Global Dynamics of Gini Coefficients of Education for 146 Countries:

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Global Dynamics of Gini Coefficients of Education for 146 Countries: Update to 1950-2015 and a Compact Guide to the Literature

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Abstract

We briefly survey the literature which uses data for Gini coefficients of education. We update the Gini coefficients of education to include the year 2015, added to the Barro-Lee data set recently, and compare them to those of the earlier data set based on older Barro-Lee data. A panel analysis shows that every five years education inequality falls by 2.8 percentage points. A stable average value is predicted to be 0.22. Kernel density world distributions for education Ginis loose their twin peaks when going from 1955 to later years, and the right tail of the distribution with high inequality is losing mass over time.

JEL classification numbers: E24, I24, I25, O15, Y1.
Keywords: Gini coefficients of education, guide to literature, new data, trend, changing global distribution.

1 Introduction

The educational data from Barro and Lee (2013) are now available as version 3.0 from September 2021 and go until 2015. This allows us to extend the data series of Gini coefficients of education, which did go until 2010 in Ziesemer (2016).[2] We use the formulas A-1 in Thomas et al (2000) and Castelló-Climent (2004) to calculate the Gini coefficients of education and do some basic data analysis of their dynamics.[3] In section 2, we indicate briefly in which areas Gini coefficients of education were used. In section 3, we provide description of the new data and indicate how they have changed through the revisions in Barro and Lee (2013) and later. In section 4, a dynamic analysis (i) confirms the known falling global trend in Gini coefficients of education, (ii) estimates an autoregressive progress in Gini coefficients of education and indicates where it goes in a panel average, and (iii) shows how the world distribution of Gini coefficients of education changes in the different parts of the world distribution. Section 5 briefly summarizes.

2 A Guide to the Literature: Effects, Explanations, and Alternatives

Verway (1966) constructed Gini indices of education across school age classes for US states. For developing countries, the first set of Gini coefficients of education achievement is that by Maas and Criel

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[2] Lee and Lee (2018) report having education Gini data until 2015 for 138 countries. Benaabdelaali and Catin (2018) have a data set with some own decisions for making the data for 2015 for seven levels of education, distinguishing between completed and not completed primary, secondary, and tertiary schooling.
[3] We do not look at disaggregations in regard to age, gender, or other aspects.

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(1982) for 15 Eastern African countries; they do this for primary schooling across districts. Another early one is Hicks (1997) for 20 OECD countries. Hicks constructs them on the basis of data from Barro and Lee (1993) modified by Ahuja and Filmer (1995, 1996). He modifies the human development index consisting of three variables X_i , which he multiplies by their Gini coefficient. The HDI education sub-index takes adult literacy and enrolments into account and becomes $(1\text{-}G)*X_i$, which enters the HDI. Lopez et al. (1998) show the negative relation of education Ginis and growth and investigate the complementary policies.

Later, based on the work of Thomas et al (2000), Gini coefficients of education have been useful in analyzing the relation of education inequality with education expansion and income distribution (Sarwar et al. 2021), other education related topics, health, economic growth, savings, inflation, and trade. We briefly indicate where readers can find applications and the relation to other variables, skipping appearances such as statistically insignificant control variables.

Watarai and Tomita (2017) emphasize that Gini coefficients of education fall for Korea and Japan and go to the relatively constant and low value of the USA. Morrison and Murtin (2010) emphasize that for larger samples the fall in education Ginis is widespread and comes mainly from one in illiteracy. This goes together with an accumulation of human capital in both countries, a statement that appears first in Maas and Criel (1982) for primary education in African districts and has been reproduced often for average years of schooling (Lee and Lee 2018; Ziesemer 2016; Thomas et al. 2000). Qi et al. (2021) confirm this for 141 countries and report that educational inequality goes together also with an uneven distribution of rural-urban population across regions. Castelló and Doménech (2008) report an interaction of human capital accumulation, education inequality and life expectancy, where life expectancy is reduced in 1985 by educational inequality in 1960 in a regression for a sample of 92 countries in which African countries have an education Gini twice as large as OECD countries. Human capital accumulation is affected only by life expectancy, indicating what the causality is: health policies could trigger human capital investment and reduce its inequality. Földvari and van Leeuwen (2011) find a negative effect of education Ginis on per capita income for non-OECD countries but not for OECD countries when education Ginis are made from Barro-Lee data, but not when made from Cohen-Soto data leading to half the number of observations. Irarrázaval (2020) shows for average numbers across Latin American countries that average years of schooling are increasing since the availability of data in 1900, Gini coefficients of education are falling since their availability 1950 and the polity2 index goes up only since 1970.

Blom et al. (2001) attribute a reduction in wage inequality for Brazil more to the fall of returns to education than to educational inequality. Checchi (2001) finds a negative relation between income and educational inequality whereas Gregorio and Lee (2002) as well as Mahmood and Noor (2013) find a positive one. Földvari and van Leeuwen (2011) find a positive effect for OECD countries when using IV estimators. Cruces et al. (2011) find an inverted u-shape relation with limited significance though depending on controls and periods. Castelló-Climent and Doménech (2014) explain the absence of a clear relation between Ginis for income and education in the literature saying, "increasing returns to education and exogenous forces such as skill-biased technological progress or globalization have offset the effects of the fall in education inequality." Lee and Lee (2018) as well as Madsen and Le (2020) have a similar summary. Coady and Dizioli (2018) suggest a strongly positive relation between income and education inequality provided dynamic panel data techniques are handled well. Serwach (2021) shows a positive relation between Gini coefficients for education and income in new EU member states. Castelló-Climent and Doménech (2021) suggest an inverted u-shape relation for labour income Ginis and a positive relation for income Ginis dependent on choosing adequate controls. Saglam (2021) emphasizes that controls affect

different income levels of countries differently. Castelló-Climent and Doménech (2021) and Saglam (2021) both survey the literature on the problem broadly.

Murillo Lozano (2021) surveys literature showing an effect of educational inequality on growth rates and levels. She compares papers finding positive or negative relations with the u-shaped effect on log-levels with a minimum at 0.3 in Ziesemer (2016) and points out that the latter has a close relation with the theoretical model of Galor and Tsiddon (1997). Charles-Coll (2010), using many educational control variables, had suggested an inverted u-shape relation for the transitional growth rate.[4] Argov and Tsur (2019) and Tsur and Argov (2019) find a negative impact of educational inequality on GDP per worker in an average across 16 cross-country regressions for 70 countries or only advanced countries in 2010, with a larger effect for the full sample, but an insignificant one when controls are used. Qi et al. (2021) find a slower linear and a higher quadratic growth if initial education Ginis are higher. Whereas education Ginis keep falling in recent periods, those for rural-urban population Ginis and Night-light development index stop falling in 2000. Sauer and Zagler (2014) present positive growth effects of education Ginis and years of schooling with a negative interaction effect. At low schooling, educational inequality therefore has a positive effect and at high schooling (5 years and more) educational inequality has a negative effect. Education Ginis have a much clearer effect on growth than income Ginis (Castelló and Doménech 2002). Zheng et al. (2020), providing a theoretical growth model, suggest that inflation has a positive (negative) impact on income inequality if educational inequality dominates (is dominated by) that of wealth in addition to other conditions. Sauer and Zagler (2012) as well as Ibourk and Amaghouss (2013, 2015) survey literature on educational inequality and growth; Cunha Neves and Tavares Silva (2014) survey the inequality-growth literature more broadly.

Besides analyses of effects of Gini coefficients of education, there are also contributions explaining the education Ginis. Maas and Criel (1982) explain East African education Ginis as a u-shaped function of enrolment in primary education. Production risks may lead to less human capital investment and more educational inequality (Checchi and García-Peñalosa 2004). Ziesemer (2011) shows through simulations in an estimated dynamic simultaneous equation model that tertiary education drives average schooling, growth, and the reduction of education inequalities. "This will be achieved by reductions in gender gaps, higher enrolment rates, and lower dropout rates, lower pupil-teacher ratios and higher public expenditure on education. There are no simple one-way causalities. Policies enhancing savings ratios and enrolment in tertiary education have the largest effects through the whole system." Coady and Dizioli (2018) conclude that education expansion will continue reducing educational inequality. Hou (2018) and Hou and Karayalcin (2019) observe that Gini coefficients of education are falling over time in Latin American countries, but primary exports mitigate this fall and lead to more inequality in education. Irarrázaval (2020) provides an IV regression where educational inequality is explained by native population density in 1500, whereas a democratization index is statistically insignificant.

A more recent branch of literature argues that the role of Gini coefficients of education or other inequality measures in regard to growth, income distribution and other issues should be interpretated after disaggregation or interaction with other aspects: bright and less bright individuals (Speciale 2005), change in years of schooling, shares of investment and government in GDP (Bowman 2007), the quintiles or tails of the income distribution (Digdowiseiso 2009; Abdullah et al. 2011), gender (Maas and Criel 1982; Zhang and Li 2002), age and development stage (Benaabdelaali et al. 2011; Cuaresma et al. 2013; Coady and Dizioli 2018; Madsen and Le 2020), fertility and life expectancy (Castelló-Climent 2010), educational opportunity and achievement (Mejía and St-Pierre 2008; Ferreira and Gignoux 2011), the

[4] Ziesemer (2016) shows some sensitivity to control variables and that tertiary education reduces education Ginis and increases growth.

level of education (Nomura 2007; Carnoy 2011; Castelló-Climent and Mukhopadhyay 2013), Meschi and Scervini 2014a; Vegas and Coffin 2015), and race (Verway 1966; Camps and Engerman 2016). There are statistical decompositions of educational Ginis (Foldvari et al. 2010). Moreover, there are Gini coefficients of land inequality (Baten and Juif 2013; Cunha Neves and Tavares Silva 2014).
Alternative measures for inequality in education are coefficients of variation, Theil indices, modified Ginis and others (see Lim and Tang 2008, Malul et al. 2013; Meschi and Scervini 2014a,b; Cunha Neves and Tavares Silva 2014, Ibourk and Amaghouss 2013, 2015).
Braga et al. (2013) use education Ginis for policy evaluation. Jang (2021) discusses the need for education policies and socially complementary policies that could decrease the education gap in Korea.

Finally, Gini coefficients of education have been used in many single-country studies not included here for obvious reasons of space. Gini coefficients of education are an important item in the broader analysis of inequalities of education, health, income, wealth, and many others, and the related issues of development strategies (Clemens 2004), conflicts (Østby et al. 2009; Bartusevičius 2014), trust and tolerance problems (Borgonovi 2012), electoral rights (Castelló-Climent 2008), institutions (Berthélemy 2006; Braga et al. 2011), social cohesion (Green et al. 2003), crime (Kelly 2000), and policies in other fields than economics (Unterhalter 2021).

3 Data

At https://doi.org/10.34894/I1MFXW, we provide the education Gini data for all 146 countries for four classes of education - primary, secondary, and tertiary schooling as well as illiteracy - based on the average years of schooling in each class, averaged over completed and not completed, and the percentage of the population in the class. Unlike World Development Indicators, they include data for Taiwan and Reunion. The code for Serbia is changed from SRB to SER. Both data sets also differ in their codes for Republic of Moldova, Romania, and Democratic Republic of Congo. We indicate this in a column of the data file.

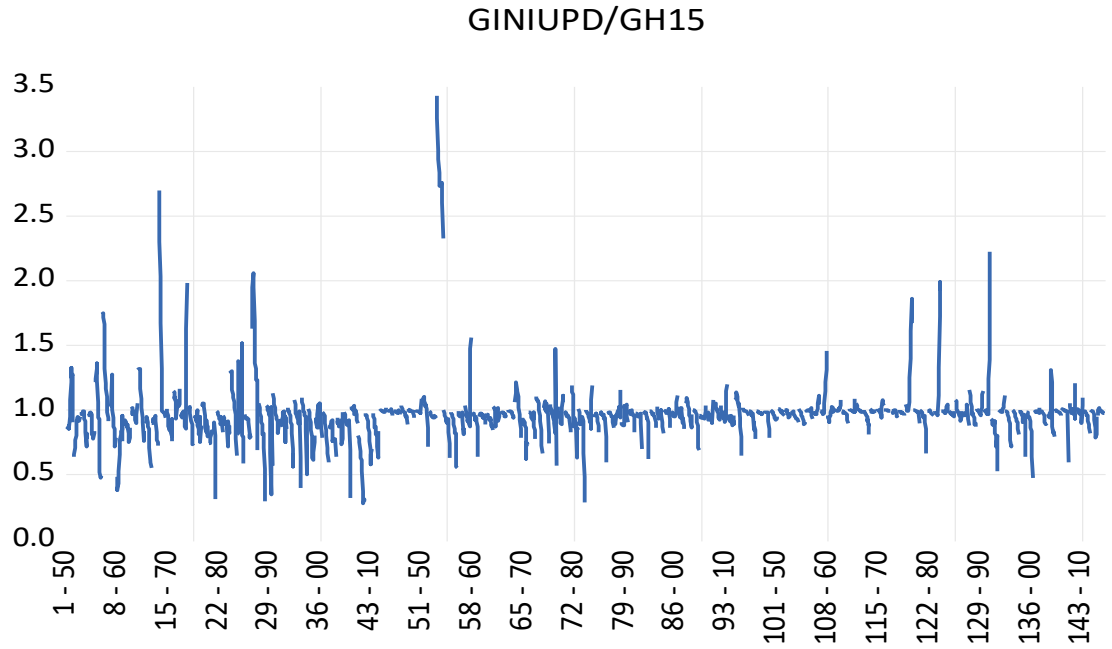

Figure 1: The ratio of Gini coefficients of education updated to 2015, GINIUPD, relative to their earlier version until 2010, gh15.

The ratio of new/old data shown in Figure 1 tells us that some new values are strongly revised upward revealing data points where much more inequality was actually present, if the new data are better than the old ones. However, many more points show a ratio below one indicating data points with less inequality after the revision.

The least-squares correlation between the older data going until 2010, named *gh15*, and the updated data called *Giniupd* is

Gh15 = 0.023073 + 0.963993GINIUPD,

with both p = 0.0000, and adjusted R-squared = 0.96 from 1898 observations.

At the lower end of Gini coefficients, near zero, the old data are a bit higher as we can see from the positive, statistically significant intercept. Comparisons between earlier data sets are shown or referred to in Ziesemer (2016).

4 Dynamics of Gini coefficients of education

The new Gini data, starting from an average of 0.573, show a downward trend of, on average, 2.8 percentage points every five years, indicating a trend towards more educational equality, which most likely stems from more investment in human capital leading to more average years of education (see Thomas et al. 2000, Castelló and Doménech 2002, Ziesemer 2016, Lee and Lee 2018):

GINIUPD = 0.573335 - 0.028117t,

with fixed effects not shown, both coefficients with p = 0.0000, and adjusted R-squared = 0.906 from 2044 observations. Where are Gini coefficients on average heading to? The following dynamic panel 2SLS regression with p-values in parentheses[5] leads to an answer.

GINIUPD = 0.0258 + 1.29GINIUPD(-1) - 0.41GINIUPD(-2)

(0.0167) (0.00) (0.03)

Adding up the slope coefficients leads to a value of 0.88, below that of a unit root. The long-run value than would go to about 0.22 for a panel average, which is now 0.334. Therefore, education will continue to go to more equality. As simulation of a dynamic model based on more controls and equations for them is also contained in Ziesemer (2011); there, the long-run value is even a bit lower and achieved in 2045.

[5] Periods: 10; observations 1460; cross-section weights for panel-corrected standard errors; period and country fixed effects; Instrument specification: C GINIUPD(-3) GINIUPD(-4). Mean dependent var = 0.334, Adjusted R-squared = 0.987. Durbin-Watson stat = 2.07, "is formed simply by computing
the first-order residual correlation on the stacked set of residuals" (eviews12 2020) . Trying the orthogonal deviation version of system GMM of Arellano and Bover (1995) we cannot find any case passing the Hansen-Sargan test.

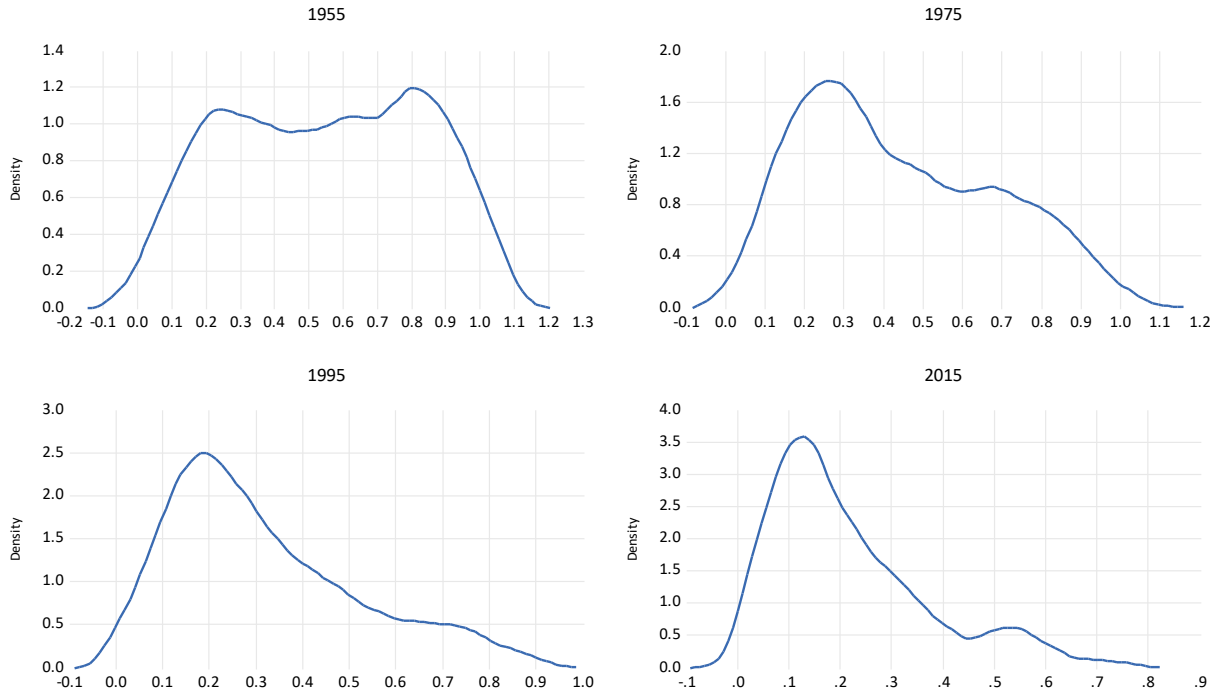

Figure 2: Cross-country kernel density distributions of Gini coefficients of education for 146 countries in 1955, 1975, 1995, and 2015.

The kernel density distribution of Gini coefficients across countries for a certain year is shown in Figure 2 for steps of twenty years.[6] In 1955 there are two peaks, reminiscent of Danny Quah's (1993) twin peaks for GDP per capita data. The peak of high inequality countries has Gini coefficients of 0.8 whereas the low one is at 0.25 with relatively little inequality. The high peak vanishes until 1995 but is back as a very small peak in 2015. The low peak first increases to 0.27 and then goes down to 0.19 and 0.13 because emerging economies invest in human capital. The rich countries with much human capital go to very little inequality of education. In the right tale of the distribution there is less and less mass for Ginis above 0.4.

5 Summing up

Barro and Lee have strongly revised the educational data. As a consequence, some of the Gini coefficients of education are also strongly revised as revealed by our Figure 1. However, there is a strong correlation between the old and the new data for Gini coefficients of education. On average, Gini coefficients of education are reduced by 2.8 percentage points every five years and are going towards an average value of 0.22 according to our dynamic regression. The dynamics of the kernel density distribution shows that the higher of two peaks vanishes and the lower one moves to having a peak at lower values at 0.13 than the panel average of 0.22. All these results indicate a global average trend towards more equality in education.

[6] In the literature we find something similar only in Chambers et al. (2019) who present one distribution over income Ginis.

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