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Assessing the Impact of Social Grants on Inequality: A South African Case Study

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Abstract

The democratic government in South Africa has developed a social protection net to combat the high levels of poverty and inequality inherited from the apartheid regime. With the help of modest economic growth and an associated increase in per capita household income, the introduction and expansion of social grants has helped alleviate the inherited burden of poverty. On the other hand income inequality has remained stubbornly high in post apartheid South Africa and the role of these grants in inequality reduction remains unclear. We use national household survey data from 1993 and 2008 and the major income inequality decomposition techniques in order to assess the impact of a change in these government transfers on inequality. This South African case study allows for a side-by-side assessment of these income inequality decomposition techniques. We find that the social assistance awarded to the elderly has contributed dramatically to the decline in poverty but has not reduced income inequality. On the other hand social protection programs directed at child minders of poor children had an equalizing effect. More recent decomposition techniques allow us to net out the effect of changes in household composition on inequality from the impacts of social protection on inequality. This is shown to notably lower the direct impact of the social grants on inequality.

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Introduction

The purpose of this paper is to investigate the role of social grants on income inequality during the first 15 years of democracy in South Africa. Since the transition to democracy in 1994, the South African government has dramatically expanded this system of social grants. Building on an existing but racially biased social security system developed by the apartheid government, the social grant system was expanded to include all races and then, through the 1990s, additional social transfers were instituted.

The reform of the social safety net coupled with increases in per capita household income associated with modest economic grow has reduced poverty levels in the country. However the very high levels of inequality that were bequeathed as a legacy of apartheid have remained stubbornly high and static income source decomposition work in South Africa suggests that these grants do not and have not reduced inequality. Given the magnitude and apparently effective targeting of these social grants, this seems incongruous and has to raise the question of whether this result may more a consequence of the technique rather than the actual operation of the grant system itself. The paper uses the South African situation over the post-apartheid period for a side-by-side assessment of a variety of income source decomposition techniques. It interrogates what insights can be gleaned from each technique about the impact of the extensive and growing social grant system on inequality over this recent period.

Section 2 outlines the relevant survey data employed. Drawing on the rich datasets from 1993 and 2008, a detailed picture is obtained of household income sources and their changes over time. We begin in Section 3 by applying a static, within period decomposition of per capita household income for both periods. This replicates the established result that social grants seem to have a limited impact on the distribution of income. This discussion is followed in Section 4 by the application of a dynamic income decomposition technique, which directly captures the effect of changes in the composition of income sources on changes in inequality. With the decomposition framed in this way, we find that changes to some of the social grants do indeed appear to have reduced inequality but others do not. In Section 5 we apply a dynamic decomposition to simulate the role of different income components in the changing real income distribution. Again we find that changes to some of the social grants appear to have reduced inequality but others do not. These dynamic simulations allow us to disentangle the effect of changes in household composition on inequality from the impacts of social grants on inequality. However, changes in household composition are shown to notably lower the direct impact of the social grants on inequality.

In the concluding section (6) we look across these techniques. It seems that the large state old age pension scheme, which has played a large poverty reduction role, has not had an equalizing effect on income inequality. On the other hand a large new programme of social grants directed at caregivers of poor children has had an equalizing effect.

Data

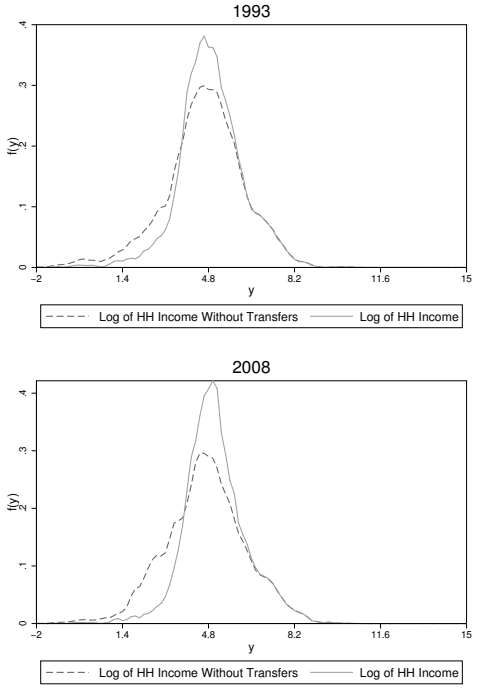
To sufficiently assess the impact of government transfers on welfare measures of inequality and poverty adequate data containing comprehensive income measures for all components for both periods are crucial. For the pre apartheid period the choice is limited to the Project for Statistic on Living Standards and Development (PSLSD) dataset conducted by South Africa Labour and Development Research Unit (SALDRU) at the University of Cape Town. The PSLSD, was conducted in 1993 in an attempt to overcome the lack of national data collected by the apartheid government as, no nationally representative data-

set including all races existed (Wilson, 1995). A complex survey design was implemented with sampling executed as a two stage self weighting approach with Census Sub Enumeration Districts and household as first and second stage units respectively, which can be weighted to be national representative. In contrast the post apartheid period contains plethora of potential datasets thanks to the data gathering efforts of the strong national statistical office, Statistics South Africa, as well as various academic and private research units. The National Income Dynamics Study (NIDS) is the preferred dataset of choice as it is both South Africa's first nationally representative a panel study as well as the cousin of the PSLD as it is conducted in a similar fashion to the PSLSD. A two stage clustering design was implemented in 2008 by first selecting on enumeration level before randomly selecting households within the selected EAs (Leibbrandt et al., 2009). By taking into account the complex survey designs, nationally representative statistics can be obtained.

Household income can be desegregated into various components by source such as labour, interest, remittances, agricultural income, old age pension, child support and other government transfer income. As the focus of this investigation is primarily concerned with the effects of social assistance from government on income inequality, we place income into four components, labour, state old age pension, other government transfers and other income. Labour income is selected as a separate category due to its dominant share of total income and its effects on inequality as reported by various previous studies (see Leibbrandt et al. (1996)). It includes all labour market income earned by members of a particular household. Income obtained through the provision of the State Old Age Pension is categorized as pension income. Other government transfer income includes grants such as disability grants, foster care grants, poor relief (in 1993) unemployment insurance and child support. It should be noted that despite its prominence in 2008, the child support grant (CSG) was only introduced in 1998 and, by 2007, reached more than 8 million beneficiaries; making the CSG the largest social assistance program in terms of the number of beneficiaries reached (United Nations Children's Fund, 2008). Despite the CSG's prominence it cannot be included as a separate income component as, in 1993, the CSG was not in place and the mean of the CSG will be zero resulting in any welfare indicator's calculation based on the mean intractable. Consequently the CSG is pooled together with other government transfers excluding the State Old Age Pension into the other government transfer category. In 2008 the CSG comprised two-thirds (66.40%) of other government income and thus any change attributed to the other government transfer component is mainly driven by the introduction and coverage of the CSG. The share of income from other government transfers excluding the CSG remained fairly stable during the period reporting 0.0306 in 1993 and 0.0331 in 2008. Income not classified into any of these three categories is aggregated into the other income category.

Figure 1 charts the densities of log of total household income per capita with and without government transfers in both 1993 and 2008. The graphs capture the essence of the impact of increased targeting and additional grants on the income distribution in South Africa. In the pre apartheid period, the addition of government transfers on the income distribution is significant but small. The density of total household income without government transfers lies close to the total household income with government transfers densities. In contrast the post apartheid period density indicates the effect of government transfers on the income distribution with various discrepancies particularly in mean and the bulge in the left tail. The left most corner of the density indicates the effect of government transfer on poverty with the density of household income including transfer lying to the right of the density excluding transfer suggesting that the lowest ranked household according to household income with transfers is better off than the lowest ranked household according to household income without transfers. The contribution of the State Old Age pension has remained fairly constant overtime as and so the majority of the expansion of the social

Figure 1: Density of Log of Household per Capita Income



system is due to the introduction of the CSG[4].

To assess the change in each chosen component between the periods our attention is directed to Table 1 which provides the initial descriptive statistics for total household income per capita and, separately, for all four components of per capita income[5]. We present the share of the component in total income, the correlation of each component with total income and two inequality measures for that component. For the total household income, the mean income across the period 1993 and 2008 has increased from 329.7 to 442.1 coupled with an increase in the standard deviation implying a leftward shift in the income distribution between the period accompanied by stretching of the distribution. Income inequality has remained stubbornly high with slight increases as captured by the Gini Coefficient from 0.666 to 0.671.

Labour income comprises the largest share of household income in both periods reporting a share of 59.2% in 1993 increasing to 61.5% in 2008, and consequently reports a high correlation with household income of 0.581 in 1993 increasing to 0.906 in 2008. Inequality in labour income is rife obtaining a Gini Coefficient for the labour component of 0.767 in 1993 and increasing to 0.794. Considering the large share labour income comprises of total income the dramatic increase in inequality within the labour income component

[4] There is an historical review of these grants in Woolard and Leibbrandt (2010) the evolution and impact of unconditional cash transfers.

[5] From this point on, for ease of exposition we speak of incomes even though all incomes in this paper are per capita incomes. All results are calculated attributing the relevant per capita household income to each member of that household and to weight up to national population totals using individual design weights.

Table 1: Basic Descriptive Statistics on the Components of Household Income for 1993 and 2008

	1993	2008
Household Income per Capita		
Mean	329.271	442.052
SD	4.383	10.889
Share	1	1
Correlation with Total Income	1	1
Proportion of HH with Component	1	1
Gini Coefficient	.666	.671
Household Labour Income per Capita		
Mean	195.065	285.648
SD	2.082	7.867
Share	.592	.6146
Correlation with Total Income	.581	.906
Proportion of HH with Component	.605	.707
Gini Coefficient	.767	.794
Old Age Pension Income per Capita		
Mean	17.218	13.114
SD	.18	.232
Share	.052	.030
Correlation with Total Income	-.051	-.023
Proportion of HH with Component	.241	.202
Gini Coefficient	.807	.816
Other Government Transfer Income per Capita		
Mean	3.543	28.71
SD	.091	.309
Share	.011	.065
Correlation with Total Income	-.015	-.128
Proportion of HH with Component	.056	.552
Gini Coefficient	.955	.601
Other Income Per Capita		
Mean	113.445	114.581
SD	3.654	4.752
Share	.345	.259
Correlation with Total Income	.871	.721
Proportion of HH with Component	.888	.900
Gini Coefficient	.83	.794
$N_{unweighted}$	39067	28212
$N_{weighted}$	42 781 962	43 812 042

Notes: Own Calculations using NIDS and PSLSD weighted
Standard errors in parentheses.

alludes to the driver of changes in aggregate income inequality. Over the period pension income decreased slightly from an average of 17.2 in 1993 to 13.1 in 2008 coupled with a decrease in the share of total income from 0.052 to 0.030.

Other government income has increase from 3.5 to 28.71 over the period accompanied by a dramatic increase in the share of total household income from 0.011 to 0.065 most likely attributed to the introduction of CSG. The role out of the CSG is apparent from the share of households with income from other government sources increasing from 0.056 in 1993 to 0.552 in 2008. The pension and other government transfer components are the only components reporting negative correlation coefficient across both periods indicative of the progressive nature of the government social assistance. The other income component comprises 0.345 of income in 1993 decreasing to 0.259 in 2008. A positive and large correlation coefficient of the other income component in both periods is obtained.

Changing household sizes are important to changing per capita incomes. Also, government transfers are granted to particular individuals in households such as the elderly or primary care giver of a child. Thus changes to these demographic variables are a potentially important part of changing contributions from each income source to household income and household income inequality. Descriptive statistics for household composition in each period are provided in Table 2. Across the period household size decreased from 4.38 to 3.57 with a corresponding change in number of adults a household from 2.7 to 2.1. However the number employed adults in a household have decreased with the average share of employed adults of adults decreasing 0.37 to 0.25.

Table 2: Descriptive Statistics of Household Composition

	1993	2008
Household Size	4.387	3.572
	(2.936)	(2.523)
Number of Adults in HH	2.718	2.346
	(1.645)	(1.438)
Number of Employed in HH	.368	.251
	(.352)	(.347)
Adults Share of HH	.717	.755
	(.255)	(.248)
Employed as Share of Adults	.478	.309
	(.385)	(.387)

Notes: Own Calculations using NIDS and PSLSD weighted
Standard errors in parentheses.

Thus, as described, both the 1993 and 2008 data sets allow for a disaggregation of total household income into a consistently defined set of income components including the state old age pension and other social grants. This allows for the investigation of the impact of social grants on income inequality. The rest of this paper proceeds to interrogate this question making use of a series of income source decompositions. Our particular focus is on what each of these different decompositions tells us about this relationship and how it changes over time.

Static Income Inequality Decompositions by Source

Building on the Shorrocks' (1982) source contribution decomposition, income inequality decompositions by source was derived by Lerman and Yitzhaki (1985) based on a derivation of the Gini Coefficient by Stark et al (1986) and provides a static decomposition within period with inter-temporal comparison achieved only by contrasting the results from 1993 to 2008. The Lerman and Yitzhaki (1985) approach is similar to Shorrocks (1982) decomposition rule for which inequality yet specifically derived for the Gini Coefficient as a measure of inequality. However the effect of a change in an income source on the Gini Coefficient within period can be obtained by taking the derivative of the Lerman and Yitzhak approach as derived by Stark et al. (1986). The first application of this income decomposition technique on South African data was conducted by Leibbrandt et al (1996). A condensed overview of the derivation of the Lerman and Yitzhaki Decomposition and the extension by Stark et al (1986) is provided in order to ground the interpretation of the decomposition for both the 1993 and 2008.

In a sample of n households deriving income from K distinct sources or components, let y_i represent the total income of household i where $i = 1, 2, .., n$. Thus $y_i = \sum_{k=1}^{K} y_{ik}$ where y_{ik} denotes the income of household i from source k, where $k = 1, 2, .., K$. $y_i^{pc} = \frac{1}{n} \sum_{k=1}^{K} y_k$ provides the per capita household income where n is the number of household members. The distribution of income component k is given by $Y_k = (y_{1k}, y_{2k}, .., y_{Nk})$ and similarly the distribution for the total household income per capita is given by $Y = (y_1^{pc}, y_2^{pc}, .., y_N^{pc})$. Let the Gini's mean difference[6] (A) be defined as:

$$A = \int_a^b F(Y)[1 - F(Y)]d$$

as per Lerman and Yitzhaki (1985), where a represents the lowest income and b the highest income in the population. Using integration by parts it follows that:

$$A = \int_a^b Y[F(Y) - \frac{1}{2}]f(Y)dy$$

As F is uniformly distributed with mean $\frac{1}{2}$ we obtain

$$A = 2cov[Y, F(Y)] \tag{1}$$

As $y_i = \sum_{k=1}^{K} y_{ik}$, equation 1 can be rewritten as:

$$A = 2 \sum_{k=1}^{K} cov[y_k, F(Y)] \tag{2}$$

[6] The Gini Mean Difference, also know as the mean difference, is the absolute difference between indepedent points drawn from a probability distribution.

The $cov(y_k, F)$ is the covariance of income component K with the cumulative distribution of income. Dividing (2) by the mean of y the Gini coefficient is obtained:

$$G = \frac{2}{\mu} \sum_{k=1}^{K} cov[Y_k, F(Y)]$$

By multiplying and dividing each component k by $cov(y_k, F_k)$ and by μ_k as per Lerman and Yitzhaki (1985) and denoting $F(Y_k)$ as the cumulative rank distribution of income source k, yields the decomposition by source:

$$G = \sum_{k=1}^{K} (\frac{cov[Y_k, F(Y)]}{cov[Y_k, F(Y_k)]})(\frac{2}{\mu_k} cov[Y_k, F(Y_k)])(\frac{\mu_k}{\mu})$$

Which yields:

$$G = \sum_{k=1}^{K} R_k G_k S_k \tag{3}$$

where $S_k$is the share of component k of total income ($S_k = \frac{\mu_k}{\mu}$), G_k is the Gini of component k and thus captures inequality within income component k, R_k is the gini correlation between income component k and total income, similar to the pearson's correlation, and defined as:

$$R_k = \frac{cov[Y_k, F(Y)]}{cov[Y_k, F(Y_k)]}$$

R_k will thus be equal to positive when an income component is an increasing function of total income and negative when an income component is a decreasing function of total income and thus lowers the overall Gini coefficient for total income. Thus the effect of income component k on total income inequality is decomposed into share of the component in total income, the inequality the component and a measure for the correlation between the component and total income.

The effect of a change in an income source on the Gini Coefficient using the Lerman and Yitzhaki approach was developed by Stark et al (1986).

Let φ represent a percentage change in income source k such that $y_k(\varphi) = (1 + \varphi)y_k$. Then:

$$\frac{\partial G}{\partial \varphi} = S_k(R_k G_k - G)$$

Dividing by G:

$$\frac{\partial G / \partial \varphi}{G} = \frac{R_k G_k S_k}{G} - S_k$$

The percentage change in inequality due to a change in component k is equal to the initial share of component k in inequality less the share of component k in total income (Stark et al., 1986). As a result if component k has a negative or zero Gini correlation, R_k, a positive change in component k will have an equalizing effect on inequality. However if $G_k > G$ and R_k is positive then then the $R_k G_k - G$ is negative resulting in an increase in inequality associated with component k. This is due to $R_k \leq 1$ (Stark et al., 1986).
The major disadvantage of this approach is its one dimensionality as it provides a snap shot of drivers of income inequality in a particular period and so is limited in assessing how changes in the components of income have resulted in an aggregate change in equality.

The application of the Lerman and Yitzhaki decomposition to 1993 and 2008 is provided in Table 3. However apart from Gini correlation, R_k, the share of component k of total income ($S_k = \frac{\mu_k}{\mu}$) and the Gini of component k, G_k, can be found in descriptive Table 1 for each component k.

Table 3 provides the results for the Lerman and Yitzhaki decompositions in 1993 and 2008. As per equation 3 above, the contribution of each income component to the aggregate Gini coefficient is the product of (a) the share of that component in total income, (b) the inequality in its distribution and (c) the correlation with the distribution of total income. Before we analyse social grants in detail it is worth noting that the main driver of income inequality in both periods is labour income. In 1993 labour income contributed 0.64 of total income inequality increasing to 0.73 in 2008. Income from other sources also contributed substantially to total income inequality at 35 percent and 26 percent respectively for 1993 and 2008. Within each period both labour income and income from other sources have strong disequalizing effects.

With regard to social grants, the decompositions suggest that these grants have either a small negligible effect or small equalizing effect on total income inequality. In 1993 the pension reports a relative contribution of -0.001 increasing slightly to 0.002 in 2008. Other government transfers report a small negligible effect of -0.0001 in 1993 becoming more equalizing in 2008 reporting a relative contribution of -0.001. Despite the large inequality within the distribution of the government transfer components which should favour the less fortunate, the small share of total income of these sources results in a small effect on total income inequality. Government transfers appears to reverse some of the disequalizing effects of labour income, however their impact is quite small.

The small shares of government income characterizing the 1993 period are attributed to the modest social assistance system present in South Africa at the time. In 2008 the state old age pension reports a smaller share of total income (0.052). However the expansion of the social assistance mainly through the CSG is captured by the increase of the share of other government income's share in total income increasing to 0.065. The importance of income from government assistance with respect to total income has increased between the periods due to an increase in other government transfer income while the significance of labour income has also increased between the periods.

With regard to the Gini Coefficient of each source (G_k), both forms of government assistance report high levels of inequality in both periods. The State Old Age Pension reports a Gini Coefficient of 0.8 in 1993 and 0.81 in 2008. Other government income reports a Gini Coefficient of 0.955 in 1993 decreasing dramatically to 0.601 in 2008. The high inequality in the distribution of government grants is understandable, as many individuals do not receive government assistance reporting zero income from such sources resulting in an unequal distribution of the component. In line with this, it is most likely the expansion of the social assistance system through the CSG that brought down the Gini coefficient

for this component.

Then, with regard to the correlation of grant income to the distribution of total income (R_k), Table 3 reports that these correlations are low or negative for income from social grants. The Old Age Pension reports a correlation of -0.008 in 1993 and 0.06 in 2008 while other government income reports a correlation in -0.09 and -0.014 in 2008 respectively. As grant income is means tested and supposed to target the poor, the negative coefficient is a good thing. A priori we would expect these income sources to be strongly negative. We do not find this strong negative relationship. However, it is clear that in general a rise in total income not attributed to an increase in government assistance results in a decrease in grant income.

Applying the Stark et al. (1986) extension, the impact of a 1% increase in an income component on total income inequality can be assessed. In both 1993 and 2008 small increases in social assistance lead to decreases in income inequality as measured by the Gini coefficient. Both the pension and other government income report such negative results for a 1% increase in the particular component for 1993 and 2008. In 1993 a 1% increase in the pension would lead to a -0.052 decrease in income inequality as measured by the Gini with a corresponding -0.027 decrease in 2008 while other government transfer reports values of -0.009 and -0.066 in 1993 and 2008 respectively.These findings are driven by the negative correlation (R_k) coefficient obtained for these income sources.

Thus, this marginal change analysis is more positive about the redistributive impact of the social grants than the static decompositions. However, a note of caution about this approach is in order. This analysis hinges on the assumption that all other components remain unchanged. The validity of this assumption is questionable as an increase in labour income might disqualify an individual from obtaining means tested government assistance.

A more important limitation of this static decomposition is that it does not directly explore the impact on changes in state transfers on changes in inequality. In this section we have explored to cross-sectional snapshots and then connected them by comparing the changes to each of the components of the decomposition. This is usefully suggestive but not more than this. We now go on to look at some more recent decomposition approaches that focus directly on the changes in inequality that result from changes in income sources including social grants.

Table 3: Static Decomposition of the Gini Index by Incomes Sources

Source	Income Share (S_k)	Gini Correlation (R_k)	Gini Index (G_k)	Absolute Contribution ($S_k.R_k.G_k$)	Relative Contribution ($\frac{S_k.R_k.G_k}{G}$)	Change $\frac{\partial G/\partial \varphi}{G}$
			1993			
Labour	0.592	0.939	0.767	0.427	0.641	0.049
	(0.007)	(0.001)	(0.002)	(0.005)	(0.011)	
Old Age Pension	0.052	-0.008	0.807	-0.001	-0.001	-0.052
	(0.001)	(0.007)	(0.002)	(0.001)	(0.001)	
Other Gov Transfer	0.011	-0.091	0.955	-0.001	-0.001	-0.009
	(0.000)	(0.014)	(0.001)	(0.000)	(0.000)	
Other Income	0.345	0.832	0.830	0.238	0.357	0.012
	(0.007)	(0.007)	(0.005)	(0.008)	(0.011)	
Total	1.000	-	-	0.667	1.000	
	0.000	-	-	(0.004)	0.000	
			2008			
Labour	0.646	0.956	0.794	0.491	0.731	0.085
	(0.007)	(0.002)	(0.004)	(0.007)	(0.010)	
Old Age Pension	0.030	0.066	0.816	0.002	0.002	-0.027
	(0.001)	(0.015)	(0.004)	(0.000)	(0.001)	
Other Gov Transfer	0.065	-0.014	0.601	-0.001	-0.001	-0.066
	(0.002)	(0.011)	(0.004)	(0.001)	(0.001)	
Other Income	0.259	0.871	0.794	0.179	0.267	0.007
	(0.007)	(0.007)	(0.006)	(0.007)	(0.010)	
Total	1.000	-	-	0.671	1.000	
	0.000	-	-	(0.011)	0.000	

Source: Own calculations using the Lerman & Yitzhaki (1985) framework.
Data used: NIDS and PSLSD Weighted

Standard errors in parentheses.

Dynamic Decompositions

The Lerman and Yitzhaki (1985) decompositions provide static decompositions of the effect of an income component on income inequality but fall short of providing insights into changes in welfare indicators over time due to changes in an income component. The expansion of the South Africa government social assistance system from 1993 to 2008 resulted in changes in the distribution of a source. In order to capture the impact of the extension of the social assistance on inequality a different approach is required. Wan (2001) derives a framework that decomposes the change in Gini coefficient by income components allowing for dynamic changes to be assessed.

Following Wan (2001) let the discrete Gini be denoted as G_d, and given by the decomposition:

$$G_d = PQI \tag{4}$$

where P is a $1 \times N$ row vector of shares of income receiving units, I is a $N \times 1$ column vector of income shares and Q is a $N \times N$ matrix with zero on the diagonal, $+1$ in the upper triangular region $(i < j)$ and -1 on the lower triangular region $(j > i)$ as per Silber (1989). The decomposition in equation 4 can be applied to component $k's$ Gini coefficient, G_k, as follows:

$$G_k = P_k Q I_k$$

where P_k is a $1 \times N$ row vector of shares of y_k receiving units and I_k is a $N \times 1$ column vector of k^{th}income shares. Rankings within P_k and I_k are determined by ascending values of y_k. The concentration index C_k of component k, can be similarly obtained and given by:

$$C_k = P_k^* Q I_k^*$$

where P_k^* and I_k^* is defined in a similar fashion as P_k and I_k except that rankings within P_k^* and I_k^* are determined by household per capita income as opposed to y_k. The relation between C_k and G_d is given by:

$$G_d = \sum_{k=1}^{K} (\frac{\mu_k}{\mu}) C_k$$

where μ_k is the mean of component k and μ is the mean of total household per capita income, and thus the Gini can be interpreted as the weighted concentration index of each components with the share of each component acting as weights. For simplicity let $S_k = \frac{\mu_k}{\mu}$ and thus:

$$G_d = \sum_{k=1}^{K} S_k C_k \tag{5}$$

Using subscripts t and $t+1$ to indicate the two time periods, the change in G_d can be obtained from equation 5:

$$G_{d,t+1} - G_{d,t+1} = \sum_{k=1}^{K} (S_{k,t+1} C_{k,t+1} - S_{k,t} C_{k,t})$$

Allowing delta, Δ, to specify the difference between two periods we obtain:

$$\Delta G = \sum_{k=1}^{K} (\Delta S_k + S_{k,t})(\Delta C_k + C_{k,t}) - S_{k,t} C_{k,t}$$

Which can be rewritten as:

$$\Delta G = \sum_{k=1}^{K} \Delta S_k C_{k,t} + \sum_{k=1}^{K} \Delta C_k, S_{k,t} + \sum_{k=1}^{K} \Delta C_k \Delta S_k \tag{6}$$

Equation 6 decomposes changes in the Gini into three unique terms: changes in income shares, $\Delta S_k C_{k,t}$, changes in concentration index, $\Delta C_k, S_{k,t}$ and the interaction of these two effects, $\Delta C_k \Delta S_k$ labeled as the Structural Effect, Real Inequality Effect and Interactive Effect respectively (Wan, 2001).

Table 4 provides the results of the Wan (2001) dynamic decomposition approach of income components for the Gini Coefficient for the period spanning 1993 to 2008. The table presents the structural effects due to changes in income shares ($\Delta S_k C_{k,t}$), the real inequality effects due to changes in income concentration indices ($\Delta C_k, S_{k,t}$) and the interaction effects ($\Delta C_k \Delta S_k$) as outlined in equations 6.

Table 4: Wan's Dynamic Decomposition of the Gini Index by Income Sources

	Structural Effect	Real Inequality Effect	Interactive Effect	Full Contribution
Labor	.024	.138	-.011	.152
Old Age Pension	-0.001	-.016	.005	-.011
Other Gov Transfer	-.016	-.003	-.023	-.043
Other	.075	.159	-.046	.189

Notes: Own Calculations using Wan (2001) approach on NIDS and PSLSD weighted
Standard errors in parentheses.

The structural effects are driven by the change of a component's share of total income(ΔS_k) and the baseline inequality within the income component captured by the concentration index of the component in question (C_k) in the initial period. Over the period pension and other government transfers have had an equalizing structural effect. However these effects are small at -0.001 and -0.016 respectively. The structural effects are dominated by labour and other income effects both in magnitude and signs. Labour income and other income sources are found to have disequalising structural effects while the income from both government transfers have equalizing structural effects. Over the period 1993 to 2008

the change in labour income has lead to a disequalizing (positive) structural effect of 0.024 while income from other sources has had a similar disequalizing structural effect of 0.075. As previously mentioned, Table 1 provides the shares and Gini Coefficients of the various components. Both labour income and income from other sources report high levels of within source inequality. Unlike labour income whose share of total income has increased during the period, the share of income from other sources has decreased during the period.

The real income inequality effect, which is driven by changes in within component inequality and the share of the component of total income, indicate similar trends to the structural effects. Labour income and income from other sources are found to be disequalizing while the pensions and other government transfers are found to be equalizing. Pensions and other government income report equalizing effects of -0.016 and -0.003 respectively. However, similar to the structural effects the real inequality effects are overwhelmed both in magnitude and sign by income from other sources and labour income. On the other hand changes in the labour income component across the period leads to a real income inequality effect of 0.138 while other income reported a real income inequality effect of 0.159.

Finally the interaction of the two effects indicates equalizing effects for labour income, other government transfers and other income. Interestingly the interaction of pension income indicates a small disequalizing effect on total income during the period.

The full contribution of changes in an income component during the period is obtained by summing the above mentioned effects. Changes in both pension income and income from other government transfers during the period have had equalizing effects on total income of -0.011 and -0.043 respectively. The equalizing effect obtained from changes in social assistance during the period is undone by the large disequalizing effect from changes in labour income and income from other sources. The change in labour income during the period has had a disequalizing effect on total income inequality of 0.152. Similarly changes in income from other sources have also had a disequalizing effect on total income of 0.189.

The application of the Wan (2001) approach has allowed us to assess the effects of changes of income components across the period on changes in total income inequality. Labour income and income from other sources dominate the aggregate effect. Their disequalizing effects result in an increase in overall income inequality. Nonetheless, the approach supports the aggregate picture of the impact of social grants on income inequality in South Africa that was painted earlier by comparing two static snapshots. The changes in social grants are found to have equalizing effects on total income. Also the decomposition adds some relevant detail in showing that both the increasing shares of income from social grants and their narrowing inequality were responsible for their equalizing contribution. However, this is not as clean as one would like it to be as the interaction term involves some element of both.

Thus, at the end of the day it is the aggregate impacts of each source that are useful. We are left with the problem of disentangling the impact of the important components of the changes in social grant income within a dynamic decomposition. Besides the changing shares of grants and the intra-component inequality there are two other important components. The first is the change in the targeting of grants. The static decomposition highlighted the importance of the correlation between grant income and total income as a signal for whether grants are effectively targeted at the bottom of the distribution. Grants can become more equalizing if they become more tightly targeted at the bottom of the distribution. Second, as we are measuring the inequality of per capita incomes, changes in inequality could be due to changes in household size and composition. This possibility

is important in its own right. In the context of this paper, it is especially important in terms of netting out these demographic effects from the effects of the income components. Up to this point, the techniques have not allowed for this possibility, thereby implicitly attributing these demographic effects to the income sources. In the next section we introduce more recent simulation based work that shows some promise in terms of unravelling these components.

Dynamic Decompositions using Simulations

Despite the dynamic nature of the Wan (2001) approach, which decomposes the changes in the Gini Coefficient during the period by accounting for the changes in the various income sources, it does not isolate the impact of a change in an income source on inequality. In an ideal situation, the impact of the extension of the social grant system in South Africa between 1993 and 2008 would be assessed against a counterfactual of an unchanged 1993 system operating in 2008. A novel approach by Barros et al. (2006) investigates the determinants of inequality across a period based on a series of counterfactual simulations in an attempt to quantify the contribution of changes in demographics, social assistance and labor income.

In order to assess the drivers affecting the change in wellbeing as measured by inequality, we follow the approach outlined by Barros et al (2006), Azevedo et al (2013) and Azevedo et al (2012). Following the notation from the previous sections,$y_i = \sum_{k=1}^{K} y_{ik}$ and $y_i^{pc} = \frac{1}{n}\sum_{k=1}^{K} y_{ik}$ which can be rewritten as:

$$y^{pc} = \sum_{k=1}^{K} y_{ik}^{pc} \tag{7}$$

where y_{ik}^{pc} is the household per capita income of component k. For simplicity sake decompose income (y_i) into only two sources and name these sources grants (G) and non-grants (NG) income thus letting $k = G,\ NG$. Equation 7 can thus be rewritten as

$$y^{pc} = \sum_{i=1}^{n} y_{i,\,G}^{pc} + \sum_{i=1}^{n} y_{i,\,NG}^{pc} \tag{8}$$

The cumulative density function of household income per capita, F(.) is thus dependent on the factors outlined in equation 8, namely government income ($y_{i,\,G}$) and non-government income ($y_{i,\,NG}$). Let ϑ be any welfare indicator of inequality which is dependent on the distribution of income and thus the factors outlined. ϑ is now given by:

$$\vartheta = \Psi(F(Y^{pc}(\sum_{i=1}^{n} y_{i,\,G}^{pc}, \sum_{i=1}^{n} y_{i,\,NG}^{pc}))) \tag{9}$$

In order to assess the impact of a change in a component (k) of the income distribution F(.), between two periods, on a particular welfare indicator of inequality, a counterfactual income distribution is required for the second period where the component in question is left unchanged. However as no such distribution exists, Barros et al (2006) constructs counterfactual distributions for the second period given that the distributions of per capita income is known in both periods. For a change in a particular component, say $y_{i,\,NG}$, the indicator is calculated for the first and second period based on the income distribution F(.). In addition, the 1993 real values of the component, $y^{pc}_{,\,NG}$, is substituted into the income distribution of the second period resulting in:

$$\hat{\vartheta} = \Phi(F(Y^{pc}(\sum_{i=1}^{n} y^{pc}_{i,\,G}, \sum_{i=1}^{n} \hat{y^{pc}}_{i,\,NG}))) \tag{10}$$

$\vartheta - \hat{\vartheta}$ simulates the impact of the change in that component on inequality. It is the simulation equivalent of the total effect from Wan decomposition.However as y^{pc}_{ik} is the household per capita income of component k, the effect to household compositional changes on welfare indicators has not been explicitly taken into account. One benefit of this simulation approach is that the impact of changes in household composition can be simulated too. To account for this equation 7 can be written as:

$$y^{pc}_i = \frac{n_a}{n}(\frac{1}{n_a}\sum_{k=1}^{K} y_{ik}) \tag{11}$$

where n_a is the number of adults in household i. Consequently equation 11 is now defined as:

$$y^{pc}_i = \frac{n_a}{n}(\frac{1}{n_a}\sum_{k=1}^{K} y_{i,\,G} + \frac{1}{n_a}\sum_{k=1}^{K} y_{i,\,NG})$$

Which can be further extended by letting n_o denote the number of employed adults in household i:

$$y^{pc}_i = \frac{n_a}{n}[\frac{n_o}{n_a}(\frac{1}{n_o}\sum_{k=1}^{K} y_{i,\,G}) + \frac{1}{n_a}\sum_{k=1}^{K} y_{i,\,NG}] \tag{12}$$

The factors affecting the cumulative density function of household income per capita, F(.) is now government income ($y_{i,\,G}$) and non-government income ($y_{i,\,NG}$) as well as the number of adults per household (n_a), number of employed adults per household (n_o), number of household members (n). ϑ, which is dependent on the distribution of income and thus the factors outlined, is now given by:

$$\vartheta = \Phi(F(Y^{pc}(n, \frac{n_a}{n}, \frac{n_o}{n}, \frac{1}{n_o}\sum_{k=1}^{K} y_{i,\,G}, \frac{1}{n_a}\sum_{k=1}^{K} y_{i,\,NG}))) \tag{13}$$

For a change in a particular component, say $y_{i,\,NL}$, the indicator is calculated for the first and second period based on the income distribution F(.) resulting in equation 13 being written as:

$$\hat{\vartheta} = \Phi(F(Y^{pc}(n, \frac{n_a}{n}, \frac{n_o}{n}, \frac{1}{n_o}\sum_{k=1}^{K} y_{i,\,G}, \frac{1}{n_a}\sum_{k=1}^{K} \hat{y}_{i,\,NG}))) \tag{14}$$

The contribution of a change in non-grant income of household i is given by the difference between the actual observed welfare indicator ϑ in period 2 and the estimated welfare indicator $\hat{\vartheta}$ in period 1 as captured by equation 9 and 10 or equation 13 and 14 depending on the treatment of household compositional factors.

In the absence of panel data, substitution of a particular component between periods becomes complex as the same households are not observed in subsequent periods. Following Azevedo et al (2013) a rank-preserving transformation to assign first-period characteristics to the second period is employed by ordering households by per capita household income and dividing the population into quantiles. The mean of each component listed for each quantile can then be substituted by its corresponding quantile in the previous period. Thus, to assess the impact of a change in grant income, households are ranked in both periods according to household income per capita and placed into quantiles. The value of grant income in period 1 is then substituted for the value of grant income in period 2 across corresponding quantiles in order to obtain equation 14. So, for example, by inserting 1993 real values one would be removing the values embodying the roll out and implementation of the CSG from 2008 data. It is the comparison of inequality measured with these simulated data with the actual 2008 inequality that then provides the estimate of the impact that this income source has had on inequality. Households may also be ranked by the components themselves in order to provide insights into the impact of a change in distribution of the particular component has on a welfare indicator. If a component is highly correlated with total household income per capita the rankings of households may not differ when ordered accordlying to the component as oppose to total household income per capita. However, as is likely with the roll out of the CSG, there will changes to which parts of the distribution are receiving the income from these sources. This re-ordering process enables us to separate out the changes in the real value of the income from this source from changes in targeting of this income within the distribution.

As it is unlikely that only one component has changed between periods, all components should be substituted across periods in a successive manner such that first component 1 is substituted and the indicator calculated, followed by the additional substitution of the 2nd component and so on. However the choice of order of indicators to be substituted in is not sequential and hinge on the order. Several remedies for path dependence has been proposed in the micro-decomposition literature (see Essama-Nssah (2012) and Ferreira (2010)). Following Azevedo et al (2013) the Shapley solution is followed; that is, the effect is calculated across all possible paths . Thus all cumulative decomposition paths in every possible order is calculated and the effect per component is average across paths in order the Shapely-Shorrocks estimate of each component.

The implementation of equations 9 and 10, which allows for straightforward application of the Barros et al. (2006) method without explicitly accounting for household compositional factors can be used as a benchmark for additional output as various aspects of the procedure are adapted. Table 5 presents the results of the Barros et al. (2006) approach for the period 1993 to 2008.

Table 5: Dynamic Decomposition using Simulations

	Gini	% Change
Labor	.011	1.7
Old Age Pension	.026	3.90
Other Gov Transfer	-.044	-6.6
Other	.008	1.2

Notes: Own Calculations using Barros et al. 2006
Data: NIDS and PSLSD weighted
% Change calcuated by source's contribution
over the 1993 Gini Coefficient.
Standard errors in parentheses.

Similar to the findings of the Lerman and Yitzhaki (1985) and Wan (2001) approach, Labour income is found to have a disequalizing effect. Between the period 1993 to 2008 labour income has resulted in an increase in total income inequality by increasing the Gini Coefficient by .011 units (1.7%). Interestingly income from the State Old Age Pension is shown to have a disequalizing effect resulting in an increasing Gini Coefficient by .026 units (3.9%). On the other hand income from other government transfers has an equalizing effect; decreasing the Gini Coefficient by -.044 (-6.6%). The total impact of government transfers on income inequality during the period is thus equalizing as the net effect of the two income components is -0.014 (-2.1%). Similar to the Lerman and Yitzhaki (1985) and Wan (2001), income from other sources is found to have a disequalizing effect reporting a positive contribution to increasing the Gini Coefficient by .008 units. Despite the equalizing effects of other government transfers and income from other sources the large disequalizing effect of labour income results in a small net increase during the period. At this stage of the application of the Barros et al. (2006) approach is comparable to the Wan (2001) approach. Both approaches indicate that labour income is disequalizing while transfers from other government income in found to be equalizing. However where the Wan (2001) approach found the pension to be equalizing and other income to be disequalizing, the Barros et al. (2006) approach find the opposite effects for the two components.

The Barros et al. (2006) approach allows us to delve into this aggregate changes and separate out the contribution of demographics. In addition we can re-rank the observations by a component's distribution as opposed to the distribution of total income in order to evaluate the impact of changes in the distribution of component on total income inequality. For social grants the re-ranking according to the grants distribution allows us to gauge the impact of changes in targeting of social grants on total income inequality. Table 6 provides the results from implementing all of these changes; in other words, equations 13 and 14.

Early in the paper we presented Table 1 to provide key demographic statistics for both 1993 and 2008. To recap, household size decreased slightly from mean size of 4.87 to 3.57. Alarmingly, the number of employed adults in a household decreased from 0.36 in 1993 to 0.25 in 2008. However the change in the number of employed adults has had a disequalizing effect on income inequality as shown in Table 6 contributing to an increase in the Gini of .034 units. Despite the slight decrease in the number of adults in a household the share of adults in a household decreased from 4.4 in 1993 to 3.6 in 2008. As per Table 6 this has had a small disequalizing effect on total income inequality of .002. Table 5 indicated that the share of employed adults decreased from 0.479 in 1993 to 0.309 in 2008. This had a small disequalizing effect on income inequality as indicated in Table 6. Collectively,

the impact of these demographic changes on total income inequality has been equalizing; reporting a net effect of -0.011 (-0.01-0.02+0.011+0.008).

Table 6: HH Compositions and Targeting in Dynamic Decompositions using Simulations

	Gini	% Change
Household Composition		
Share of Adults in HH	.002	0.3
Share of Employed of Adults	-.023	-03.4
One over employed	.034	5.10
One over adults	.014	2.10
Labour		
Ranked by Total HH Income	-.012	-1.8
Ranked by Labour Income	-.008	-1.2
Old Age Pension		
Ranked by Total HH Income	.016	2.4
Ranked by Pension Income	.004	0.6
Other Gov Transfer		
Ranked by Total HH Income	-.035	-5.2
Ranked by Other Gov Trans Income	-.027	-4.0
Other		
Ranked by Total HH Income	.003	0.4
Ranked by Other Income	-.015	-2.2

Notes: Own Calculations using Barros et al. 2006
Data: NIDS and PSLSD weighted, % Change calcuated by source's contribution over the 1993 Gini Coefficient. Standard errors in parentheses

Having netted out these demographic effects, we now go on to look at the income components. Unlike to the previous application of Barros et al. (2006) where the explicit contribution of demographic changes is not separated out, changes in labour income across the period have had aequalizing effect on inequality. Once accounting for the changes in demographics the equalizing effect of labour income is slight reduced to only -.012 units (1.8%). Incomes from other sources are found to be disequalizing; increasing the Gini by .003 units (0.4%). Interestingly income from the State Old Age Pension remains slightly disequalizing increasing the Gini by .016 units (2.4%).

When conducting the simulations by re-ranking the distribution by their position in the pension distribution the State Old Age Pension is still disequalizing but this effect is greatly reduce. The impact of the change in the State Old Age Pension's distribution on the impact of the State Old Age Pension on total inequality alludes to the impact of changes in targeting has had on total income inequality. The changes in targeting, as captured by changes in the State Old Age Pension's distribution, occurring between 1993 and 2008 have led to an increasing in the Gini by .004.

Income from other government transfers has had an equalizing effect on total income inequality. Changes in income from other government transfers during the period 1993 to 2008 resulted in a decrease in the Gini of -.035 units. The changes in targeting, as expressed by changes in the distribution of income from other government income, occurring during 1993 and 2008 decreased the Gini by -.027 (-4%). The impact of changes in social grants on inequality during 1993 to 2008 has been equalizing with a negative net effect

decreasing the Gini Coefficient by -0.019 (-.035+0.016) (-2.8%).

The application of the Barros et al. (2006) approach has allowed for a more nuanced approach to evaluating the impact of changes to social grant income on changes to income inequality. The results of the application of this technique on South African data for 1993 and 2008 are provided. In sum then the approach aims to isolate the direct impact of a change in an income source on the total income inequality by providing a simulated pseudo counterfactual thus accounting for both the dynamic nature and need for a counterfactual. One of the novelties of the Barros et al. (2006) is in its ability to tease out the impact of demographical changes on income inequality. Demographical changes in South Africa, such as the number of adults and employed adults in a household, have had a small disequalizing effect on income inequality in South Africa. Once this effect is netted out, the income components is then ascertained, net of this effect. Similar to the Lerman and Yitzhaki (1985) and Wan (2001) labour income is found to have a disequalizing effect on income inequality while social grants have an equalizing effect. Re-ranking the distributions by income components themselves has indicated the equalizing effect an increase in target of grants has had on income inequality.

Conclusion

The introduction and expansion of social grants by the democratic government in South Africa has led to a decrease in poverty. However, until now the effect of this expansion on inequality has remained elusive. Given the positive poverty reduction impact and the fact that the expansion of social grants has been large, there is a prior assumption that these cash transfers have been equalizing. This prior view is strengthened by density plots of total household per capita income with and without social grants that show a substantial income contribution at the bottom of the income distribution.

We have applied a variety of decomposition techniques which assess the contribution to inequality of each component of total per capita income. The development of such techniques have taken into account dynamic changes as well as the need for a suitable counterfactual constructed through simulations. In addition allowance has been made for demographical changes and the ability to analyze changes in the targeting of grants resulting in a rich decomposition of income inequality.

Looking across the results it appears that social assistance awarded to the elderly has had little effect on equality. Changes in the targeting of the state pension have lead to a small disequalizing effect. However additional social protection programmes initiated in the post-apartheid period have had an equalizing effect. Part of this effect is due to the fact that these grants are well targeted. Disentangling the demographic effects lowers the direct impact of social grants and all income sources on inequality.

Social grants have made contributions to reducing South Africa's stubbornly high inequality. However with income inequality still relatively high a greater effort to reduce inequality is required.

In terms of methodology, advances in decomposition analysis have taken us quite far down the road of answering questions about the effects of the ambitious post-apartheid policy on social grants. We could deduce that, in line with priors, the roll out of these grants has been equalizing. We could go further and net out the impacts of changes in household size and household composition from the impacts of changes to the income sources. Then,

within each income sources we were able to separately ascertain the portion of the aggregate impact that is due to the changing size of the grant and the targeting of the grant. Through this we learn that even though the child support grant makes a small contribution to total income this contribution has increased substantially over the post-apartheid period and when this is combined with the fact that it is well targeted at the bottom of the income distribution, leads it to have a notable impact on reducing inequality. In contrast the very large state old age pension has not had a big impact on reducing inequality. A version of this programme was in place at the start of the post-apartheid period. Thus, its changing importance as an income source was unspectacular and, in fact, mildly negative in real terms. Then, the changes in its targeting reveal a slight worsening. Thus, it is assessed as worsening inequality by a small amount.

This is an appropriate concluding point as it draws attention to a remaining limitation in both old and new income source decomposition techniques. Given the striking before and after densities, it is hard to believe that the state old age pension really makes very little difference. However, these techniques are not equipped to handle before and after scenarios. In the static case, the decomposition really examines the impact of the pension in an ex post sense; i.e., only after it has already made many of the poor better off. In the dynamic case, the fact that some version of state pension policy was already in place in the base year is crucial to the analysis of changes. At the same time, if the policy is not there at all, it is impossible to do an analysis of changes. Thus, none of the decompositions are assessments of the before and after comparisons naively pictured in the densities. Moreover, these decompositions need to be imbedded in a good deal of complementary analysis to really add value.

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