

Why has falling schooling inequality not led to falling earnings inequality in South Africa?

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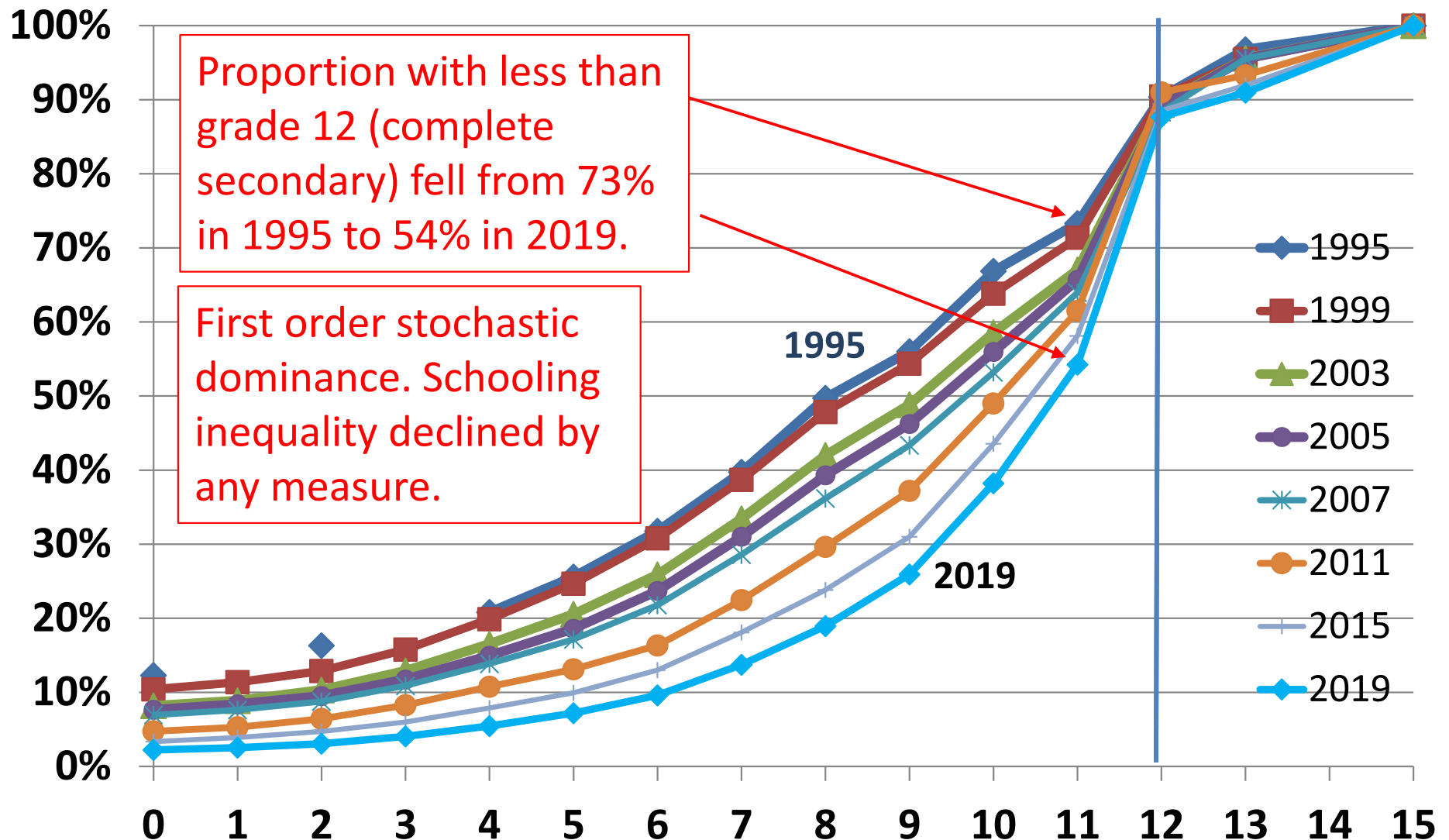
***Celebrating the work of
Professor Martin Wittenberg***
University of Cape Town
October 27, 2023

Some comments about Martin
and this project

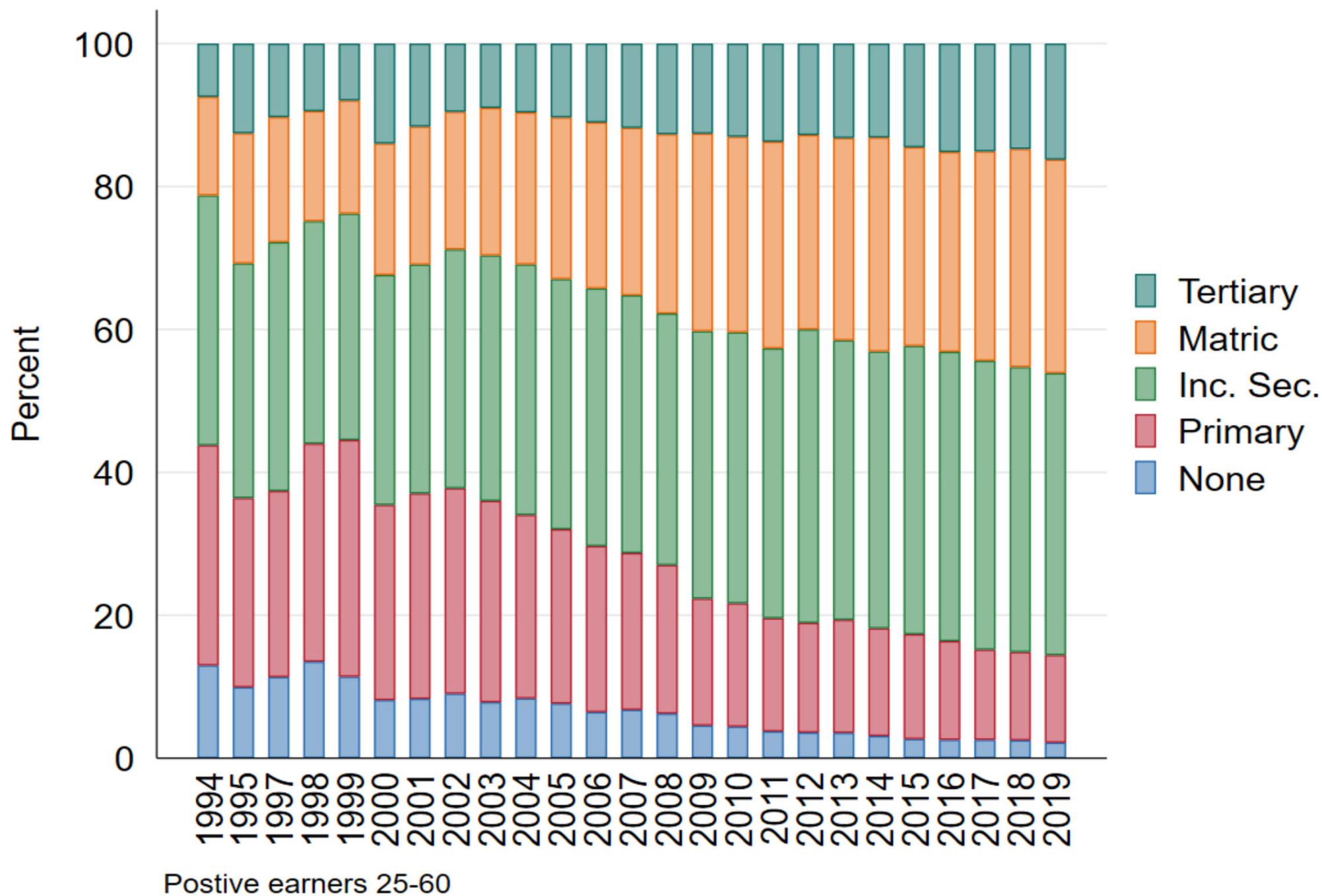
Overview of paper

- South Africa has long had one of the highest levels of income inequality in the world.
- Education plays an important role in this inequality through two pathways:
 1. Education is highly unequal.
 2. There is a strong relationship between schooling and earnings.
- Issues considered in this paper:
 - What has happened to the distribution of education?
 - What has happened to returns to schooling?
 - How have these two factors affected earnings inequality?
 - How can we model the relationship theoretically, especially when returns are not constant across years of schooling?

Cumulative distribution of schooling of labor force aged 25-60, South Africa



Distribution of schooling, positive earners aged 25-60



Theoretical Background on relationship between schooling inequality and income inequality

Using a standard human capital earnings equation, denote the logarithm of the i th worker's earnings with the following expression, where y_i is earnings, S_i is years of schooling, and u_i is a residual uncorrelated with schooling.

$$y_i \equiv \log(Y_i) = \alpha + \beta S_i + u_i$$

The variance of log earnings, $V(\log y)$, a standard mean-invariant measure of earnings inequality, is

$$V(y) = \beta^2 V(S) + V(u)$$

Theoretical Background on relationship between schooling inequality and income inequality

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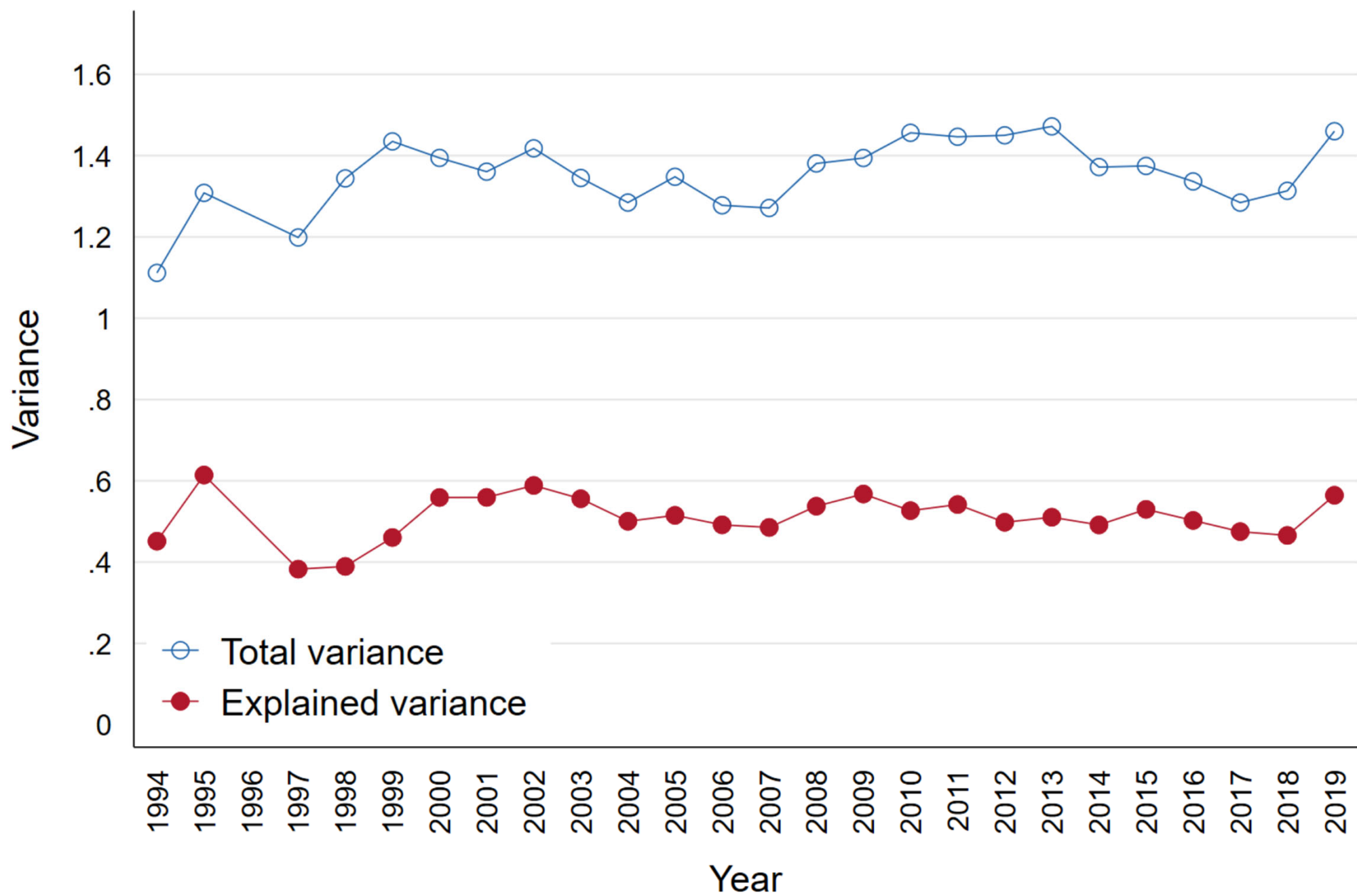
$$V(y) = \beta^2 V(S) + V(u)$$

Total variance

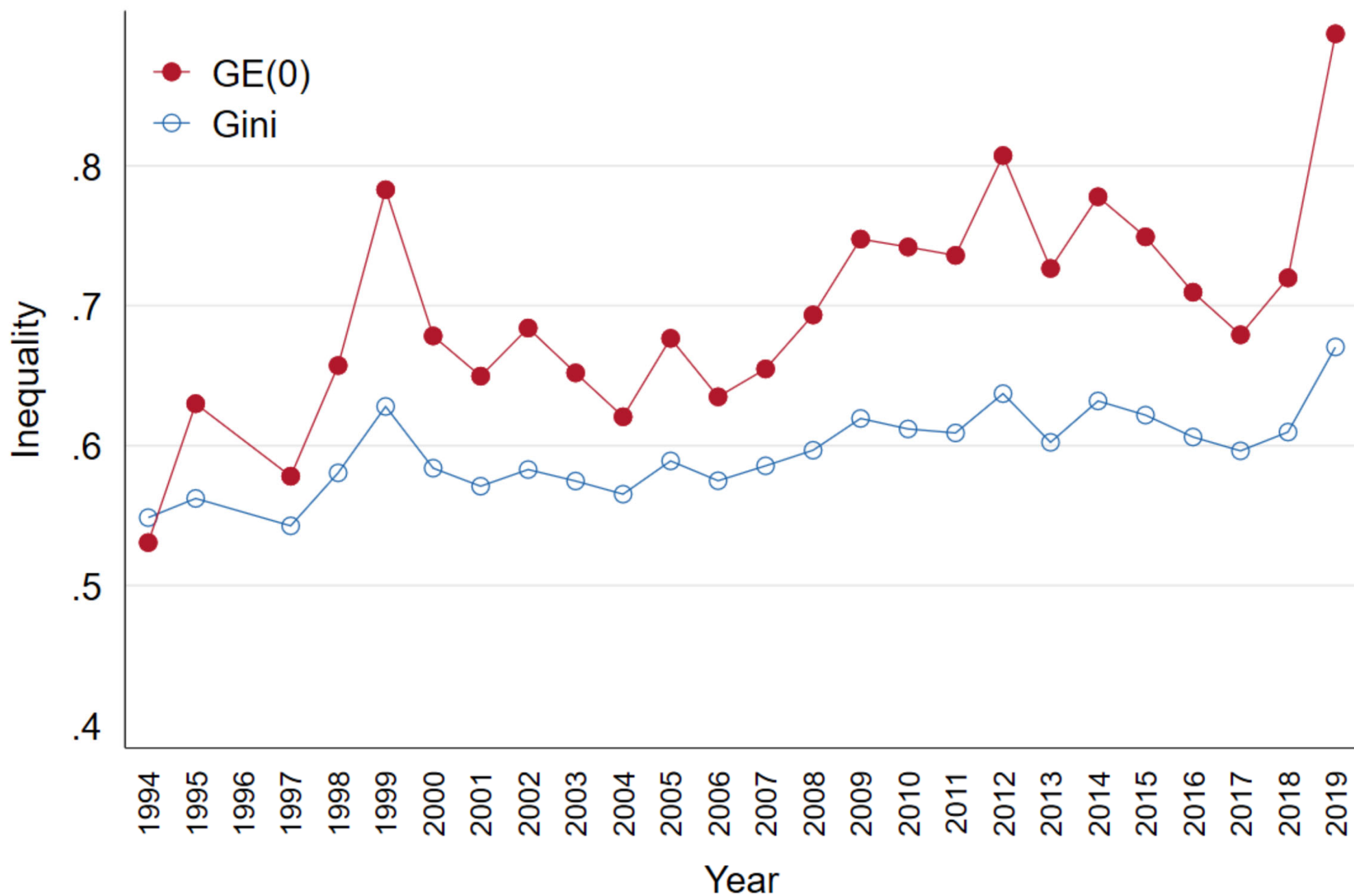
Explained variance

Increases in returns to schooling or variance of schooling will increase earnings inequality.

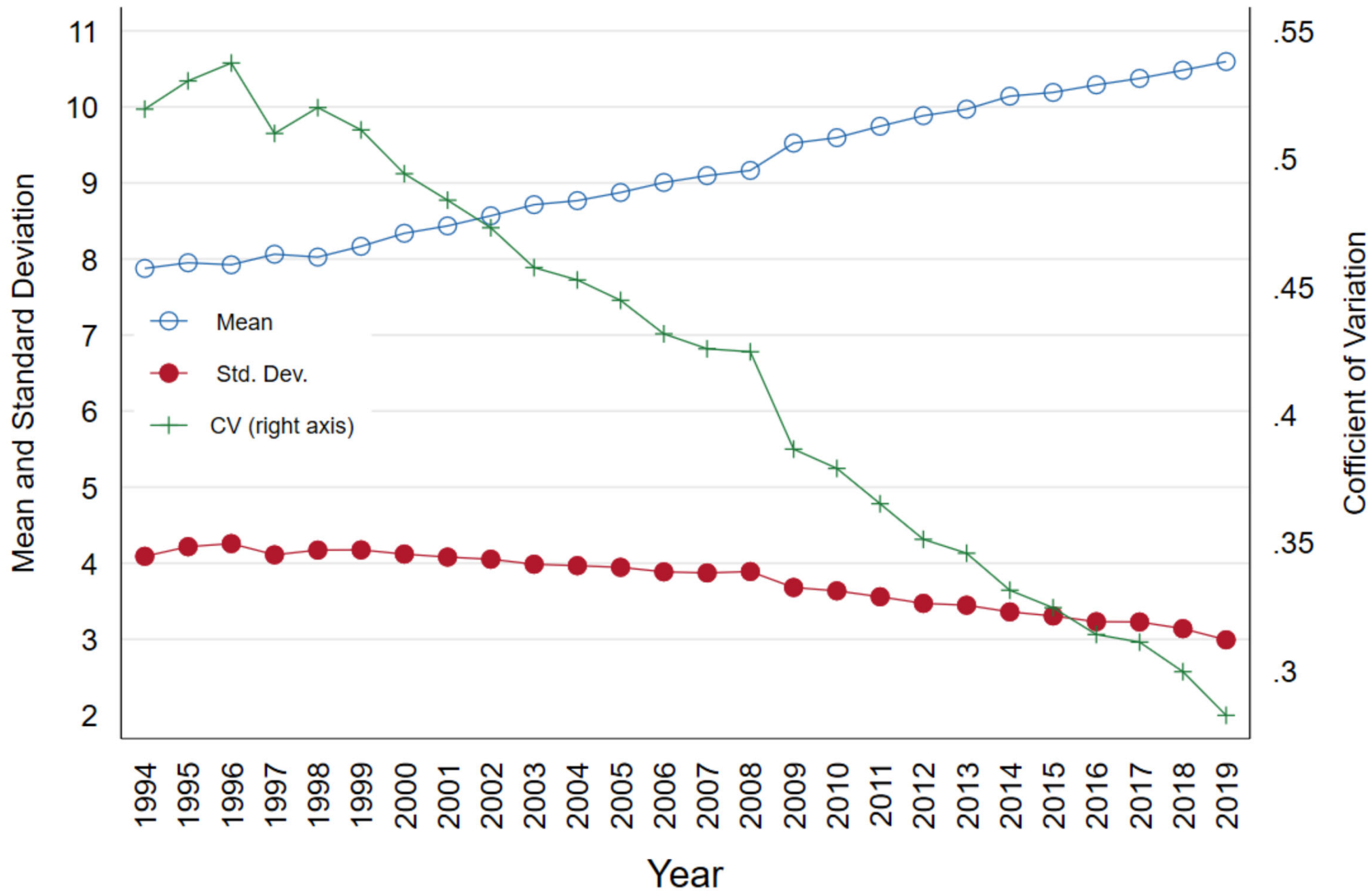
Variance of log earnings, South Africa 1994-2019



Measures of earnings inequality, South Africa 1994-2019



Mean, standard deviation, and coefficient of variation in years of schooling
South Africa population aged 25-59



Theoretical Background on relationship between schooling inequality and income inequality

$$y_i = \alpha + \beta S_i + u_i$$

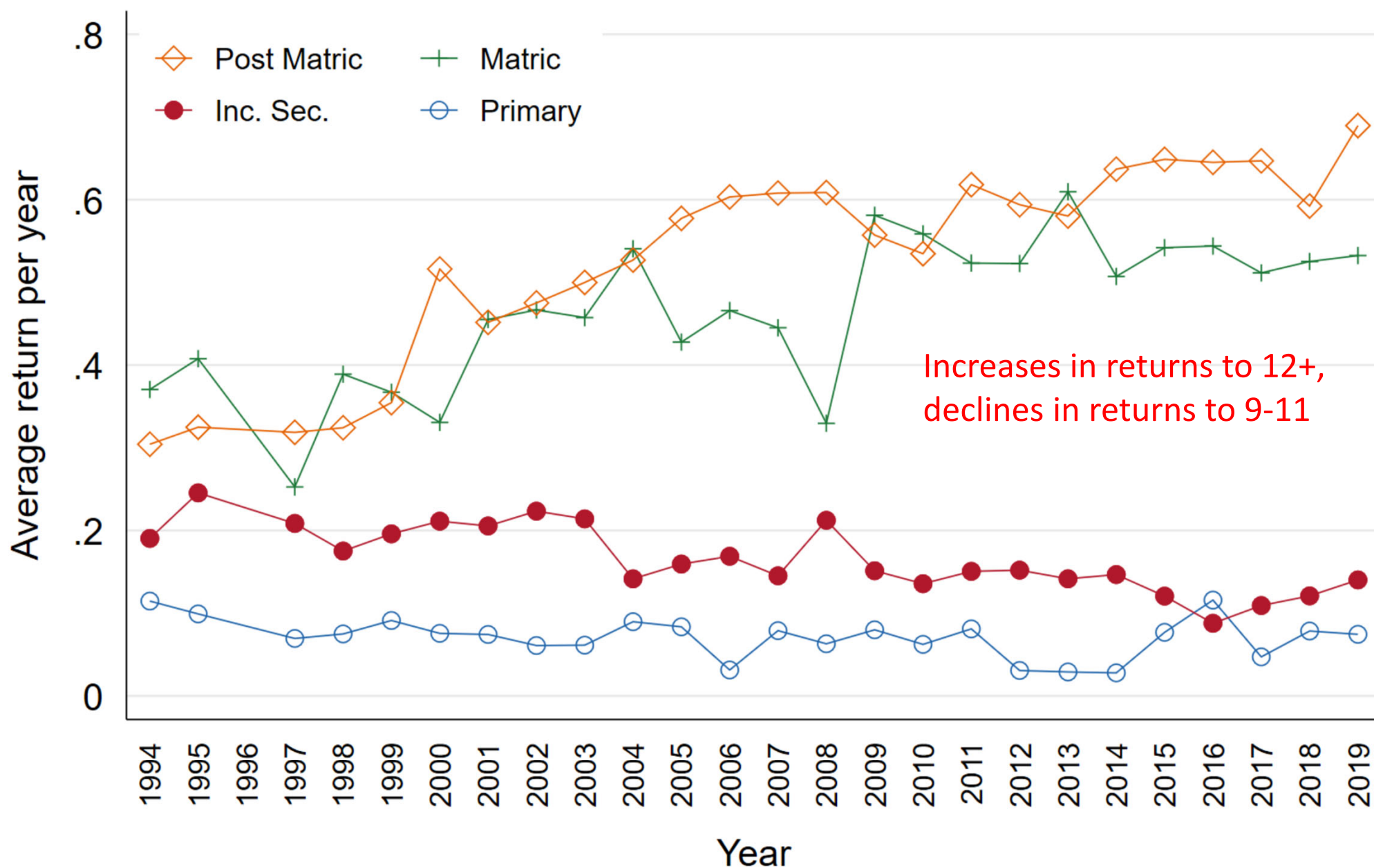
The variance of log earnings, $V(y)$, a standard mean-invariant measure of earnings inequality, is

$$V(y) = \beta^2 V(S) + V(u)$$

Increases in returns to schooling will increase earnings inequality.

But returns are not typically constant across years of schooling.

Average returns to schooling in schooling groups, South Africa 1994-2019



Weighted average of marginal returns to each year of schooling in schooling range

Schooling inequality and income inequality

What if we have a much more general relationship between schooling and earnings, with j schooling dummies:

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

The variance of log earnings is now:

$$V(y) = \sum_j \beta_j^2 V(S_j) + V(u) - \sum_j \sum_k p_j \beta_j p_k \beta_k$$

Schooling inequality and income inequality

What if we increase income at one schooling level:

$$\frac{\partial V(y)}{\partial \beta_1} = 2p_1 [\bar{y}_1 - \bar{y}]$$

- Inequality decreases if the schooling level has earnings below mean log earnings.
- Inequality increases if the schooling level has earnings above mean log earnings.
- Magnitude of change depends on distance from mean and size of group.

Effect of increasing income of some person in income distribution

- This is related to the question of what would happen if we gave some additional income to one person in the income distribution, without changing that person's rank in the income distribution
- If the person is poor, inequality declines
- If the person is at the mean, inequality declines
- If the person is rich, inequality increases
- This implies that there must be some person in “the middle” (but not too close to the mean) for whom an increase in income does not change inequality
- In general, this “fixed point” will be different for different measures of inequality

Effect of change in schooling distribution

What if we shift population from group 2 to group 1:

$$\frac{\partial V(y)}{\partial p_1} = (\bar{y}_1 - \bar{y})^2 - (\bar{y}_2 - \bar{y})^2$$

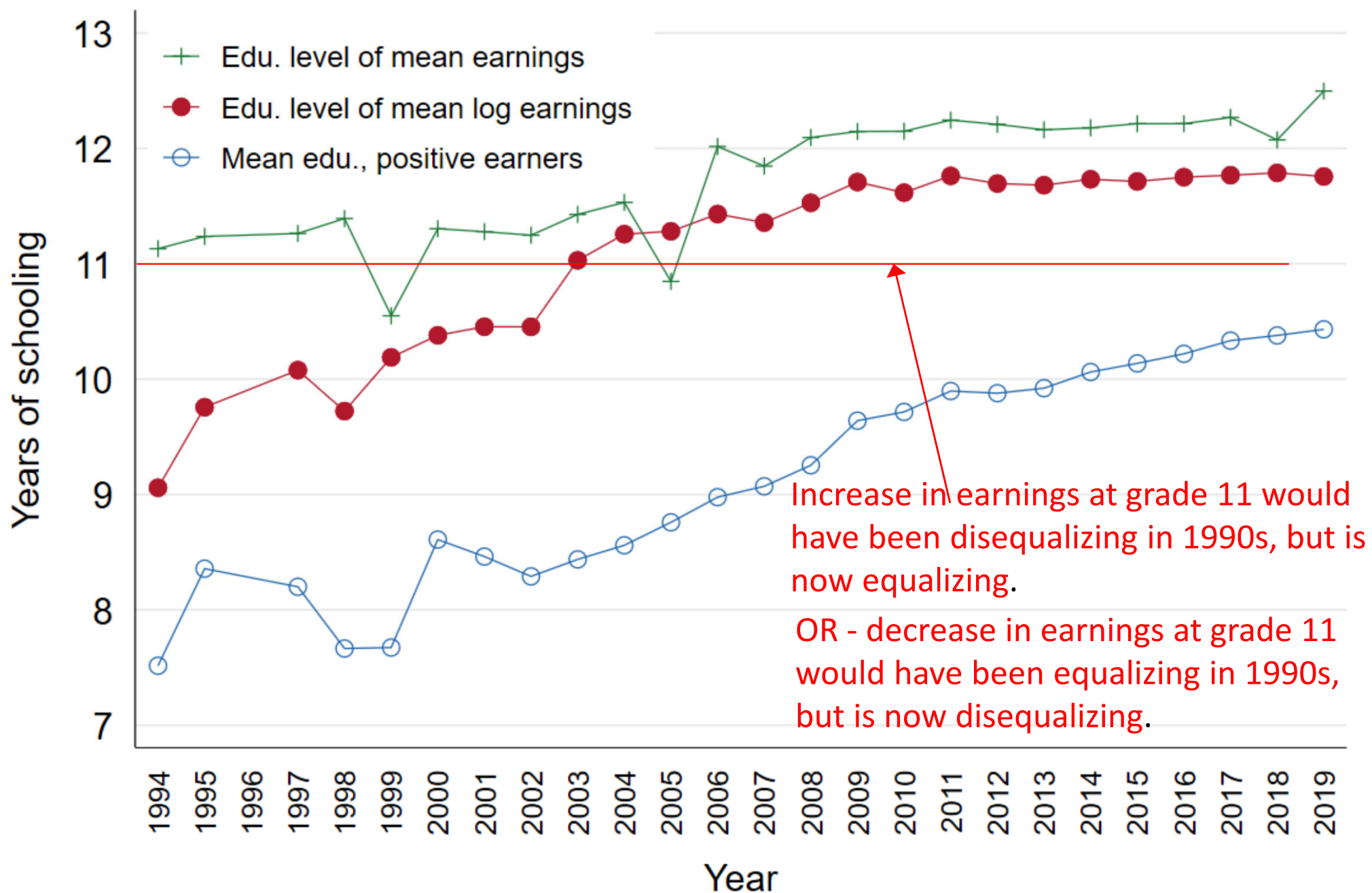
- Now the effect depends on whether we move people toward the mean, in either direction.
- If group 1 is closer to mean than group 2, shift from group 2 to group 1 will decrease inequality.
- For example, shifting people from grade 4 to grade 8 will decrease inequality if grade 8 income is closer to the mean.
- These results are for log variance, but similar results will hold for any measure of inequality.

Return to case of increasing returns to schooling
at some level of schooling

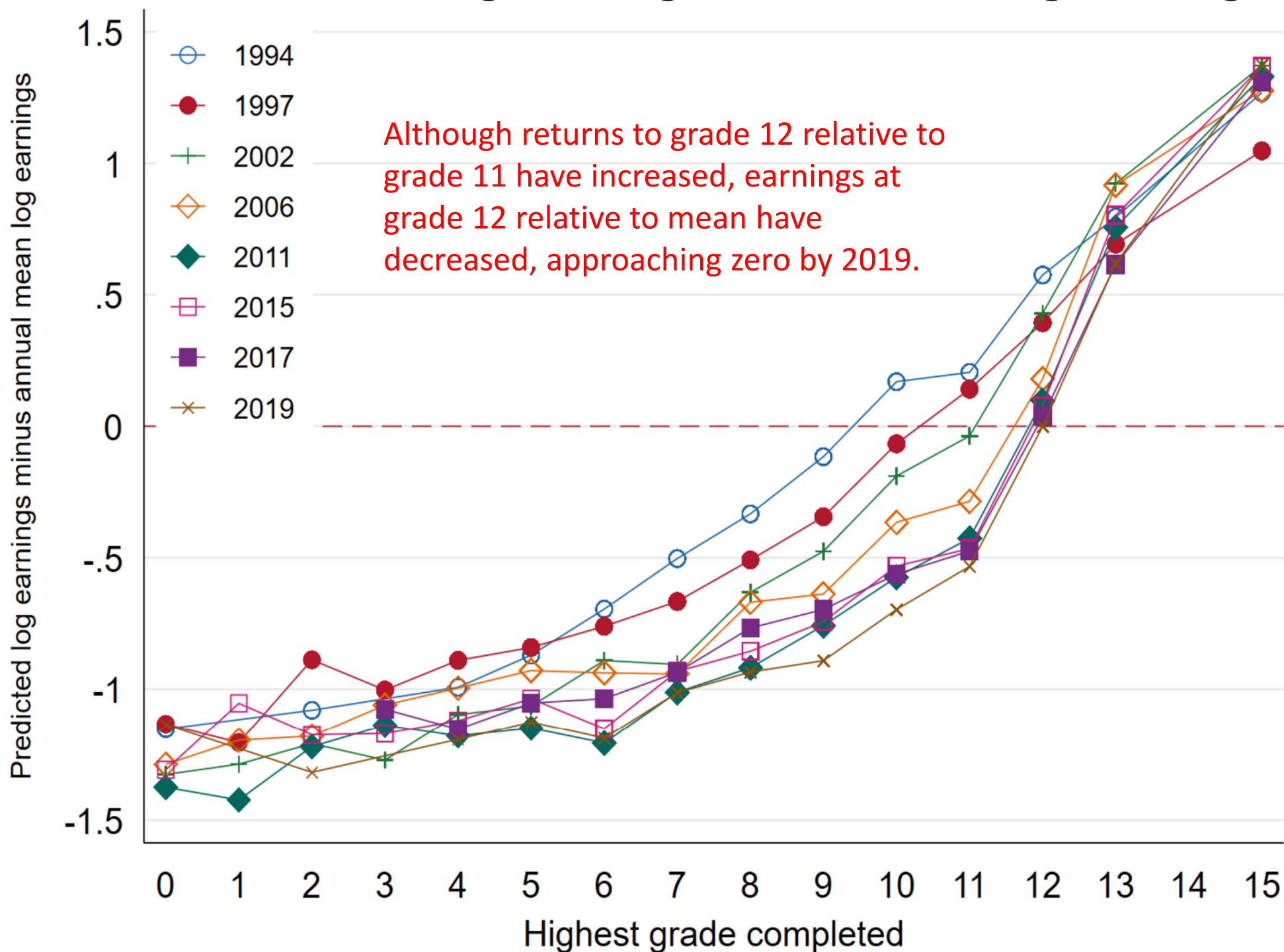
$$\frac{\partial V(y)}{\partial \beta_1} = 2p_1 [\bar{y}_1 - \bar{y}]$$

- Inequality decreases if the schooling level has earnings below mean log earnings.
- Inequality increases if the schooling level has earnings above mean log earnings.
- Magnitude of change depends on distance from mean and size of group.
- What is the level of schooling corresponding to mean log earnings?

Mean education and education of mean log earnings and mean earnings, SA 1994-2019



Predicted log earnings minus mean log earnings



Other measures of inequality

We also get a simple analytical result for the Generalized Entropy (0) measure (Theil L): $GE(0) = \frac{1}{n} \sum_{i=1}^n \log \left(\frac{\bar{Y}}{Y_i} \right)$

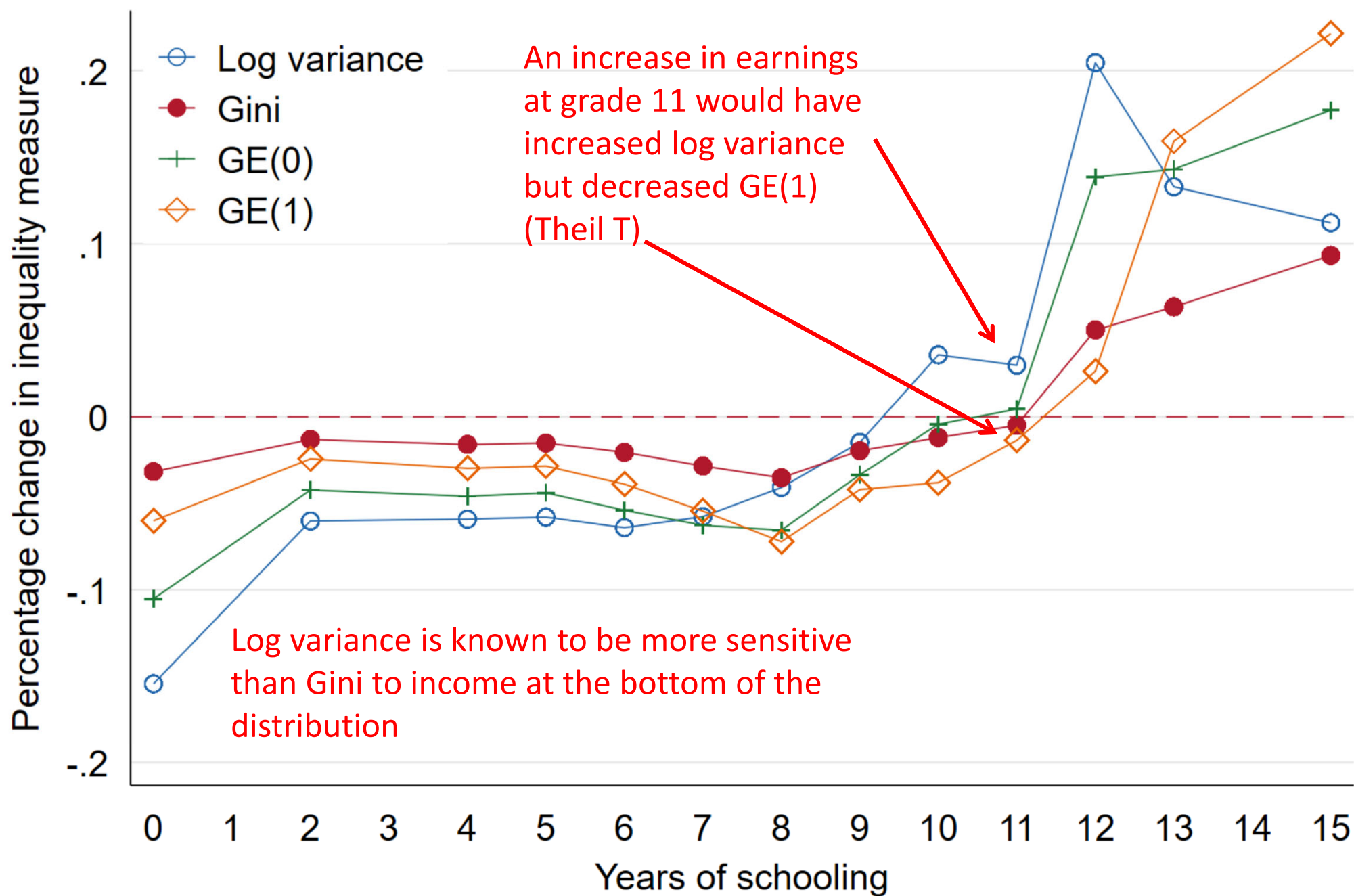
$$\frac{\partial GE(0)}{\partial \beta_1} = \frac{1}{n} \sum_{i=1}^n \frac{\partial \log \bar{Y}}{\partial \beta_1} - \frac{1}{n} \sum_{i=1}^n \frac{\partial \log Y_i}{\partial \beta_1} = p_1 \left(\frac{\bar{Y}_1}{\bar{Y}} - 1 \right)$$

- Now inequality decreases if the schooling level has earnings below the mean (not log mean).
- Inequality increases if the schooling level has earnings above the mean.
- Magnitude of change continues to depend on distance from mean and size of group.

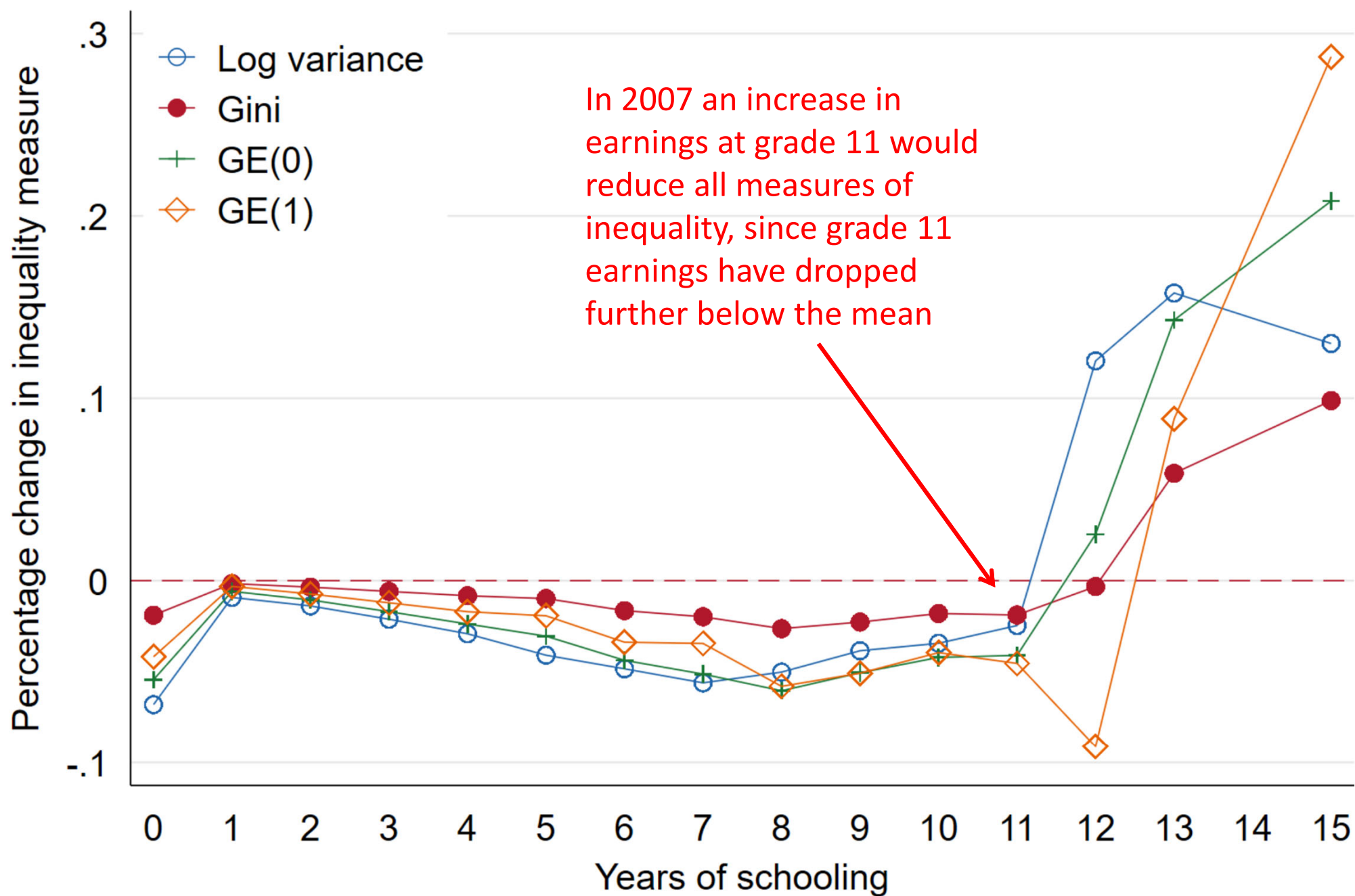
Other measures of inequality

- Deriving simple analytical results for other measures of inequality (Gini, etc.) will in general not be this simple.
- We can easily generate the answer for a given population and a given inequality measure, however, by simulating small perturbations in the returns to schooling at each level of schooling.
- We can find the cutoff that divides equalizing from disequalizing increases in returns to schooling (in practice this may not always be a single crossing)

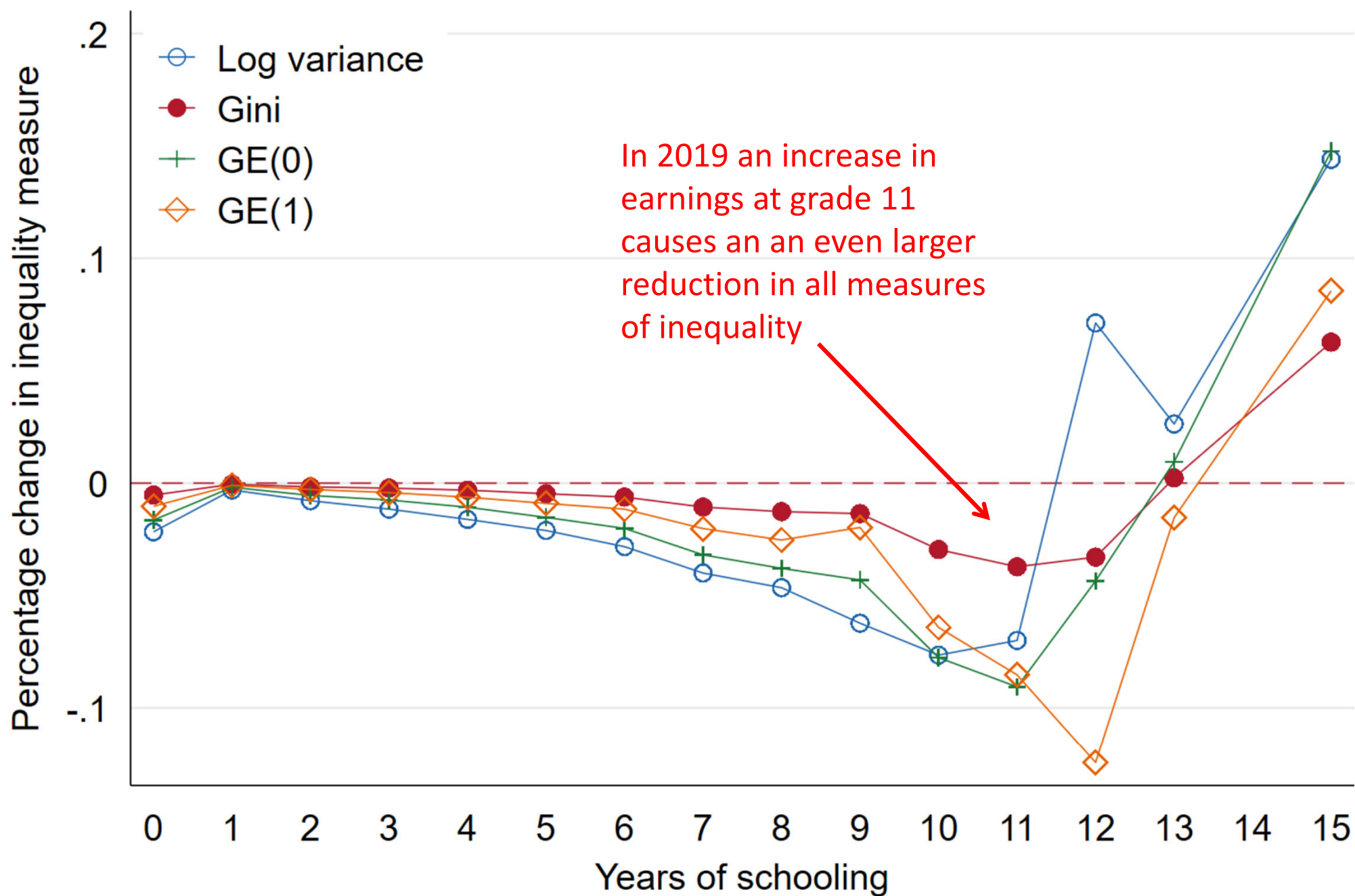
Impact of 1% increase in earnings at each grade on earnings inequality, 1995



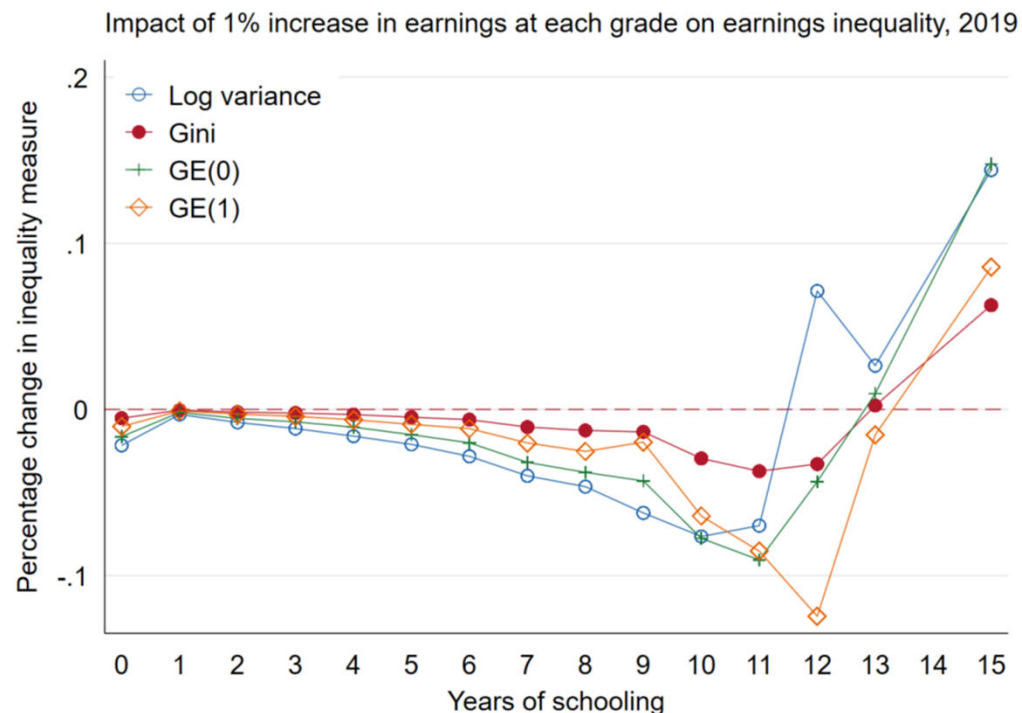
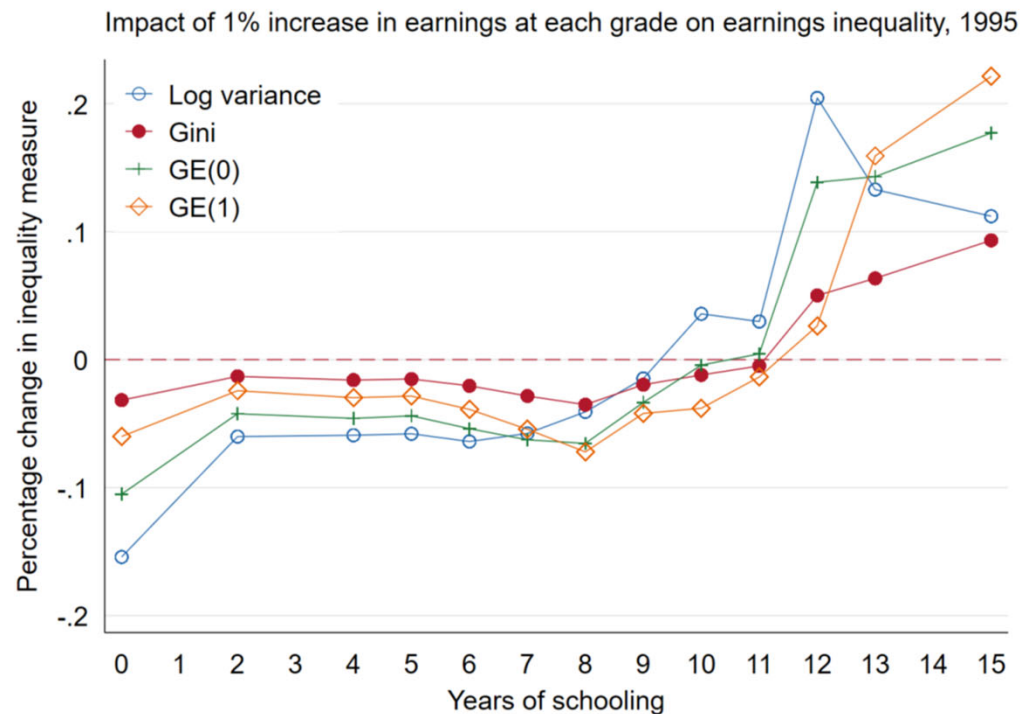
Impact of 1% increase in earnings at each grade on earnings inequality, 2007



Impact of 1% increase in earnings at each grade on earnings inequality, 2019



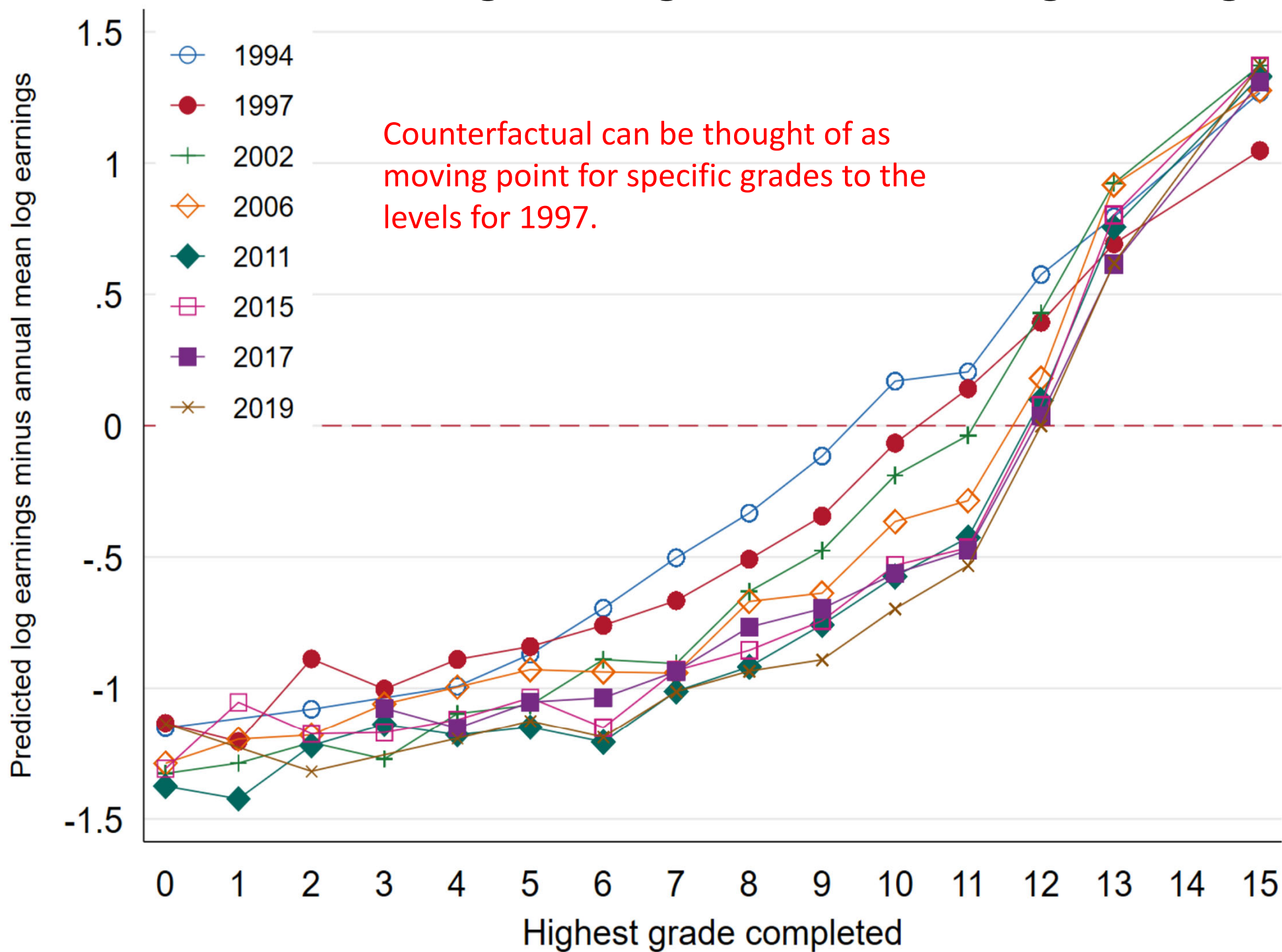
Increases in earnings at low levels of schooling have smaller effects in 2019 because there are fewer people at those grades.



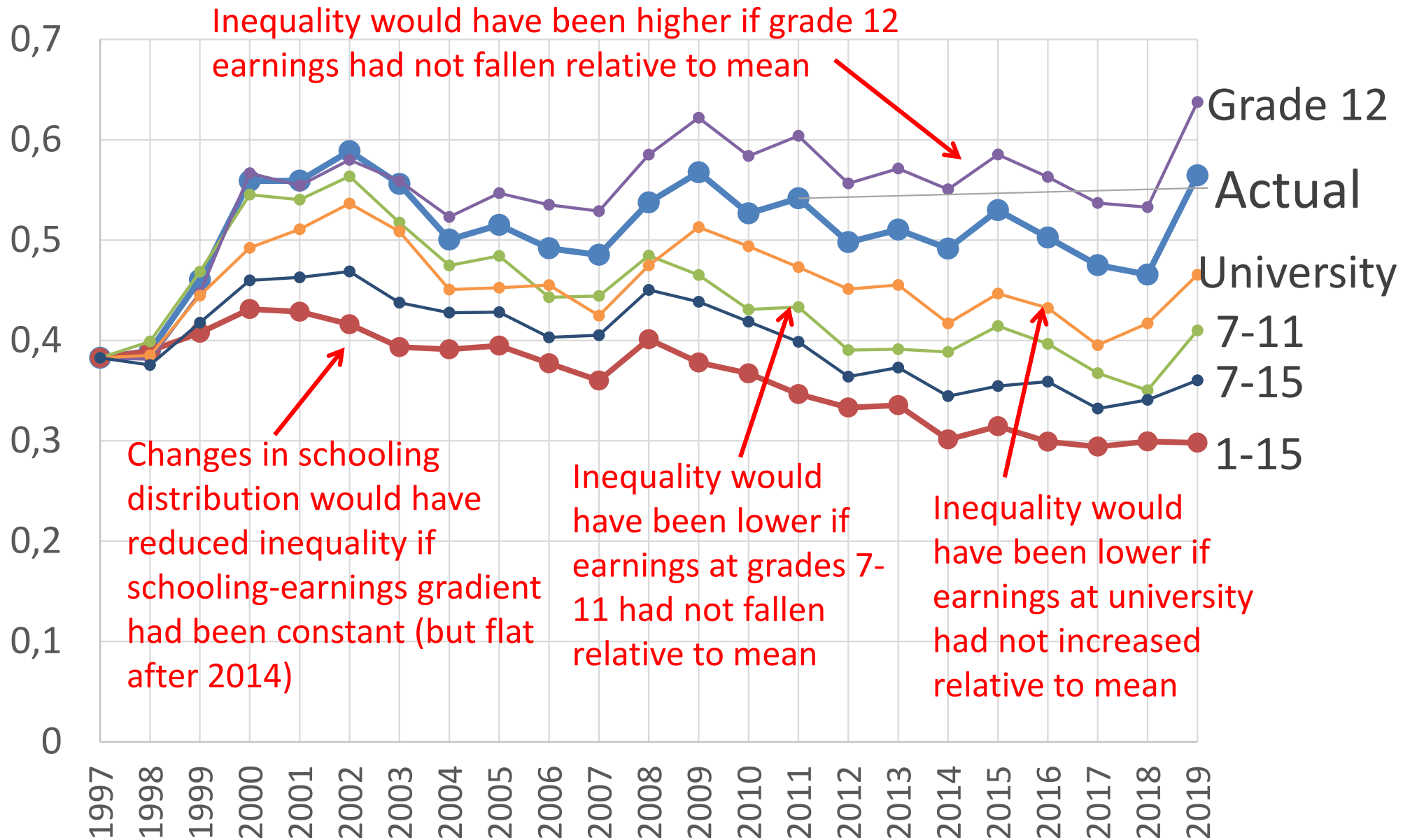
Counterfactual simulations

- We estimate counterfactual inequality if earnings relative to mean at different schooling levels had not changed
- 1997 is used as base year
- Variance of predicted log earnings is used as inequality measure – prediction based on regression with schooling dummies plus age and age squared

Predicted log earnings minus mean log earnings



Predicted variance of log earnings holding selected grades at 1997 earnings relative to mean



Conclusions

- Schooling inequality has declined substantially in South Africa since the end of apartheid, but this has not led to declines in earnings inequality
- Returns to schooling changed across schooling distribution:
 - Returns to schooling increased at high levels of schooling
 - Returns declined at low and intermediate levels of schooling
 - Earnings at intermediate levels fell relative to the mean; earnings at university increased relative to the mean
- Changes in schooling, holding returns constant, would have led to decreasing earnings inequality; this was offset by the impact of changing returns
- If earnings relative to mean for grades 7-11 had not declined, there would have been a decrease in earnings inequality.
- Increased earnings relative to mean for university graduates also contributed to rising inequality.

Predicted variance of log earnings holding selected marginal return betas at 1997 values

