the conservative standard errors that result from the sample size. The paper shows that living conditions prior to the shock were dire in the homelands and that while mining wages were low, a job in the mining industry still signified a substantial increase in household income.

The increase in family income did not affect heights of men born before the shock. This may be because the potential household income increase was not large enough to raise incomes above the poverty datum line and hence that there could be no effect or it may also be that male income increases were not passed on to existing children, the data do not allow the cause to be distinguished. The employment increases ceased to have an effect once the employment increases became permanent, perhaps as a result of household restructuring to take advantage of the shock.

This study confirms the findings on the importance of in utero nutritional intake for long run adult outcomes such as stature. The paper contributes to the

literature by isolating the effects of household income increases from regional income increases that might lead to improvements in adult outcomes because of increased public health provision in childhood and by avoiding the sample selection problems noted in Bodenhorn et al. (2013).

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Tables and Figures
Table 1A Foreign Africans employed on gold mines (including Transkei)

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
									(April)	
Foreign Africans										
Malawi	52,901	77,329	92,937	106,379	108,723	94,728	22,875	494	163	21,893
Mozambique	88,352	92,651	95,900	80,242	83,387	80,737	91,359	67,436	34,817	32,237
Other foreign	90,854	92,802	95,643	95,947	104,021	96,913	105,554	130,211	152,061	142,091
Total foreign	232,107	262,782	284,480	282,568	296,131	272,378	219,788	198,141	187,041	196,221
South African Africans										
Transkei	55,738	47,907	39,430	42,555	47,139	*	*	*	88,733	104,181
Total SA	-	-	-	91,899	96,310	76,523	100,748	142,958	194,718	228,109
Total	-	-	-	374,467	392,441	348,901	320,536	341,099	381,759	424,330

* No separation of workers in the Transkei from other South African workers in these years. – no data.
Source: South African Institute of Race Relations (1969-1978).

Table 1B Mine labour recruits by source area, 1973 - 1978

	1973	1974	1975	1976	1977	1978
Transkei	51402	53951	85345	119777	167271	144610
Ciskei ^a	9334	11137	22794	35239	43616	27237
Orange Free State ^b	4042	4506	6059	9412	15014	20936
Bophuthatswana ^c	6743	7274	13988	26201	39556	32531
Transvaal	730	668	1377	1679	18974	14871
KwaZulu and Natal	4172	5040	13057	26767	36536	29386

^a Includes urban centres in the Eastern Cape

^b Includes Thaba 'Nchu and QwaQwa

^c Excludes Thaba 'Nchu

Source: Crush et al. (1991), pg 236 – 237.

Table 2
Comparison of heights and education of Africans in South Africa, in homelands and Whites

	Men			Women		
	African not born in homeland	African born in homeland	White	African not born in homeland	African born in homeland	White
Height	168.12	168.62	176.20	157.32	158.07	163.91
s.d	11.01	14.59	17.13	12.79	13.81	9.49
N	925	2568	254	1390	4322	308
Education	8.94	7.96	11.20	8.89	7.66	11.04
s.d	6.42	8.48	2.23	6.21	10.15	3.02
N	1040	2773	333	1529	4645	421

Height measured in centimetres, education in grade levels from Grade 1 to Grade 12 as the highest level of secondary education

Source: National Income Dynamics Survey

**Table 3 Summary Statistics
Men**

	Control group, born 1941 - 1974			Born in 1975 or 1976 all homelands			Born in Eastern Cape or Boph., 1941 - 1976			Born in Eastern Cape or Boph., 1975 or 1976		
	Mean	sd	N	Mean	sd	N	Mean	sd	N	Mean	sd	N
Height	168.47	12.38	1251	169.25	9.12	105	167.33	14.33	534	169.77	10.50	40
Education level	6.90	8.44	1345	8.79	6.73	114	6.54	7.93	578	7.21	6.62	43
Health												
General health	3.51	1.85	1364	3.73	1.60	114	3.63	2.16	574	3.84	1.44	43
Specific health	44.05	4.43	1363	44.55	2.02	113	44.17	3.83	574	44.86	1.88	42
Long run health	13.72	0.74	1366	13.75	0.75	114	13.72	0.72	577	13.80	0.52	43
Emotional health	31.69	7.37	1359	31.90	4.87	112	31.33	6.72	576	31.22	4.66	43
Power	19.4%											

Notes: Height is in centimetres, education is the highest grade achieved, excluding tertiary education. General health is characterised from 1 – poor health to 5 – excellent health. Specific health is constructed from 23 health questions where the respondent answered 1 if he had the disorder and 2 if not. The responses were then added up so that the higher the number of the new variable, the fewer conditions an individual had. The same is true for long run health which is constructed from 7 long term conditions. Emotional health is constructed from 10 questions where the answers are from 1 – the condition affects me all of the time to 4 – the condition rarely bothers me. The responses for each individual were added up so that the higher the total, the less a person suffers from emotional challenges.

Table 4: OLS regression results of height on year of birth, African Males born 1941 – 1976

	(1)	(2)	(3)	(4)	(5)	(6)
1970	-1.360 (1.374)		-1.714 (1.374)		-1.695 (1.373)	
1971	0.456 (1.463)		0.793 (1.461)		0.724 (1.458)	
1972	0.851 (1.185)		0.978 (1.179)		1.234 (1.176)	
1973	1.504 (1.351)		1.338 (1.345)		1.300 (1.343)	
1974	0.580 (1.368)		0.495 (1.357)		0.348 (1.360)	
1975	0.258 (1.322)		-0.126 (1.322)		-0.0327 (1.316)	
1976	0.266 (1.350)		0.139 (1.355)		0.249 (1.351)	
Years of birth combined		0.362 (0.765)		0.294 (0.762)		0.342 (0.761)
Age	-0.0620* (0.0353)	-0.0649* (0.0348)	-0.0673* (0.0353)	-0.0688** (0.0349)	-0.0627* (0.0353)	-0.0644* (0.0348)
Birth district	No	No	Yes	Yes	Yes	Yes
Father's job	No	No	No	No	Yes	Yes
Constant	170.8*** (1.799)	170.9*** (1.775)	168.9*** (2.046)	168.9*** (2.028)	168.5*** (2.059)	168.5*** (2.041)
N	1,235	1,235	1,235	1,235	1,235	1,235
R-squared	0.011	0.009	0.057	0.054	0.074	0.071

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Years of birth combined is a dummy variable that is equal to one if a person was born between 1970 and 1976 and zero otherwise. Variables with year names are equal to one if a person was born in that year and equal to zero otherwise.

Table 5: OLS regression results of height on African males born in the Eastern Cape for different groups of birth years from 1970-1976

	(1)	(2)	(3)	(4)	(5)
	1970-1976	1971-1976	1972-1976	1973-1976	1974-1976
Treated in	1.626	1.638	1.701	1.445	1.281
Eastern Cape	(1.197)	(1.257)	(1.323)	(1.522)	(1.722)
Birth year	-0.0814	0.587	0.425	0.0124	-0.410
treated	(0.822)	(0.816)	(0.818)	(0.849)	(0.914)
Age	-0.0647*	-0.0455	-0.0526*	-0.0684**	-0.0779***
	(0.0348)	(0.0330)	(0.0314)	(0.0293)	(0.0279)
Constant	168.5***	167.5***	167.9***	168.9***	169.5***
	(2.117)	(2.002)	(1.930)	(1.812)	(1.748)
N	1,235	1,235	1,235	1,235	1,235
R-squared	0.072	0.073	0.073	0.071	0.071
N _t	83	72	63	43	32

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 Regressions include birth district and father's occupation. N_t denotes treatment group size.

Table 6: OLS regression results of height on African males born in the Eastern Cape for different groups of birth years from 1970-1977

	(1)	(2)	(3)	(4)	(5)	(6)
	1970-1977	1971-1977	1972-1977	1973-1977	1974-1977	1975-1977
Treated in	1.588	1.587	1.619	1.372	1.205	2.134
Eastern Cape	(1.129)	(1.174)	(1.223)	(1.358)	(1.481)	(1.677)
Birth year	-0.132	0.486	0.321	-0.112	-0.520	-0.816
treated	(0.804)	(0.792)	(0.784)	(0.794)	(0.826)	(0.874)
Age	-0.064*	-0.044	-0.052*	-0.068**	-0.078***	-0.079***
	(0.0343)	(0.0326)	(0.0311)	(0.0290)	(0.0276)	(0.0263)
Constant	168.3***	167.4***	167.8***	168.8***	169.3***	169.3***
	(2.082)	(1.971)	(1.901)	(1.786)	(1.722)	(1.666)
N	1,291	1,291	1,291	1,291	1,291	1,291
R-squared	0.071	0.072	0.071	0.070	0.070	0.070
N _t	96	85	76	56	45	33

Standard errors in parentheses. ** p<0.01, * p<0.05, * p<0.1 Regressions include birth district and father's occupation. N_t denotes treatment group size.

Table 7: OLS regression results of height on African males born in the Eastern Cape and Bophuthatswana for different groups of birth years from 1970-1976

	(1)	(2)	(3)	(4)	(5)
	1970-1976	1971-1976	1972-1976	1973-1976	1974-1976
Born in	1.840	2.014	2.178	1.535	0.986
Eastern Cape	(1.240)	(1.304)	(1.372)	(1.573)	(1.780)
Born in	0.968	1.615	2.013	0.393	-1.258
Bophuthatswana	(1.452)	(1.493)	(1.553)	(1.718)	(1.910)
Birth year	-0.302	0.206	-0.0589	-0.0791	-0.112
treated	(0.886)	(0.889)	(0.899)	(0.938)	(1.020)
Age	-0.0649*	-0.0458	-0.0531*	-0.0685**	-0.0778***
	(0.0348)	(0.0330)	(0.0314)	(0.0293)	(0.0279)
Constant	168.5***	167.6***	168.0***	168.9***	169.4***
	(2.118)	(2.003)	(1.930)	(1.814)	(1.749)
N	1,235	1,235	1,235	1,235	1,235
R-squared	0.072	0.074	0.074	0.071	0.071
N _t E. Cape	83	72	63	43	32
N _t Boph.	62	56	49	37	29

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 Regressions include birth district and father's occupation. N_t denotes treatment group size.

Table 8: OLS regression results of height on African males born in the Eastern Cape and Bophuthatswana for different groups of birth years from 1970-1977

	(1)	(2)	(3)	(4)	(5)	(6)
	1970-1977	1971-1977	1972-1977	1973-1977	1974-1977	1975-1977
Born in	1.650	1.768	1.855	1.241	0.741	1.804
Eastern Cape	(1.167)	(1.215)	(1.266)	(1.401)	(1.527)	(1.726)
Born in	0.290	0.813	1.045	-0.594	-2.099	-1.527
Boph.	(1.374)	(1.404)	(1.448)	(1.562)	(1.684)	(1.875)
Birth year	-0.197	0.298	0.0780	0.0221	-0.0444	-0.478
treated	(0.861)	(0.856)	(0.854)	(0.870)	(0.910)	(0.968)
Age	-0.064*	-0.045	-0.052*	-0.068**	-0.078***	-0.079***
	(0.0343)	(0.0326)	(0.0311)	(0.0290)	(0.0276)	(0.0263)
Constant	168.3***	167.4***	167.8***	168.7***	169.3***	169.3***
	(2.084)	(1.973)	(1.903)	(1.788)	(1.723)	(1.667)
N	1,291	1,291	1,291	1,291	1,291	1,291
R-squared	0.071	0.072	0.071	0.070	0.071	0.071
N _t E. Cape	96	85	76	56	45	33
N _t Boph.	70	64	57	45	37	28

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 Regressions include birth district and father's occupation. N_t denotes treatment group size

Table 9 OLS regression of height on African males born in each possible affected birth year in the Eastern Cape, Bophuthatswana and Kwa-Zulu

	(1)	(2)	(3)	(4)	(5)	N _t
Born in	-0.349	-0.111	-0.140	-0.453	-0.184	30
1970	(2.835)	(2.834)	(2.833)	(2.856)	(2.856)	
Born in	-0.0202	0.196	0.0981	-0.0433	0.179	31
1971	(3.697)	(3.685)	(3.685)	(3.726)	(3.715)	
Born in	-0.653	-0.591	-0.583	-0.750	-0.649	45
1972	(2.306)	(2.308)	(2.307)	(2.324)	(2.325)	
Born in	2.518	2.356	2.386	2.453	2.334	31
1973	(2.564)	(2.559)	(2.558)	(2.583)	(2.578)	
Born in	-4.107	-4.096	-4.231	-4.158	-4.187	35
1974	(2.770)	(2.778)	(2.779)	(2.790)	(2.799)	
Born in	0.151	0.417	0.367	0.111	0.454	36
1975	(2.479)	(2.484)	(2.484)	(2.497)	(2.505)	
Born in	4.259	3.920	3.815	4.169	3.737	41
1976	(2.854)	(2.866)	(2.865)	(2.875)	(2.889)	
Born in	2.033	2.235	2.201			41
1977	(2.509)	(2.503)	(2.502)			
Age			-0.648			
			(0.465)			
Father's job	No	Yes	Yes	No	Yes	
Constant	165.1***	164.9***	184.7***	163.7***	164.2***	
	(2.354)	(2.430)	(14.38)	(2.736)	(2.835)	
N	1,291	1,291	1,291	1,235	1,235	
R-squared	0.092	0.107	0.109	0.094	0.108	

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Year of birth and birth district included as controls. N_t denotes number of observations in the treatment group.

Table 10: OLS regression of height on African males born in the Eastern Cape and Bophuthatswana in 1975 & 1976

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Born in treated group	1.546 (1.718)	1.497 (1.730)	1.686 (1.711)	1.608 (1.732)	0.991 (1.754)	1.068 (1.783)	0.954 (1.752)
Born in treated region	-1.856*** (0.494)		-2.005*** (0.495)	-1.085 (2.003)	-2.808** (1.109)	1.299 (2.742)	-2.850*** (1.099)
Born in treated year	0.454 (1.065)						-0.527 (1.141)
Age							-0.0761*** (0.0265)
Year of birth	No	Yes	Yes	Yes	Yes	Yes	No
Birth district	No	Yes	No	Yes	No	Yes	No
Father's job	No	No	No	Yes	Yes	Yes	Yes
Language	No	No	No	No	Yes	Yes	Yes
Constant	168.7*** (0.319)	166.3*** (1.691)	167.2*** (2.185)	167.1*** (2.226)	170.2*** (3.223)	167.4*** (3.804)	173.0*** (3.149)
Observations	1,235	1,235	1,235	1,235	1,220	1,220	1,220
R-squared	0.013	0.090	0.056	0.105	0.085	0.118	0.051

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Regressions include year of birth as a control. Treatment group size is 40.

Table 11: OLS regression of height on African males born in the Eastern Cape and Bophuthatswana in 1975 – 1977

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Born in treated group	0.138 (1.408)	0.289 (1.411)	0.271 (1.402)	0.480 (1.411)	-0.0501 (1.421)	0.117 (1.441)	-0.0996 (1.421)
Born in treated region	-1.856*** (0.490)		-2.005*** (0.492)	-0.466 (1.948)	-2.730** (1.084)	2.011 (2.648)	-2.763** (1.074)
Born in treated year	0.787 (0.872)						-0.386 (0.966)
Age							-0.0761*** (0.0263)
Year of birth	No	Yes	Yes	Yes	Yes	Yes	No
Birth district	No	Yes	No	Yes	No	Yes	No
Father's job	No	No	No	Yes	Yes	Yes	Yes
Language	No	No	No	No	Yes	Yes	Yes
Constant	168.7*** (0.317)	166.5*** (1.564)	167.2*** (2.169)	166.7*** (2.062)	170.0*** (2.769)	166.8*** (3.335)	173.2*** (2.843)
Observations	1,291	1,291	1,291	1,291	1,276	1,276	1,276
R-squared	0.014	0.087	0.055	0.103	0.085	0.116	0.051

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Regressions include year of birth as a control. Treatment group size is 61.

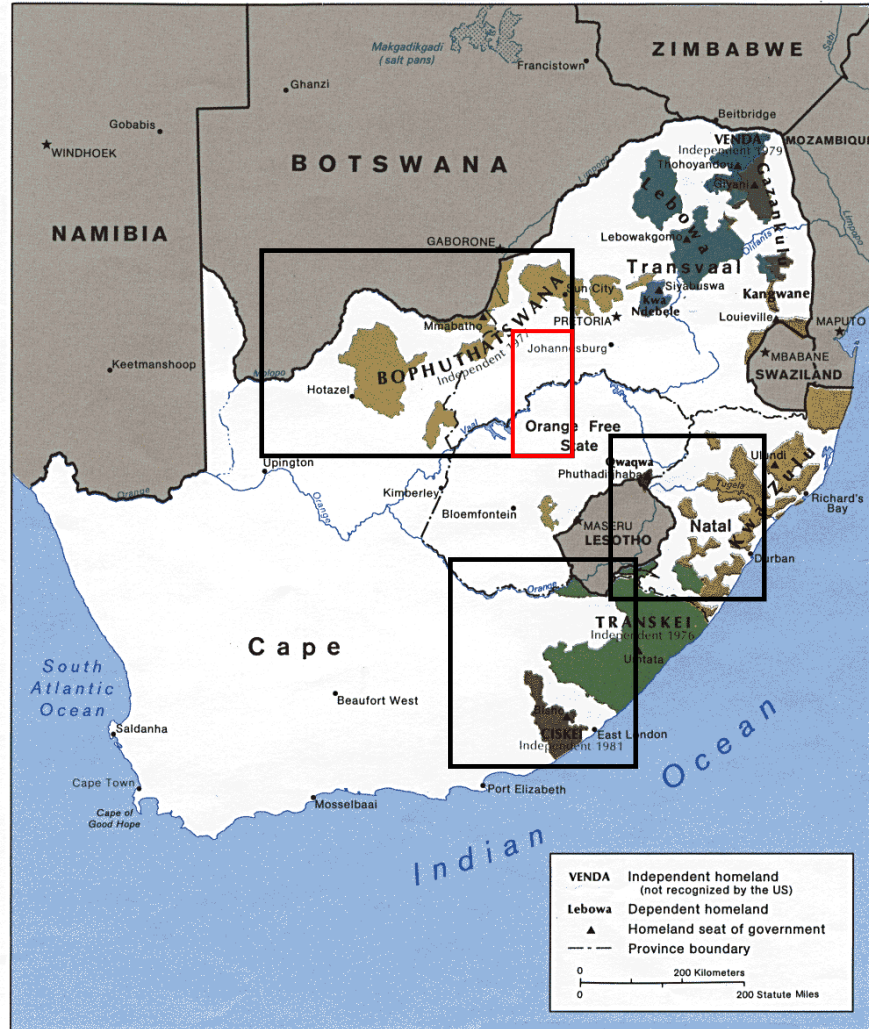
Table 12: Testing the effects of treatment on men born after the shock, toddlers, small children, and teenagers

	(1)	(2)	(3)	(4)	(5)	N _t
Born in treated region in treated years	1.577 (1.735)	1.549 (1.738)	1.548 (1.739)	1.817 (1.740)	1.262 (1.730)	40
Born in the treated region 1 to 5 years after the shock					-1.665 (1.088)	290
Born 1 to 2 years before the shock	-0.693 (1.919)		-0.296 (2.419)			66
Born 2 to 5 years before the shock		-0.581 (1.338)	-0.455 (1.687)			172
Teenager during the shock				1.475 (1.221)		211
Born in treated region	-1.024 (2.011)	-0.942 (2.030)	-0.947 (2.032)	-1.447 (2.025)	-2.130 (1.793)	
Constant	167.0*** (2.229)	167.0*** (2.235)	167.0*** (2.236)	167.3*** (2.231)	169.5*** (1.891)	
Observations	1,235	1,235	1,235	1,235	1,628	
R-squared	0.105	0.105	0.105	0.106	0.098	

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. N_t denotes size of treatment group. All specifications include year of birth dummies and father's job dummies. Birth years in the sample are from 1941 – 1977.

Figure 1
Provinces and homelands during apartheid

South Africa: Black Homelands



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Bordered areas in black are the affected former homelands, bordered areas in red are the gold mining areas.

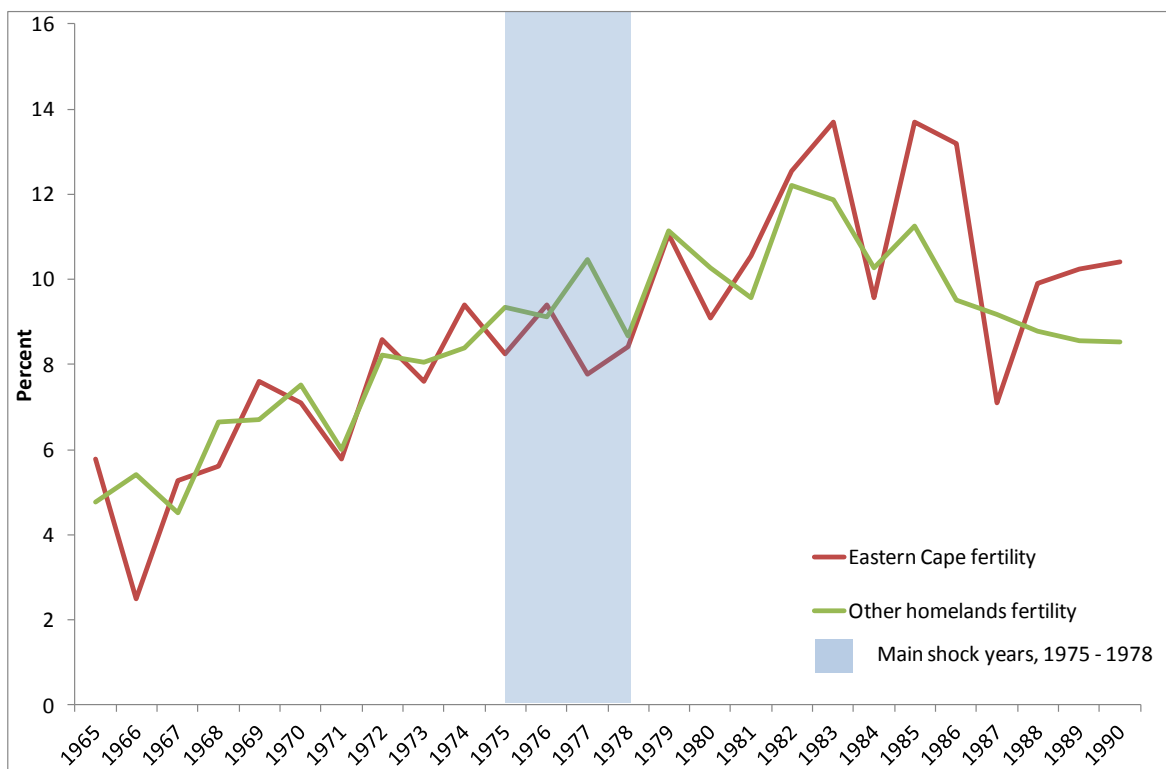
Source: Unites States Central Intelligence Agency, 1986.

Figure 2
Provinces after 1994



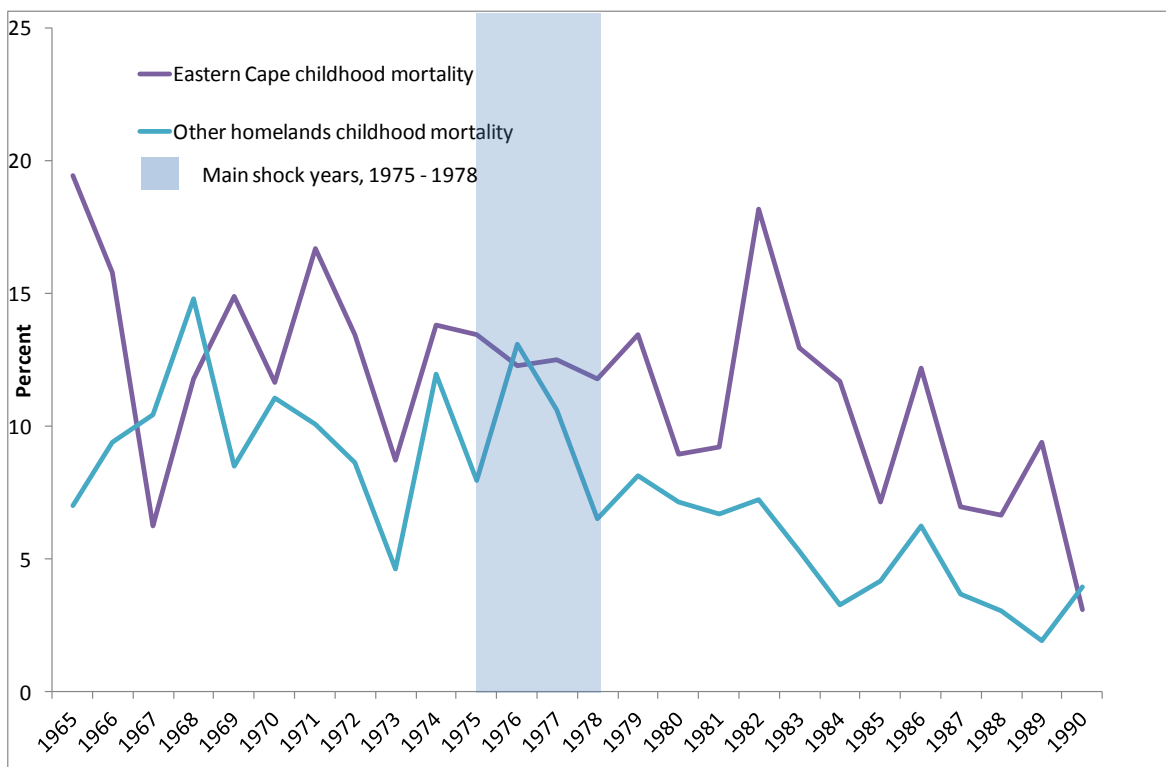
Source: United States Central Intelligence Agency, 1995

Figure 3 Female Fertility, percentage women giving birth each year, 1965 – 1990



Source: NIDS Wave 1

Figure 4 Childhood mortality, percentage of children dying under the age of 10, 1965 – 1990



Source: NIDS Wave 1