

# **Why has decreasing schooling inequality not led to decreasing earnings inequality in South Africa? (*Extended abstract*)**

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The goal of this paper is to advance our understanding of both the theory and the empirical evidence regarding the interactions of schooling inequality, returns to schooling and earnings inequality. We focus on two main questions. First, what is the relationship between inequality in schooling and inequality in earnings? As shown by Knight and Sabot (1983), Lam and Levison (1992), and Bourguignon et al. (2005), it is theoretically possible to generate increases in earnings inequality by expansions of schooling that decrease schooling inequality. This phenomenon of declining inequality in schooling associated with rising earnings inequality in earnings seems to have been the case for Brazil (Lam and Levison 1992) and may actually be quite common during the early stages of economic development (Lam 2020). We elaborate on these issues and discuss how they apply to post-apartheid South Africa.

We also consider how changes in returns to schooling affect earnings inequality when returns differ by schooling level. What happens if the earnings of workers with grade 8 increase while earnings at all other grades remain constant? A common feature of labour markets has been for returns to schooling to change at different rates (and even in different directions) at different levels of schooling. Returns to university may have increased at the same time that returns to secondary schooling declined. In this context it can be misleading to generalize about whether the change in average returns to schooling has been equalizing or disequalizing. As we show, and as makes sense intuitively, increases in earnings at low grades tend to be inequality reducing, while increases in earnings at high grades are inequality increasing. This implies that there is some intermediate cutoff that divides these two situations.

We develop a general framework to analyse these issues. The results call attention to a summary statistic that has not previously been studied – the year of schooling which separates equalizing from disequalizing increases in grade-specific earnings. In the case of the variance of log earnings, we show that this is the level of schooling at which mean log earnings is earned. Increases in earnings above this level will be disequalizing, while increases in earnings below this level will be equalizing. This also provides a benchmark for understanding how changes in the distribution of schooling affect earnings inequality. Changes in the schooling distribution that shift the distribution toward the schooling level of mean log earnings will be equalizing, while shifts away from that schooling level (in either direction) will be disequalizing. We use this framework to guide empirical analysis of schooling inequality, returns to schooling, and earnings inequality in post-apartheid South Africa.

## **Theoretical Links between Schooling Inequality and Earnings Inequality**

Our analysis begins with a simple version of the standard human capital earnings equation. Leaving experience aside, the logarithm of the  $i$ th worker's earnings can be expressed as

$$\log Y_i = \alpha + \beta S_i + \mu_i \quad (1)$$

where  $Y_i$  is earnings,  $S_i$  is years of schooling, and  $\mu_i$  is a residual uncorrelated with schooling. Given Equation (1), the variance of log earnings, a standard measure of earnings inequality, is

$$V(\log Y) = \beta^2 V(S) + V(u) \quad (2)$$

where  $V$  denotes variance. This demonstrates an important point about the link between schooling inequality and earnings inequality. If the relationship between schooling and earnings is log-linear

as in (1), then earnings inequality (as measured by the log variance) is a linear function of the variance in schooling. Suppose that we double the schooling of every worker, holding returns to schooling constant. This quadruples the variance in years of schooling and thus quadruples the explained component of earnings inequality. If we measure inequality in schooling by any standard inequality measure, this doubling of schooling would imply no change in schooling inequality, but would increase earnings inequality.

These results assume there is a single rate of return at all levels of schooling. An important recent pattern in returns to schooling around the world, however, is the emergence of convex returns to schooling, with returns increasing at higher levels (especially post-secondary) while falling at intermediate levels. This complicates the relationship between returns to schooling and earnings inequality. What happens to earnings inequality if we increase earnings for workers with grade 12 education, but reduce earnings for those with grade 8? What if we increase earnings for workers with grade 4? Our paper provides an analytical way to answer these questions. Consider a more general model of the relationship between schooling and earnings,

$$y_i \equiv \log Y_i = \alpha + \sum_j \beta_j S_{ji} + \mu_i \quad (3)$$

where  $Y_i$  is earnings,  $y_i$  is the log of earnings  $S_{ji}$  is a 0,1 indicator for whether person  $i$  is in the  $j$ th schooling category, and  $\mu_i$  is a residual uncorrelated with schooling. Denote mean log earnings as  $\bar{y}$  and mean log earnings for schooling level  $j$  as  $\bar{y}_j$ . Taking the derivative of Equation (3) with respect to  $\beta_k$  (which could represent any schooling level), we get the result that

$$\frac{\partial V(\log Y)}{\partial \beta_k} = 2p_k [\bar{y}_k - \bar{y}], \quad (4)$$

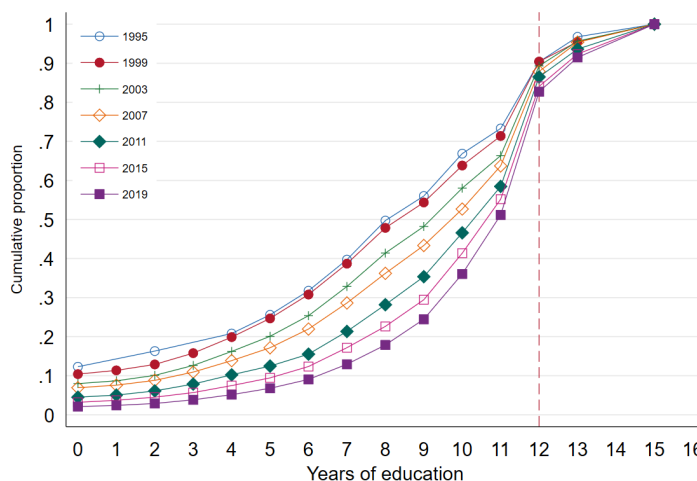
The result is intuitive. Increasing  $\beta_k$ , which increases the earnings of schooling level  $k$  relative to every other level, will be equalizing if level  $k$  has a mean of log earnings below the overall mean of log earnings, and will be disequalizing if this mean is above the overall mean. The magnitude of the change depends on how far the group's mean is above or below the overall mean, and on the relative size of the group. Equation (4) calls attention to a statistic that we do not ordinarily calculate – the year of schooling for which mean log earnings is equal to (or closest to) overall mean log earnings. Suppose there is a level of schooling  $s^*$  such that overall mean log earnings are below log earnings at all schooling levels above  $s^*$  and are above log earnings at all schooling levels below  $s^*$ . Then increasing earnings for all years below  $s^*$  is equalizing and increasing earnings for years above  $s^*$  is disequalizing.

The results above are derived for the variance of log earnings. In the paper we show that results can be derived for other measures of inequality. The level of schooling that separates equalizing from disequalizing increases in grade-specific earnings will in general be different for every measure of inequality, due to the fact that different measures of inequality are affected in different ways by income transfers at particular points in the income distribution.

## Empirical Evidence

We use earnings and education data from South Africa household and labour market surveys between 1994 and 2019. Figure 1 presents the cumulative distribution functions (CDFs) of schooling attainment for the population aged 25-59 over the period 1995-2019. It is striking how quickly educational attainment increased over the period. In 1995, approximately 70% of adult South Africans had completed grade 11 or less. By 2019, this share had decreased to 50%, with

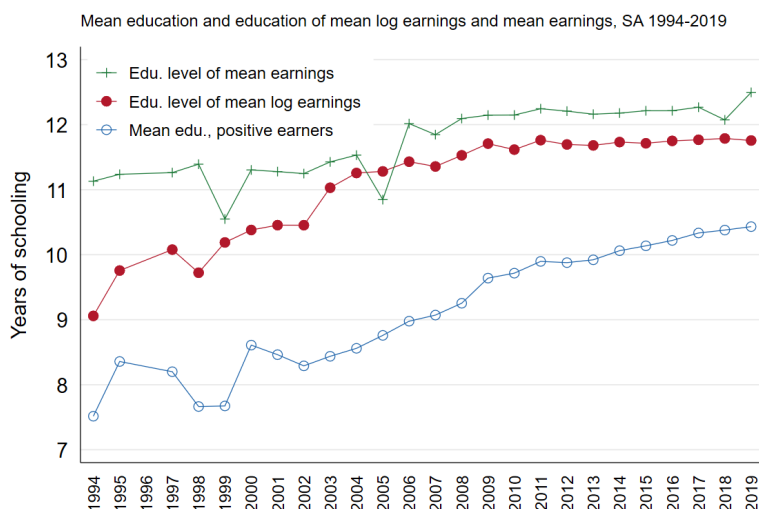
adults being more likely to complete secondary education and continue into post-secondary education. An important feature of Figure 1 is that the CDFs imply first order stochastic dominance in comparisons of every earlier schooling distribution. This implies Lorenz dominance, meaning that inequality in years of schooling unambiguously improved over time by any standard inequality measure. Beyond that, first order stochastic dominance implies Generalized Lorenz dominance, meaning that there is a steady improvement in schooling inequality accompanied by a rising mean.



**Figure 1. Cumulative Distribution Functions for years of education, South Africans aged 25-**

The paper documents trends over time in several measures of earnings inequality, including the variance of log earnings, the Gini Coefficient, and the Generalized Entropy  $GE(0)$  measure. All of the measures show relatively flat or rising earnings inequality over most of the post-apartheid period, despite the significant decreases in schooling inequality.

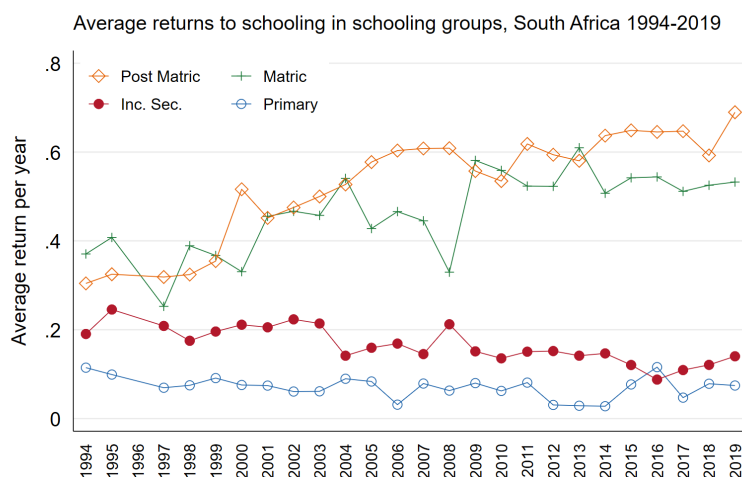
Figure 2 shows two statistics that are key to understanding the relationship between returns to schooling and earnings inequality.



**Figure 2. Mean schooling and schooling level of mean earnings and mean log earnings, aged 25-59.**

years to 12 years. An important implication of Figure 2 is that an increase in earnings for earners with schooling in the 9 to 11 range, holding earnings at other grades constant, would have been disequalizing in the 1990s and early 2000s, but would have been equalizing after 2007.

Figure 3 shows trends in returns to schooling at different points in the schooling distribution, using cutoffs for Primary (0-7), Incomplete secondary (8-11), Matric (grade 12) and Post-secondary ( $>$  Grade 12). The figure shows the average returns per year of schooling in each of these groups. The figure shows a dramatic increase in returns to grade 12 and above since 1994. Our simulations indicate that this is a key factor explaining why improvements in schooling



**Figure 3. Average returns to schooling per year in schooling groups, South African earners aged 25-59.**

inequality have not led to decreases in earnings inequality. At the same time, the declines in returns to grade 8-11 (incomplete secondary) have had a mixed impact. Based on our analytical results and the pattern shown in Figure 2, declines in relative earnings at grades 8-11 would have been equalizing in the 1990s, but became disequalizing by the mid-2000s. Our results suggest that the declines in returns to the primary (1 to 7) category should have been disequalizing, since this group has earnings well below the

mean. This effect is tempered, however, by the fact that the relative weight of this category is small and decreasing over time as the average education level of the population has risen.

Building on these results, the paper carries out a number of counterfactual simulations to look at how changes in the distribution of schooling and changes in returns to schooling have affected earnings inequality in the post-apartheid period. The results show that the improvements in the schooling distribution, with a rising mean and declining schooling inequality, would in and of themselves have reduced earnings inequality, holding returns to schooling at their baseline levels. Changes in returns to schooling were disequalizing, however, and offset the decreases that would have occurred based on improvements in the distribution of schooling. Most important was the large increase in returns to post-secondary education, shown in Figure 3. Decreases in returns to incomplete secondary schooling also played a role, since we show that this group fell below the level of mean log earnings and mean earnings by the end of the period. Our theoretical results play an important role in understanding the impact of this combination of rising returns to schooling at the highest levels and falling returns to schooling at intermediate levels.

## References

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