Production, Inequality and Poverty linkages in South Africa[1]

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Abstract

The Kuznets inequality-development hypothesis can be tested with time-series data rather than the cross-section analyses found in earlier literature. Single-country time-series analysis cannot be done without addressing endogeneity between output and inequality. South Africa has been under-researched in this area due to a lack of data. Recent data released by the Presidency of South Africa makes such analysis possible. Besides, the use of a single inequality index in such a multiracial society is likely to capture only average effects. This paper jointly estimates production, inequality (decomposed by sub-group) and poverty with 3sls using South African data. The findings suggest that production is affected negatively by between-group inequality. Credit constraints and interracial tensions are possible causes, generating significant adverse effects that stifle economic productivity. Within-group inequality enhances production, possibly due to within-group social capital. There is evidence of an inverted U-shape relationship between per capita income and between-group inequality, but a U-shaped one between per capita income and within-group inequality. However due to the effects of the active post-apartheid policies -- which reduce between-group inequality, but increase within-group inequality -- it is doubtful if this relationship is capturing a Kuznets process. There is a significant poverty-increasing (reducing) effect of total and between-group inequalities (output). The abjectly poor seem to suffer more from inequality than others do. Policy efforts have to focus on reducing between-group inequality.

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1 Introduction

The debate over the conditions necessary for economic growth to improve the lives of the poor has resulted in some consensus. The first is that the poor share in aggregate

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income growth as well as suffering the effects of economic slowdowns (Dollar and Kraay, 2002). However, there are different viewpoints over the exact conceptualisation and measurement of the extent to which growth benefits the poor. The *absolute* and *relative* concepts have been the most prominent in the policy arena. The absolute concept constitutes the *strong absolute* – which requires that the absolute income gain of the poor be more than that of the average, or of the rich (Klasen, 2005) – and the *weak absolute* – according to which growth is pro-poor if the suitably aggregated growth rate of the poor is greater than zero (White and Anderson, 2000). With the relative concept, growth has to be relatively biased towards the poor, leading to faster poverty reduction (Kakwani and Pernia, 2000).

The second consensus is that poverty reduction is fastest in situations where income growth is accompanied by falling inequality (Bourguignon, 2004; Son and Kakwani (2006)).

However, a key challenge in development policies is the nature of the relationship between growth and inequality (Bourguignon, 2004). Besides, empirical works that look at the influence of inequality on growth use only a single inequality statistic (generally the Gini coefficient). Voitchovsky (2005) suggests that such a measure of inequality could be misleading since it might only reflect an average of the shape of the income distribution curve. There are other reasons why the inequality-development relationship should be revisited for South Africa. First, South Africa has been under-researched due to lack of data. Recent data released by the Presidency of South Africa makes such analysis possible. Secondly, in a multiracial society like South Africa, inequality within groups and between groups is likely to affect (or respond to) growth in different ways and an average inequality measure may not be able to reveal the details. Thirdly, the Kuznets (1955) inequality-development hypothesis can be tested with time-series[3] data rather than the cross-section analyses found in earlier literature.

In this paper, the inequality, growth and poverty relationship is tackled in simultaneous-equations frameworks. A simple output per worker Cobb-Douglas production framework is adopted, while an inequality equation is specified by augmenting Ahluwalia's (1976a) formulation with government expenses (per unit of GDP). The framework underlying the poverty functional form is the poverty equivalent growth model due to Son and Kakwani (2006). The equations are estimated jointly in order to control for possible production-inequality endogeneity. The rest of the paper is structured as follows: Section two examines the theories related to the growth, inequality and poverty nexus; in section three, the model is developed and estimation techniques and data issues explored. Section four presents the results while section five concludes with some recommendations.

[3] The Kuznets hypothesis is originally based on time-series data for England, Germany and United States, but later literature is dominated by cross-section analyses.

2 Growth, Inequality and poverty in literature

2.1 Pro-poor Framework

Son and Kakwani (2006) show that for societal mean income (μ), and percentage share of the income of the bottom *px100* of the population *L(p)*, the growth rate of the mean income of the bottom *p* percent of the population is

$$g(p) = \Delta \ln(\mu L(p)) \quad (1)$$

such that if $g(p) > 0\ (< 0)$, for all p, then poverty has decreased (increased) unambiguously between two periods. They suggest a pro-poor growth rate (γ^*) to be the area under the poverty growth curve as follows:

$$\gamma^* = \int_0^1 g(p)dp = \int_0^1 \Delta \ln(\mu L(p))\, dp \text{ or } \gamma^* = \gamma - \Delta \ln(G^*) \quad (2)$$

where γ is the growth rate of societal mean income and $\Delta \ln(G^*)$ is the rate of change of inequality. If inequality decreases (increases) in a given period, then the pro-poor growth rate is greater (less) than the actual growth rate for that period.

However, the link between growth and inequality is a crucial issue in the pro-poor debate. In literature, this relationship can be very complex and multidimensional. There has been increasing interest in the investigation of the growth-inequality nexus in recent literature. On the one hand there are those who pursue Kuznets's (1955) inverted U-shape hypothesis, which seeks to deepen understanding on the distributional consequences of growth. On the other hand there are those who look at the growth impact of inequality.

2.2 Inequality impact of Growth

The first influential argument for the impact of growth on inequality is the work of Kuznets (1955). He hypothesises that at the early stages of growth in developing countries, inequality increases, and then starts to fall. Since then, this hypothesis has gained interest among researchers (Oshima, 1970; Ahluwalia, 1976a). Basic mechanisms have been proposed to explain this hypothesis, such as labour market imperfections, productivity differentials across economic sectors and the changing importance of the various sectors in the economy (Kuznets, 1955), but also individual accumulation behaviour and changing factor rewards (Stiglitz, 1969); changing institutions, social relations, culture etc.[4] (Justman and Gradstein, 1999). North (1990) has highlighted the possibility of transaction costs – which hinder institutional change – falling with economic growth.

Empirical works that lend support to this hypothesis make use of cross-country datasets from the1950s to 1970s, and regress a measure of inequality against a suitable function of mean income. Some of the most influential examples are Adelman and Morris (1973), Ahluwalia (1976a and 1976b) and Ram (1995). Ahluwalia (1976a) estimates inequality as a function of log of per capita income and its square to capture the

[4] This is by means of non-homothetic preferences such that the demand for social services changes with income growth. People subsequently become politically more active, leading to change in the distribution of political power and evolution of institutions.

quadratic effect in cross-section data, and confirms the existence of an inverted U-shaped relationship. Anand and Kanbur (1993a and 1993b) propose various other functional forms and show that Ahluwalia's (1976a) estimates are not robust to functional-form variations. Bruno *et al*. (1999) argue that there may be important country-specific factors (including past inequality) determining current inequality, which may also be correlated with current income levels, leading to biased estimates. This relationship was verified for the 1970s, but as more and better data became available, it was not verified for later periods. Bruno *et al.* (1999) replicated the specifications and found no evidence of an inverted U-shape relation in latter cross-sections. Bourguignon and Morrisson (1998) use unbalanced panel data for developing countries and find that this hypothesis is not verified. Deininger and Squire (1996a) use unbalanced panel data with about ten-year intervals[5]. A pool regression of Gini coefficients with respect to per capita income and its inverse gives a significant inverted U-shaped relationship. However, decadal differencing to account only for time changes gives an insignificant curvature. The introduction of country fixed effects[6] eliminates the U-shape.

As Bourguignon (2004) remarks, all the above discussions do not imply that growth has no significant impact on inequality, but rather point to the presence of several country-specific factors in the inequality impact of growth. Besides, the Kuznets inequality-development hypothesis can be tested with time-series data rather than the cross-section analyses found in earlier literature. This calls for more country-specific case studies (using time-series data). Bourguignon, Ferreira and Lustig (2003) suggest that growth indeed impacts inequality, a major contributing factor being the difficulty of the poorest households in incorporating themselves into the labour market in the advent of slow growth.

2.3 Growth impact of Inequality

Another concern that has received attention since the early 1990s is whether inequality affects growth. The works of Galor and Zeira (1993), Persson and Tabelini (1994) and Alesina and Rodrik (1994) are pioneers. Two main channels have been highlighted in the literature – credit constraints and political economic factors – both of which have implications for human and physical capital accumulation.

The evolution of inequality and output is influenced by the poor's limited choice of occupation, and constrained investment opportunities due to credit rationing. When the poor are thus prevented from making productive investments (that would benefit them and society), a low and inequitable growth process can result (Galor and Zeira, 1993; Banerjee and Newman, 1993; Aghion and Bolton, 1997). Besides, in a Keynesian economy where the marginal rate of savings increases with income, or with a higher propensity to save from capital returns than labour returns, those at the top end of the distribution may represent the main source of savings (Voitchovsky, 2005). However, in situations where ability is rewarded, there is incentive for more effort, risk taking and higher productivity, resulting in higher growth but with higher income inequality. In such cases, talented individuals will tend to seize higher return to their skills. The

[5] This is considered problematic with possible measurement errors (Atkinson and Brandolini, 2001).

[6] Country fixed effects ensure a parallel path for different countries.

resulting concentration of talents and skills in the advanced technology upper income sector becomes conducive for further innovation and growth (Hassler and Mora, 2000). Such incentive can induce greater effort in all parts of the distribution (Voitchovsky, 2005). However, frustration in the lower end of the distribution resulting from perceived unfairness may counteract the innovation gains (Akerlof and Yellen, 1990). Schwambish *et al*. (2003) find that top-end inequality strongly and negatively impacts social expenditures, while the bottom end shows a small positive effect. They suggest that high top-end inequality reduces social solidarity, with the rich trying to pull out of publicly funded programs such as health care and education, in preference to private provision.

The political economy channel argues that in the presence of high inequality, distortionary policies are adopted easily. This adversely affects investment and generates political instability, leading to stifled growth. Two main views are identified. One relies on the notion of the median voter, where wealth inequality increases the gap between the median voter and the average capital endowment of the economy, leading him to support higher capital tax rates, which in turn reduces incentives to invest in physical and human capital, hence reducing growth. Persson and Tabelini (1994) suggest that the rich spend their wealth to lobby for preferential (tax) treatment, leading to more inequality and slower growth. The other is social conflict and political instability. Alesina and Perotti (1993) argue that higher political instability can result from high inequality, the resulting uncertainty then reduces investment levels. Rodrik (1996) has noticed that divided societies with weak institutions also witnessed the sharpest fall in post-1975 growth. This situation weakened their capacity to respond effectively to external shocks. Also, a recent increase in violence in Latin America and Sub-Saharan Africa has been matched with high levels of inequality. Another channel makes use of possible positive externalities in the consumption of certain goods, whose demand may be reduced by high inequality (Shleifer *et al*., 1989).

Empirically, various authors have found a negative impact of initial inequality on growth. Persson and Tabelini (1994), using data for nine OECD countries, find that a one standard deviation increase in the income share of the top quintile reduces the growth rate by half a percentage point. Other verifications have been made, for a sample of developing countries (Clarke, 1995) and for a combination of both, in an extended dataset (Deininger and Squire, 1996b). Other works have nuanced and even contradicted the above. Fishlow (1996) for example, casts doubt on their robustness by controlling for Latin America in the dataset. He finds an insignificant effect of inequality on growth. Forbes (2000) estimates fixed-effect models using decadal country data and finds a positive association between inequality and growth. Voitchovsky (2005) controls for the shape of income distribution[7] using the Luxemburg Income Study dataset and finds that average inequality cannot efficiently capture the effect of inequality on growth. This work disaggregates inequality into sub-group components and considers possible endogeneity between inequality and output by jointly estimating production, inequality and poverty.

3 Methodology

The first part of this section adapts a Cobb-Douglas per capita production function to accommodate inequality; the second adapts a framework for inequality by augmenting

[7] By introducing 90/75 percentile income ratio for the top end and 50/10 ratio for the bottom end.

Ahluwalia's (1976a) formulation with redistributive policy indicators, and the third specifies the pro-poor framework.

3.1 The production framework

Based on a survey of the literature, it is assumed that there are two ways through which inequality can enter the production function. The first is through the credit, savings and investment channel (Aghion and Bolton, Banerjee and Newman, 1993; 1997; Bourguignon, 2004; Galor and Zeira, 1993) and the second is through the skills, incentive and innovation channel (Hassler and Mora, 2000; Voitchovsky, 2005; Akerlof and Yellen, 1990; Schwabish *et al*., 2003). These channels suggest that inequality may exert its effects through individual factor (capital and labour) productivities. The second is through its effect on the production process at large. The proposed avenue is the political economy channel[8] (Alesina and Perotti, 1993; Clarke, 1995; Deininger and Squire, 1996b; Persson and Tabelini, 1994; Rodrik, 1998). Schleifer *et al.* (1989) suggest that high inequality may lead to a reduction in the demand (and the production) of certain goods. These can be suitably captured by overall and disaggregated (between-group and within-group) inequality measures.

Let *Y*, *K*, *L* and α denote output, capital, labour and parameters respectively and θ_1, θ_2, θ_3 denote average, bottom and top inequalities[9] respectively. The basic Cobb-Douglas production function can be written as follows:

$$Y = exp^{A+\sum_i^3 ln\theta_i^{\alpha_{1i}}} K^{\alpha_2} L^{\alpha_3} \quad (3)$$

$$\alpha_2+\alpha_3 = 1 \quad (4)$$

The inclusion of inequality in equation (3) follows from the second approach in literature, i.e. exogenously. The first approach, i.e. via factor productivities, will inevitably result in non-linearity which the limitation of degrees of freedom in the data used in this work can not support. From (4), equation (3) can be expressed as follows:

$$y = exp^{A+\sum_i^3 ln\theta_i^{\alpha_{2i}}} k^{\alpha_2} \quad (5)$$

where lower cases are variables expressed in per worker terms (if the population is assumed to be equal to the work force, then these are in per capita terms). Expressing equation (5) in double log with *t* denoting time, gives:

$$lny_t = \alpha_0 + \alpha_{11} ln\theta_{1t} + \alpha_{12} ln\theta_{2t} + \alpha_{13} ln\theta_{3t} + \alpha_2 lnk_t + \varepsilon_{yt} \quad (6)$$

3.2 Inequality framework

The discussion on the Kuznets relationship and the works of Ahluwalia (1976a) and Anand and Kanbur (1996a and 1996b) suggest that inequality can be a non-linear function of per capita income (*y*). The literature also suggests that another important determinant of inequality is an indicator of redistribution policies that can be proxied by government spending as a ratio of GDP (g). This work adopts Ahluwalia's (1976a)

[8] Based on socio-political unrest, hindering both investment and employment of labour.

[9] Inequality at the top and bottom end of income distribution curve has been considered by generally taking percentile ratios. For instance, Voitchovsky (2005) uses 90/75 percentile income ratio for the top end and 50/10 ratio for the bottom end.

formulation because of the ease with which it can be incorporated in a system of equations such as the one to be used in this work. To the framework, a government expense per GDP (for redistribution policies) is added to yield the following double logarithmic functional form:

$$ln\theta_t = \gamma_0 + \gamma_1 lny_t + \gamma_2 (lny_t)^2 + \gamma_3 lng_t + \varepsilon_{\theta t} \quad (7)$$

3.3 Poverty framework

The poverty framework is adapted from the Son-Kakwani proposition in equation (2). Since it expresses poverty, mean income and inequality in first-difference form, (2) can also be expressed at level. Let $P^{\alpha}(\alpha = 0,1,2)$ be any measure of poverty from the Foster-Greer-Thorbecke (FGT) family of indices, δ parameters. A framework for poverty based on the pro-poor growth theory would be as follows:

$$P_t^{\alpha} = \delta_0 y_t^{\delta_1} \theta_t^{\delta_2} \quad (8)$$

Log linearising and introducing the error term ε_{pt} gives.

$$lnP_t^{\alpha} = \delta_0 + \delta_1 lny_t + \delta_2 ln\theta_t + \varepsilon_{pt} \quad (8')$$

Equation (8) can also be expressed in terms of factors of production by replacing income with its function:

$$P_t^{\alpha} = \delta_0 (exp^{A+\sum_i^s ln\theta_i^{\alpha_{1i}}} k^{\alpha_2})_t^{\delta_1} \theta_t^{\delta_2} \quad (9)$$

Simplifying and taking the double log of (9) gives the following functional form:

$$lnP_t^{\alpha} = \delta_0 + \delta_1 lnk_t + \delta_2 ln\theta_t + \varepsilon_{pt} \quad (9')$$

3.4 Estimation Techniques

Because of the possible endogeneity between GDP and inequality, the application of Ordinary Least Square (OLS) to the single equations of production, inequality and poverty would yield biased results. These constitute the basis of application of simultaneous equations modeling. In order to estimate a linear simultaneous equations system, a quadratic term for income in the inequality equation is exogenised by lagging it by one period. A combined framework of per capita production, inequality and poverty can be specified in simultaneous equations as follows:

$$\left\{\begin{array}{c} lny_t = \alpha_0 + \alpha_1 ln\theta_{1t} + \alpha_2 lnk_t + \varepsilon_{yt}; \\ ln\theta_t = \gamma_0 + \gamma_1 lny_t + \gamma_2 (lny_{t-1})^2 + \gamma_3 lng_t + \varepsilon_{\theta t}; \\ lnP_t^{\alpha} = \delta_0 + \delta_1 lny_t + \delta_2 ln\theta_t + \varepsilon_{pt} \end{array}\right\} \quad (10)$$

Or a system in which per capita income is replaced by its function in the poverty equation:

$$\left\{\begin{array}{c} lny_t = \alpha_0 + \alpha_1 ln\theta_{1t} + \alpha_2 lnk_t + \varepsilon_{yt}; \\ ln\theta_t = \gamma_0 + \gamma_1 lny_t + \gamma_2 (lny_{t-1})^2 + \gamma_3 lng_t + \varepsilon_{\theta t}; \\ lnP_t^{\alpha} = \delta_0 + \delta_1 lnk_t + \delta_2 ln\theta_t + \varepsilon_{pt} \end{array}\right\} \quad (10')$$

Two possible regression techniques can be applied to systems (10) and (10'). These are two-stage (2sls) and three-stage (3sls) least squares. 2sls has been thought of as more efficient than 3sls in small samples, particularly when cross-equation covariations are small. In cases of large covariation, 3sls would have an edge even if the sample is small (Theil, 1971). However, even with small covariation, Belsley (1988) has shown instances when 3sls is more efficient in small samples. In this work, cross-equation correlations are estimated. The results give preference to 3sls in all the cases (Tables 2b). Because of the limited dataset to be used, the variables for inequality at the top and bottom ends of the income distribution curve are dropped and only total, between-group and within-group Theil indices[10] are considered. In a multiracial society like South Africa, such decomposition is justified by the fact that inequality along racial lines may have a strong effect and in opposition to inequality within racial groups. As such, average inequality might show a neutral effect. The estimation method adopted is that which corrects for small sample size and reports student's t-statistics instead of the normal z-statistics. All the estimations are done using STATA software.

3.5 Variables and data

Data for this work is limited by the span of poverty and inequality series (from 1993 to 2009). The following describes the variables and data sources employed in the models: *Output per capita* (y): this is captured by GDP divided by the labour force. *Capital per worker (k)* is the ratio of gross fixed capital formation to the labour force. *Government expenses* (g) are measured by total central government expenses as a ratio of GDP. GDP, capital formation, government expenses (all in millions of constant 2000 LCU[11]) and labour force data are from the South African Reserve Bank (SARB) dataset.

Inequality (θ): Due to its advantage of being additive across subgroups, the Theil–index is preferred over the Gini coefficient for the measurement of overall income distribution. Sub-group decomposed inequalities are used in separate frameworks, such that, turn after turn, total, between-group and within-group[12] components are employed. This decomposition is relevant for a multi-racial society like South Africa where within-group and between-group inequalities are likely to affect (and respond to) economic growth differently, such that total inequality would give only average effects.

The poverty variable (P^{α}) is captured by the Foster-Greer-Thorbecke (FGT, 1984) family of poverty indices. Poverty incidence, intensity and severity[13] are derived for $\alpha = 0,1 and 2$ respectively. These three measures are considered turn by turn, together

[10] The Theil index offers the advantage of sub-group decomposability, where total inequality can be decomposed into the sum of within-group and between-group components. For more exposition of this property, see Theil (1967) and Shorrocks (1980).

[11] Local Currency Unit

[12] Between-group inequality captures interracial income distribution, within-group inequality captures income distribution intra-group.

[13] Foster *et al*. (1984) suggest a set of poverty measures that are additively decomposable with population-share weights. For an increasing ordered vector of household incomes $(y_1, y_2, \ldots, y_n)$, a strictly positive poverty line *z*, i^{th} household's income shortfall $g_i = z - y_i$, number of poor households $q = q(y; z)$ and total number of households $n = n(y)$ and for $\alpha \geq 0$, the FGT class of poverty measures P_{α} is defined as: $P_{\alpha}(y;z) = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{g_i}{z}\right)^{\alpha}$ The parameter α can be considered as a measure of poverty aversion, with larger values laying greater emphasis on the poorest of the poor. P_0 is poverty headcount (or incidence); P_1 is poverty gap and P_2 is poverty severity.

with the three inequality measures considered. Inequality and poverty[14] data are from the South African Development Indicators (2009) published by the Ministry of National Planning at the Presidency of South Africa. The dataset is based on the bi-annual (All Media and Products Survey – AMPS) data, collected by the South African Advertising Research Foundation (SAARF). This dataset is most suitable for this analysis for various reasons. First, it gives a more comprehensive time series for the variables in consideration for this type of work. Second, the dataset has been shown to be more reliable than the alternative[15] (Ardington *et al*., 2005; Hoogeveen and Ozler, 2004; Simkins, 2004; van der Berg *et al*., 2006).

It is important to justify the adequacy of a sample size of seventeen observations. It has been proven that in cases of high cross-equation covariation, 3sls can perform well in small samples (Belsley, 1988). However, the exact quantification of smallness of a given sample is not found in literature. Denton and Oksanen (1973) have acceptably used a sample size of ten observations (1955 to 1964) in a five-equation simultaneous equation model. Comparatively, this work has four equations with seventeen observations. Table 1a relates coefficients to their respective variables, equation and data source, while Table 1b gives the summary statistics.

Table 1a: Coefficients and Data Source

Coefficient	Variable	Equation	Data Source
α_0	Constant	Per capita income	
α_1	Inequality	Per capita income	SA presidency
α_2	Capital per worker	Per capita income	SA Reserve Bank
γ_0	Constant	Inequality equation	
γ_1	Per capita income	Inequality equation	SA Reserve Bank
γ_2	Square of per capita income	Inequality equation	SA Reserve Bank
γ_3	Government expenses per GDP	Inequality equation	SA Reserve Bank
δ_0	constant	Poverty equation	
δ_1	Capital per worker	Poverty equation	SA Reserve Bank
δ_2	inequality	Poverty equation	SA presidency

Table 1b: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Total Inequality (Theil)	17	0.94	0.05	0.88	1.03
Between-group inequality	17	0.49	0.06	0.34	0.55
Within-group inequality	17	0.45	0.10	0.35	0.61
Poverty incidence	17	49.06	3.43	41.00	53.00
Poverty intensity	17	23.79	2.29	19.00	27.00

[14] The poverty data is generated using a poverty line of ZAR 388 per month at constant 2008 ZAR.

[15] The alternative is the Income and Expenditure Surveys carried out by Statistics South Africa. Some of its deficiencies relative to the AMPS dataset include high number of 'zero' income households and missing income data. Statistics South Africa also admits that the IES1995 and IES2000 are not directly comparable (van der Berg *et al*., 2006). There is also evidence of underrepresentation of white and overrepresentation of black populations in IES2000 (Hoogeveen and Ozler, 2004).

Poverty severity	17	14.61	1.78	11.00	17.00
Gov't expenses/GDP const. 2000 Rands	17	0.32	0.12	0.15	0.56
Output per worker const. 2000 Rands	17	76.93	13.00	56.15	91.81
Capital per worker const. 2000 Rands	17	12.23	3.00	7.58	17.25

4 Empirical Results

The pair-wise correlation coefficients and probabilities of significance for inequality, per capita income and poverty are presented in Tables 2a. Table 2b contains cross-equations covariates of the models.

Table 2a: Pair-Wise Correlation Coefficient for Growth-Inequality Relationship

Poverty	inequality			Poverty			Output/ worker
	T	T_B	T_W	P^0	P^1	P^2	
P^1	-0.532[b]	0.883[a]	-0.810[a]	-	-	-	-
	(0.034)	(0.000)	(0.000)				
P^2	-0.495[c]	0.776[a]	-0.722[a]	-	-	-	-
	(0.051)	(0.000)	(0.002)				
P^3	-0.506[b]	0.812[a]	-0.746[a]	-	-	-	-
	(0.046)	(0.000)	(0.001)				
output per worker	0.758[a]	-0.799[a]	0.933[a]	-0.624[b]	-0.546[b]	-0.524[b]	-
	(0.001)	(0.000)	(0.000)	(0.010)	(0.029)	(0.037)	
Government	0.712[a]	-0.859[a]	0.932[a]	-0.748[a]	-0.670[b]	-0.643[b]	0.964[a]
expenses/GDP	(0.002)	(0.000)	(0.000)	(0.001)	(0.005)	(0.007)	(0.000)

Notes: [a], [b] and[c] denote significance at 1%, 5%, and 10% levels respectively. P-values are in brackets below each coefficient. T, TB and TW are total, between- and within-group inequality components respectively.

Total inequality and within-group inequality are positively and significantly associated with per capita income. By contrast, between-group inequality shows negative association with per capita income. Income, within-group and total inequality seem to associate negatively with all three measures of poverty. Because government expenses have a positive and significant relationship with GDP, within-group and total inequality, (which all relate natively to all poverty measures) and a significant negative relationship with inequality between groups (which has significant positive association with all poverty measures), it shows a negative relationship with all three poverty measures.

Table 2b: Cross-equation correlation of residuals

Model	Equation	Inequality	Poverty
Total Inequality	Production	0.924[a]	-0.863[a]
	Inequality	1	-0.742[a]
Between-group	Production	-0.836[a]	-0.707[a]
	Inequality	1	0.929[a]
Within-group	Production	0.951[a]	-0.704[a]
	Inequality	1	-0.840[a]

The cross-equation correlation coefficients in Table 2b are all significant at the 1% level, implying a strong cross-equation covariation. For this reason, 3sls is preferred over 2sls.

Table 3: 3sls Regression Results for GDP-Inequality- Output Determinants

Variable	Total inequality				Between-Group		Within-Group	
	Income in Poverty Equation		Capital in Poverty Equation					
	Coef	t-stat	Coef	t-stat	Coef	t-stat	Coef	t-stat
$ln\theta_{1t}$	0.296	0.96	0.305	0.98	-0.081[c]	-1.76	0.303[b]	2.54
lnk_t	0.625[a]	10.75	0.623[a]	10.64	0.631[a]	10.83	0.421[a]	4.12
α_0	2.803[a]	17.51	2.807[a]	17.41	2.709[a]	28.06	3.537[a]	10.22
lny_t	-5.942[b]	-2.26	-5.368[c]	-2.00	24.233[a]	5.45	-20.966[a]	-5.17
$(lny_t)^2$	0.734[b]	2.38	0.670[b]	2.14	-2.789[a]	-5.38	2.525[a]	5.30
lng_t	-0.069	-1.05	-0.081	-1.21	-0.447[a]	-4.22	0.196[b]	2.74
γ_0	11.799[b]	2.10	10.500[c]	1.84	-53.812[a]	-5.63	42.783[a]	4.99
lnk_t	-0.232[c]	-1.90	-0.166[c]	-1.95	0.071	1.46	0.426[a]	3.19
lnk_{t-1}	-	-	-	-	-	-	-0.308[a]	-3.82
$ln\theta_{1t}$	-0.240	-0.53	-0.170	-0.37	0.604[a]	6.94	-0.417[a]	-3.17
δ_0	4.877[a]	8.86	4.290[a]	18.22	4.156[a]	48.70	3.245[a]	8.53
$\mathbf{R_y^2}$	**0.95**	**162.22**	**0.95**	**161.07**	**0.95**	**168.32**	**0.95**	**139.38**
$\mathbf{R_\theta^2}$	**0.60**	**11.46**	**0.60**	**11.21**	**0.84**	**37.77**	**0.96**	**126.03**
$\mathbf{R_F^2}$	**0.39**	**6.22**	**0.45**	**6.68**	**0.76**	**38.52**	**0.74**	**18.84**
Breusch-Pagan	**4.45**	**0.217**	**3.30**	**0.348**	**11.77**	**0.008**	**9.76**	**0.021**
Joint test on lny_t and $(lny_t)^2$			**5.19**	**0.010**	**15.55**	**0.000**	**24.58**	**0.000**

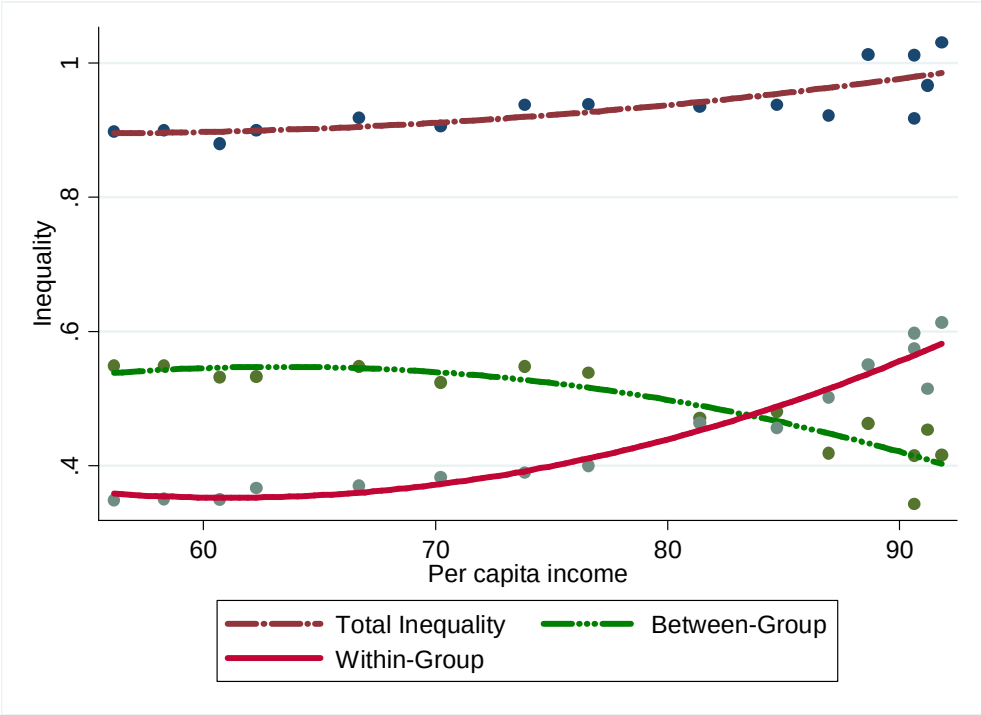
Notes: [a], [b] and[c] denote significance at 1%, 5%, and 10% levels respectively. The Breusch-Pagan Statistics is for the test of independence of residuals of the equations. F-statistics (under coef. Columns) and P-VAL (under t-stat columns) for joint Wald test on lny_t and $(lny_t)^2$ are presented on the last row.

Capital per unit labour is significant across all the sub-models. While the positive effect of total inequality on per capita income is not significant, between-group inequality has a negative and significant coefficient. Within-group inequality significantly enhances output per worker. The significant negative effect of between-group inequality on production may be explained in theory by credit constrains, political economy (i.e. distortionary policies and socio-political instability) channels, but also criminality and between-race tensions. Therefore, the interracial tensions and inequality in access to capital (mostly inherited from the apartheid era) still generate significant adverse effects that stifle economic growth. However, within-group inequality is shown to impact production positively. This does not mean that inequality should be actively promoted within groups, but simply that it should not be a major policy concern at present. The positive effect could be capturing the trickle-down effect of the fruits of growth via social capital within group, especially in African households where significant remittances may go to poorer individuals from the richer and well-endowed ones, which could serve as capital for productive ventures by the hitherto poorer members of the group. However, with active black economic empowerment, the increase in within-

group inequality may not mean that the poor are getting poorer within the group,[16] but rather that the effect of income at the top tail of within-group inequality is weighing positively in the national GDP. The findings on the effect of inequality corroborate Schwambish *et al.* (2003) and Voitchovsky (2005), i.e. that average inequality is not efficient in capturing the inequality-growth relationship.

Per capita output has a significant negative relationship with total and within-group inequality. The coefficient of its square has a positive sign on these respective measures of inequality. The signs are reversed in the between-group inequality equation. These suggest that there is an inverted U-shape inequality-per capita income relationship for between-group inequality, but a U-shaped one for total and within-group inequality. A Wald (significance) test of per capita income and its square indicates that they are jointly significant in all the inequality equations. Given the short span of the data in question (1993 to 2007), it may be difficult for one to claim that this result supports the Kuznets U-shaped development-inequality hypothesis. Ahluwalia (1976a: 335) calculates that for an economy growing at a per capita (GNP) rate of 2.5 percent, it will take about 100 years to transit from a worsening-inequality phase to a phase where inequality falls. However, the magnitude of the curvature suggests that the U-shape is a broader one (lower magnitude) than that of Ahluwalia (1976a) for panel data. It is a little more pronounced when inequality is disaggregated into sub-groups. The graphs in Figure 1, plotting the relationship between per capita income and total, between-group and within-group inequalities, may seem to indicate that South Africa is at the declining phase of the inverted-U for between-group inequality, but at the inclining phase of the U for within-group inequality.

Figure 1: Inequality-Development Graph South African Economy



[16] Blacks constitute 80 percent of the population.

However, these results agree more with the active post-apartheid policies of Black Economic Empowerment, which, while yielding fruits in the reduction of between-group inequality, actually increases within-group inequality. This is supported by the coefficients of Government expenses with significant negative and positive impacts on between-group and within-group inequality components respectively. None of the lag values of inequality was significant, so is has been excluded from the equations.

The coefficient of per capita income on poverty incidence is negative and significant (at 10% level). One percent increase in per capita income reduces poverty incidence by 0.232 percent. Regression with income substituted by production function shows that capital per worker also has anti-poverty effects (significant at 10% level). However, this effect disappears between-group and turns positive within-group. Between-group inequality (in line with theory that inequality exacerbates poverty) has poverty increasing effect. A percentage increase in between-group inequality is associated with 0.60 percent higher poverty incidence. But the same increase in within-group leads to 0.542 percent fall in poverty incidence. Table 4 indicates similar impacts on poverty intensity and severity. Output per worker and capital both lost their significance on poverty (intensity and severity) reduction in total and between-group inequality sub-models. However, capital's poverty enhancing effect remains significant within-group. This may be highlighting the fact that very poor individuals are less endowed in productive capital than the just poor. One percent increase in between-group inequality leads to 0.853 and 1.093 rise in poverty intensity and severity respectively, suggesting that the abjectly poor suffer more from inequality than others. This effect is reversed within-group, the same increase is associated with 0.632 and 0.916 percent fall in the respective poverty measures.

The fact that within-group inequality has positive effect on output and negative effect on poverty (with strongest effect on poverty severity), can only make sense in terms of within-group solidarity, where growth at first widens inequality within-group when the relatively well-endowed individuals access some of the fruits of economic growth. The well-endowed individuals then remit some of the growth returns to their poorer family members. These remittances may then serve as productive capital thereafter. This intuition is supported by the fact that regression with the first lag of capital is poverty reducing in within-group inequality (Tables 3 and 4). The fact that within-group inequality has strongest effect on poverty severity implies that this redistribution effort within-group happens for altruistic motives, with the very poor receiving more attention. Statistics South Africa (2002) reports that the most important source of income for the South African unemployed is financial support from other working members of their household.

By deduction (from the fact that government expenses reduce total and between-group inequalities) and in line with the correlation coefficients of government expenses (negative and significant) on all poverty measures, one would conclude that government efforts are yielding some anti-poverty fruits. However, as the coefficients indicate, these efforts are a little biased towards the just poor than the very poor.

Table 4: 3sls Results for Poverty Intensity and Severity

Variable	Total inequality	Between-Group	Within-Group	
			With capital	With income

	P^1	P^2	P^1	P^2	P^1	P^2	P^0	P^1	P^2
$ln\theta_{1t}$	0.305	0.309	-0.080[c]	-0.078[c]	0.304[b]	0.311[b]	0.306[b]	0.311[b]	0.318[b]
lnk_t	0.623[a]	0.623[a]	0.632[a]	0.632[a]	0.421[a]	0.416[a]	0.418[a]	0.413[a]	0.408[a]
α_0	2.807[a]	2.809[a]	2.708[a]	2.707[a]	3.537[a]	3.557[a]	3.547[a]	3.563[a]	3.582[a]
lny_t	-5.297[c]	- 4.912[c]	23.379[a]	21.858[a]	- 20.972[a]	-20.231[a]	- 19.170[a]	- 19.883[a]	-19.92[a]
$(lny_t)^2$	0.662[b]	0.618[c]	-2.691[a]	-2.509[a]	2.532[a]	2.450[a]	2.315[a]	2.400[a]	2.412[a]
lng_t	-0.083	-0.085	-0.441[a]	-0.462[a]	0.171[b]	0.154[c]	0.209[b]	0.198[b]	0.167[c]
γ_0	10.337[c]	9.499	-51.954[a]	-48.812[a]	42.655[a]	40.966[a]	38.975[a]	40.450[a]	40.363[a]
lnk_t	-0.166	-0.167	0.139	0.201[c]	0.544[b]	0.714[b]	1.011[b]	0.768	0.820
lnk_{t-1}	-	-	-	-	-0.317[c]	-0.310	-0.731	-0.154	0.172
$ln\theta_{1t}$	-0.452	-0.746	0.853[a]	1.093[a]	-0.632[a]	-0.916[a]	-0.469[a]	-0.864[a]	-1.266[a]
δ_0	3.545[a]	3.039[a]	3.444[a]	2.975[a]	2.078[a]	0.913	2.271[a]	-0.198	-2.645
$\mathbf{R_y^2}$	**0.95**	**0.95**	**0.95**	**0.95**	**0.95**	**0.95**	**0.95**	**0.95**	**0.95**
$\mathbf{R_\theta^2}$	**0.60**	**0.60**	**0.85**	**0.85**	**0.96**	**0.96**	**0.96**	**0.96**	**0.96**
$\mathbf{R_P^2}$	**0.35**	**0.31**	**0.63**	**0.57**	**0.66**	**0.62**	**0.83**	**0.74**	**0.68**

Note: [a], [b] and[c] denote significance at 1%, 5%, and 10% levels respectively. Two models of within-group inequality are estimated, one with lag-value of capital and the other with income in place of capital, in poverty equations. The lag values are not significant in other inequality models and are excluded.

5 Conclusion and Policy implications

This study aimed at investigating the link between per capita income, inequality and poverty in South Africa. For this purpose, a per capita aggregate production function is adapted following theory, with inequality. Based on literature, an appropriate framework for inequality is also developed. These are then combined with poverty frameworks, and estimated jointly by means of 3sls Regression technique. Data for this work is taken mainly from SARB and South African Development Indicators (2009).

The results of the study suggest that between-group inequality reduces output per worker while within-group inequality enhances it. Between-group effect may be explained in terms of credit constrain, political economy channel (i.e. distortionary policies and socio-political instability), and criminality and between race tensions which concur to generate significant adverse effects that stifle economic growth. That of within-group inequality could be capturing the trickle-down effect of the fruits of growth via social capital within-group especially in African households where significant remittances may go to poorer individuals from the richer and well endowed ones, which could serve as capital for productive ventures by the hitherto poorer members of the group. However, with active black economic empowerment, increase in within-group inequality may not mean that the poor within-group are getting poorer, but rather that the effect of income at the top tail of within-group inequality is weighing positively in the national average income. The findings corroborate Schwambish et al (2003) and Voitchovsky (2005) i.e. that average inequality is not efficient in capturing inequality-growth relationship.

There is evidence of inverted U-shape relationship for per capita income with between-group, but a U-shaped one with total and within-group inequality. Given the short span of the data in question, this result may not signify a Kuznets U-shaped development-

inequality hypothesis. This rather agrees with the active post-apartheid policies of black economic empowerment, which, while yielding fruits in the reduction of between-group inequality, actually increases within-group inequality.

Per capita income has poverty-reducing effects. Substituting income by its function shows that capital per worker weakly reduces poverty incidence, but weakly enhances poverty intensity and severity. This is possibly due to weak or no access to productive capital by the abjectly poor. Widening between-group inequality has poverty-increasing effects, with the abjectly poor suffering more than the rest. Within-group inequality has a reversed effect, with the strongest effect on poverty severity, which can make sense in terms of within-group solidarity, where growth at first widens inequality within group when the relatively well-endowed individuals access some of the fruits of economic growth. The well-endowed individuals then remit some of the growth returns to their poorer family members. The fact that within-group inequality has the strongest effect on poverty severity implies that this happens for altruistic motives, with the very poor receiving more attention. This intuition is supported by the fact that the first lag of capital is poverty reducing in within-group inequality. It has been shown that the most important source of income for the unemployed in South Africa is financial support from other working members of their household (STATSA, 2002).

It can be recommended from this finding that redistribution efforts should focus on the 'bad' type of inequality – between group. The effect of government expenses shows that public effort is doing a great deal to reduce between-group inequality and must be encouraged. More access to capital by the relatively poorer groups of South Africa may widen within-group inequality, but, in the long run, will translate into poverty reduction through social capital.

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