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Human Capital and Income Inequality: New Facts and Some Explanations

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Introduction

- Most developing countries have made a great effort to eliminate illiteracy rates
- As a result, the average human capital Gini coefficient dropped from 0.55 in 1960 to 0.28 in 2005
- In spite of the equalizing process in the distribution of education, inequality in the distribution of income has hardly changed
- The income Gini coefficient for the same group of countries was almost equal in 1960 (0.42) than in 2005 (0.41)
- This paper analyses this evidence in detail and tests several hypothesis that can explain the lack of correlation between the evolution of human capital and income inequality

Alternative explanations

- Different factors may explain changes in income inequality and human capital is just one of them

$$Y = w(H) + rK + TR - T \tag{1}$$

- Transfers. Whereas the gross income Gini coefficient has fallen 4.7 pp from 1960 to 2005 its net counterpart has remained almost constant (-0.02 pp)
- Income composition. Karabarbounis and Neiman (2013) have found evidence of a decline in the labour share in most countries since 1975. Checchi and García-Peñalosa (2010) have shown that the labour share is negatively correlated with the income Gini coefficient.
- Capital income inequality. Piketty and Zucman (2014) have documented an increase in wealth income ratios since the 1970s in the top eight developed economies.

Paper contributions

- Estimate a new measure of years of schooling inequality for a large sample of countries from 1960 to 2010
- Analyse the evolution of years of schooling and income inequality across countries and over time
- Estimate the distribution of wages using recent estimates of rates of return to years of schooling for 139 countries by Montenegro and Patrinos (2014)
- Analyse the sensitivity of the Gini coefficient of wages to years of schooling, the share of illiterates and returns to education
- Estimate the average contribution of wage inequality to income inequality

Main results

- A clear U-inverted relationship between the Gini coefficient of years of schooling and of simulated wages for 139 countries from 1950 to 2010, in line with Lim and Tang (2008) and Morrison and Murtin (2013)
- We find a composition effect consistent to Robinson (1976), Knight (1976), Knight and Sabot (1983), Anand and Kanbur (1993) and Fields (1993): a transfer of workers from the low to the high-education group raises the inequality of wages until the high-education group reaches a certain share
- Maximum Gini coefficient for wages reached when $n_0 = 0.4$: to reduce inequality countries should ensure that all population has completed at least primary schooling (6 years on average)
- Returns to years of schooling do not affect the inverted U-shape. Increasing returns augments inequality, particularly when $n_0 = 0$ (advanced economies)
- The estimated average contribution of wage inequality to income inequality is statistically significant, relatively stable and economically relevant: approximately each point of change in the Gini coefficient of wages contribute to half a point in the change of the Gini coefficient for income.

New improved measure of human capital inequality

- We use the new Barro and Lee (2013, 2016) data set, which reduces measurement error by using more information from census data and a new methodology that makes use of disaggregated data by age group
- Following Castelló and Doménech (2002), the human capital Gini coefficient has been defined as

$$Gini^h = \frac{1}{2\overline{H}} \sum_{i=0}^{6} \sum_{j=0}^{6} |\widehat{x}_i - \widehat{x}_j| \, n_i n_j \tag{2}$$

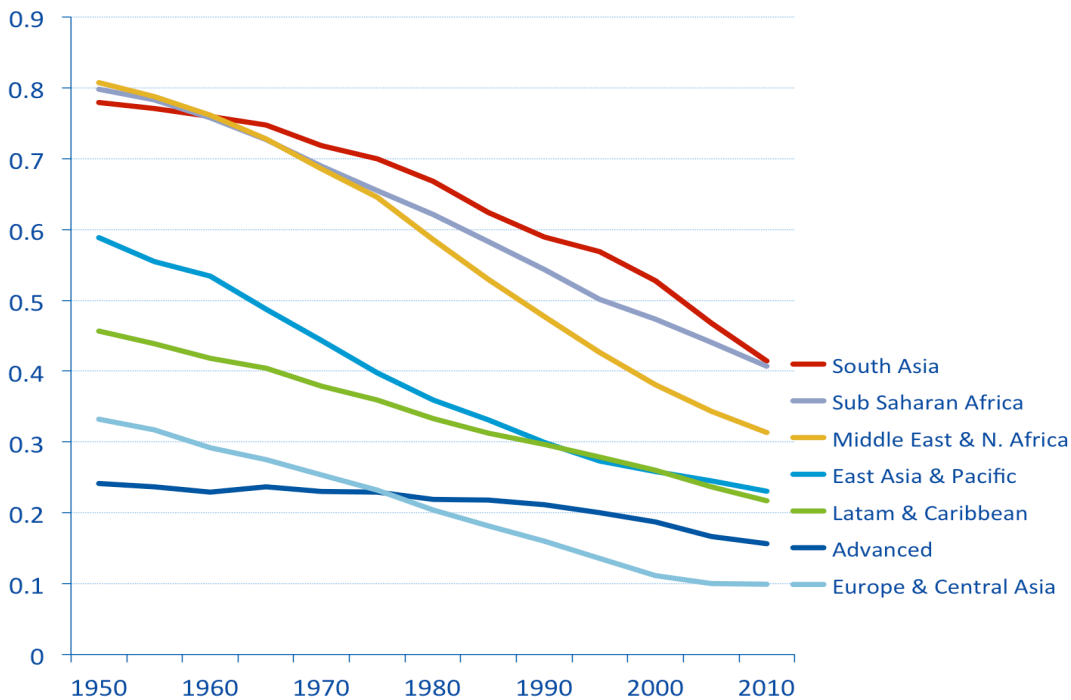
$$Gini^h = n_o + (1 - n_0) \, Gini^{LIT} \tag{3}$$

- The new inequality indicators are available for 146 countries from 1950 to 2010 in a 5-year span

Stylized facts about human capital inequality

Fact 1: From 1950 to 2010 there has been a significant reduction in human capital inequality around the world

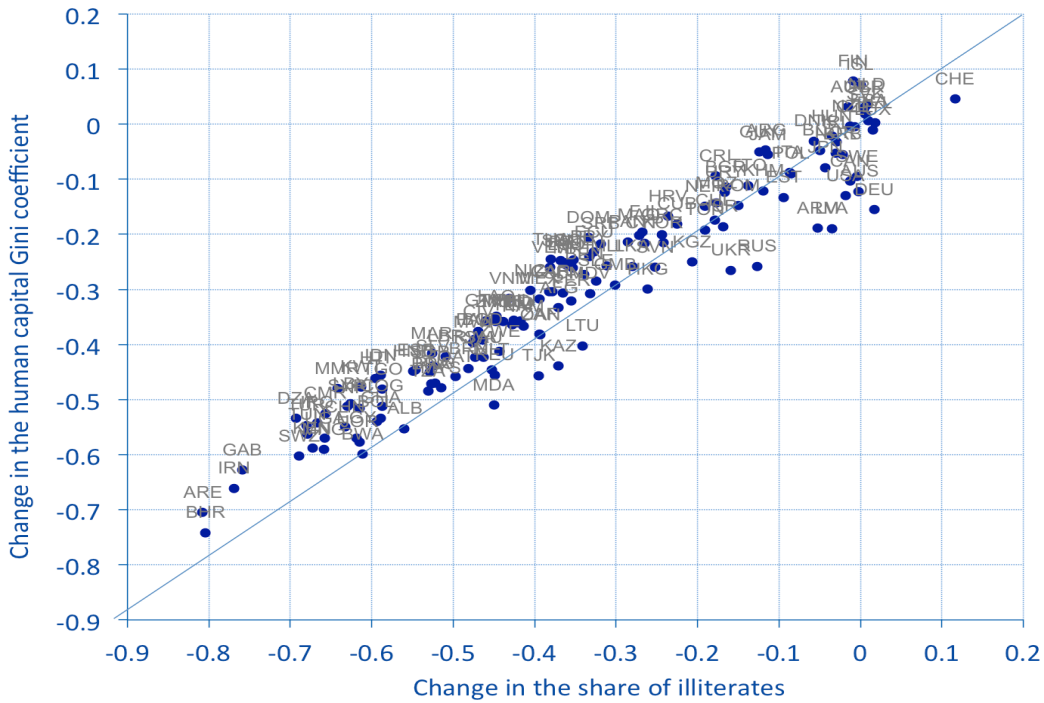
Human Capital Gini Coefficient of population 15+



Stylized facts about human capital inequality

Fact 2: In most countries the large reduction of education inequality has mainly been due to the sizeable decline in the share of illiterates

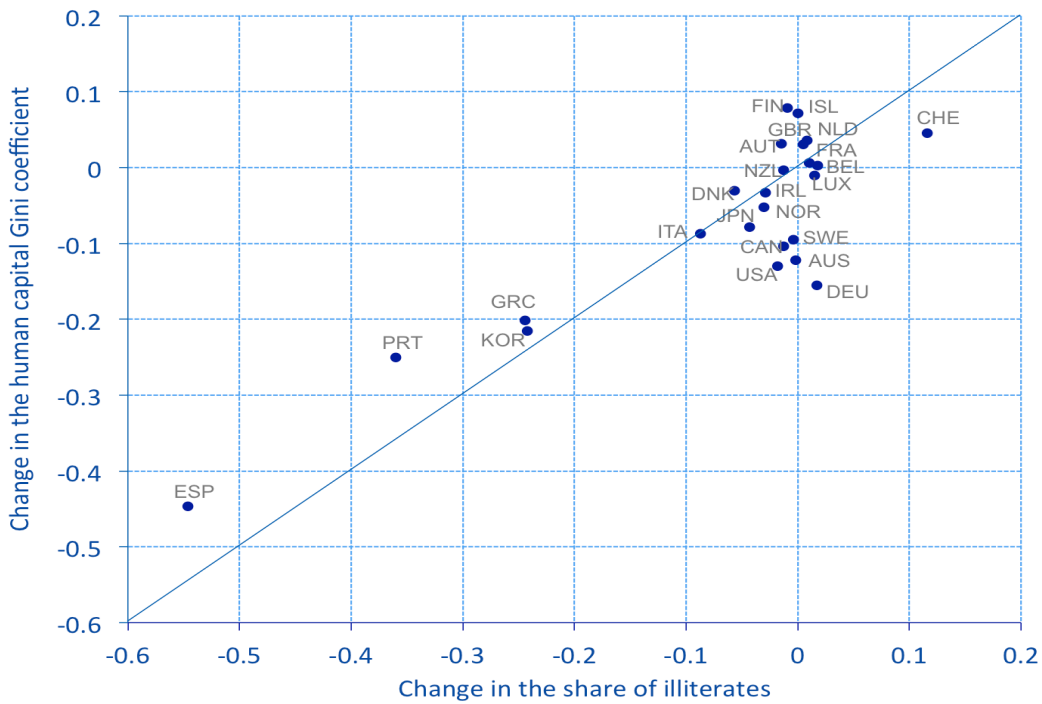
Change in the human capital Gini coefficient and in the share of illiterates, 1950-2010



Stylized facts about human capital inequality

Fact 3: In most advanced countries there is not a clear correlation between education inequality and the human capital Gini coefficient

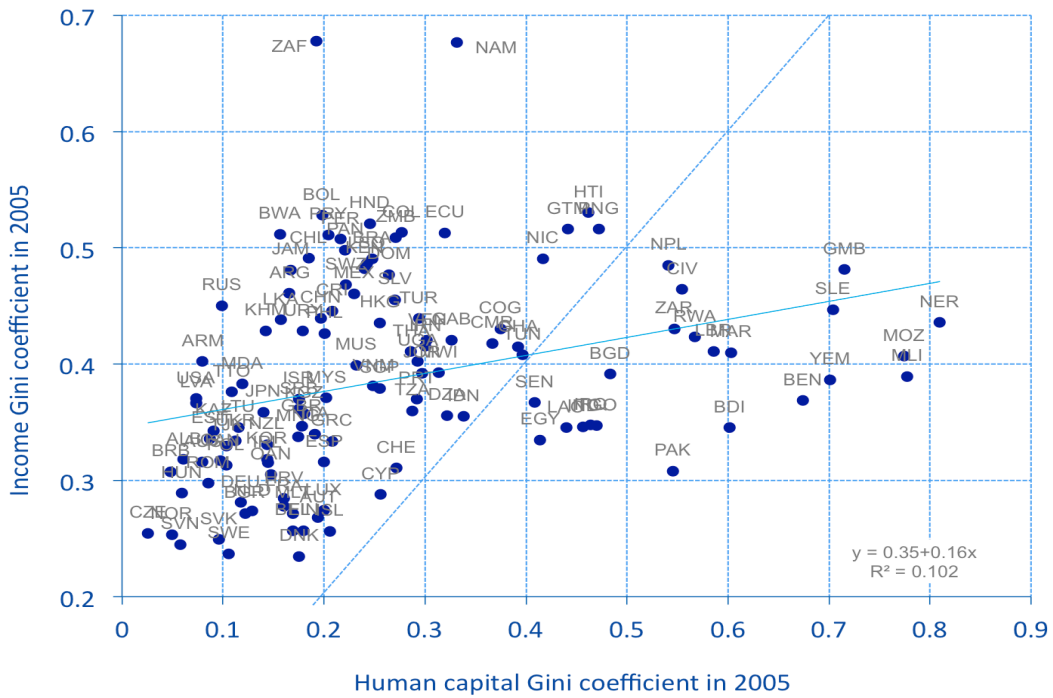
Change in the human capital Gini coefficient and the share of illiterates. High income countries, 1950-2010



Human capital and income inequality

Fact 4: The correlation between income and human capital Gini coefficients is low

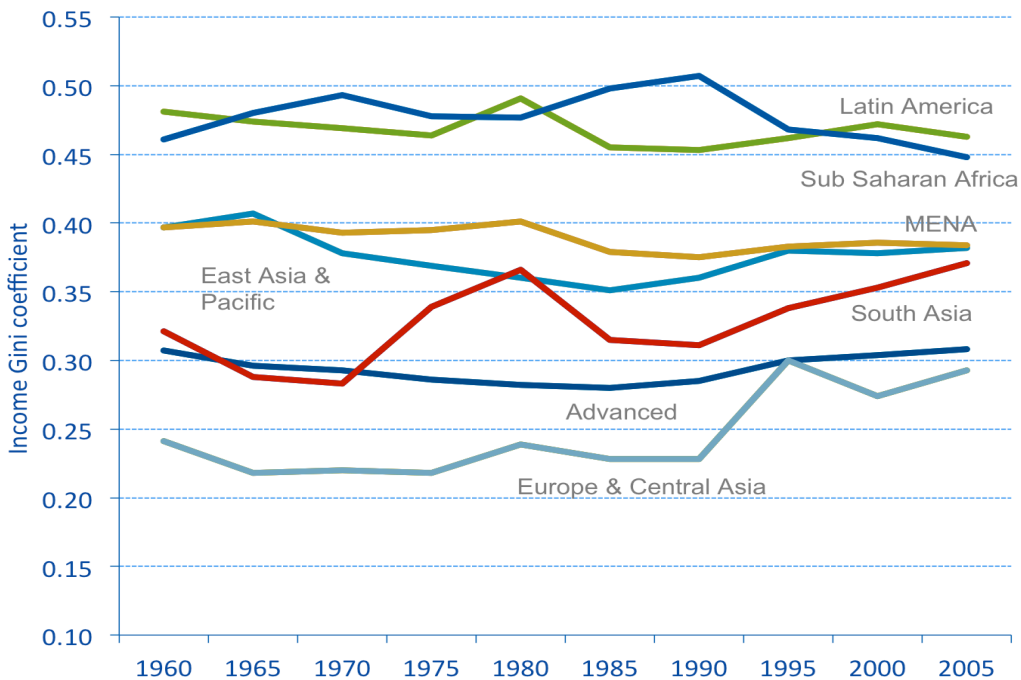
Human capital and income Gini coefficients across countries in 2005



Human capital and income inequality

Fact 5: Both across world regions and a large sample of countries, income inequality has remained relatively stable, despite the significant reduction in human capital inequality from 1960 to 2005

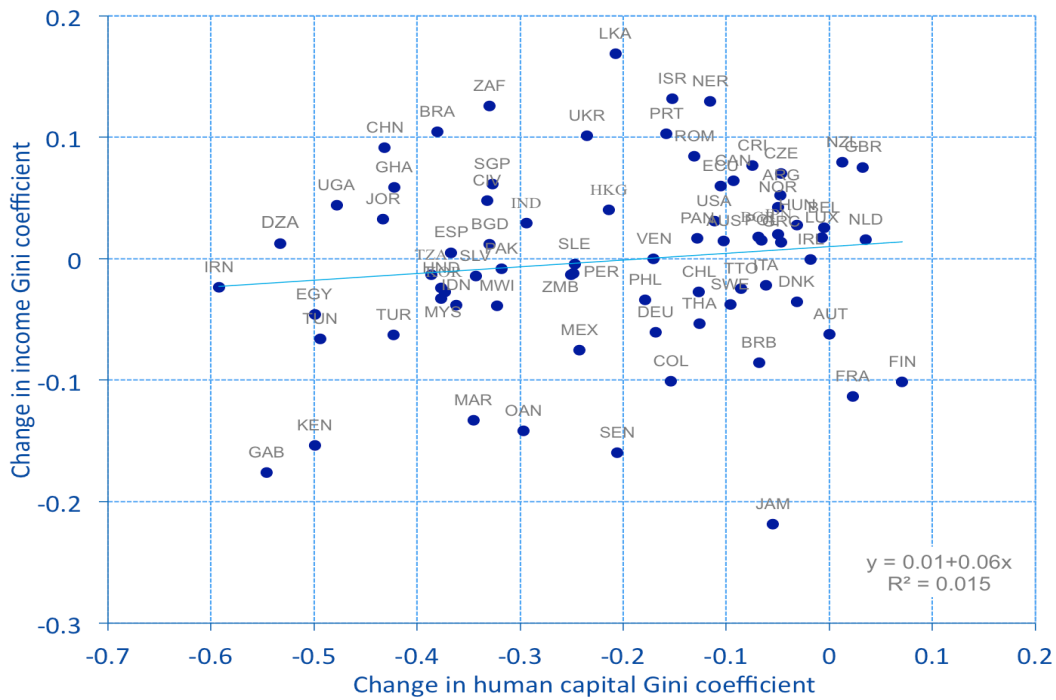
Evolution of the income Gini coefficient across regions, 1960-2005. World Income Inequality Database, v3.0



Human capital and income inequality

Fact 6: The reduction in human capital inequality has not been accompanied by an improvement in the income Gini coefficient

Change in income and human capital Gini coefficients across 75 countries, 1960-2005



Human capital and income inequality

- Main result: The evidence shows that most countries have experienced a very significant reduction in human capital inequality, mainly due to the decrease in the share of illiterates, which has not been accompanied by a fall in income inequality

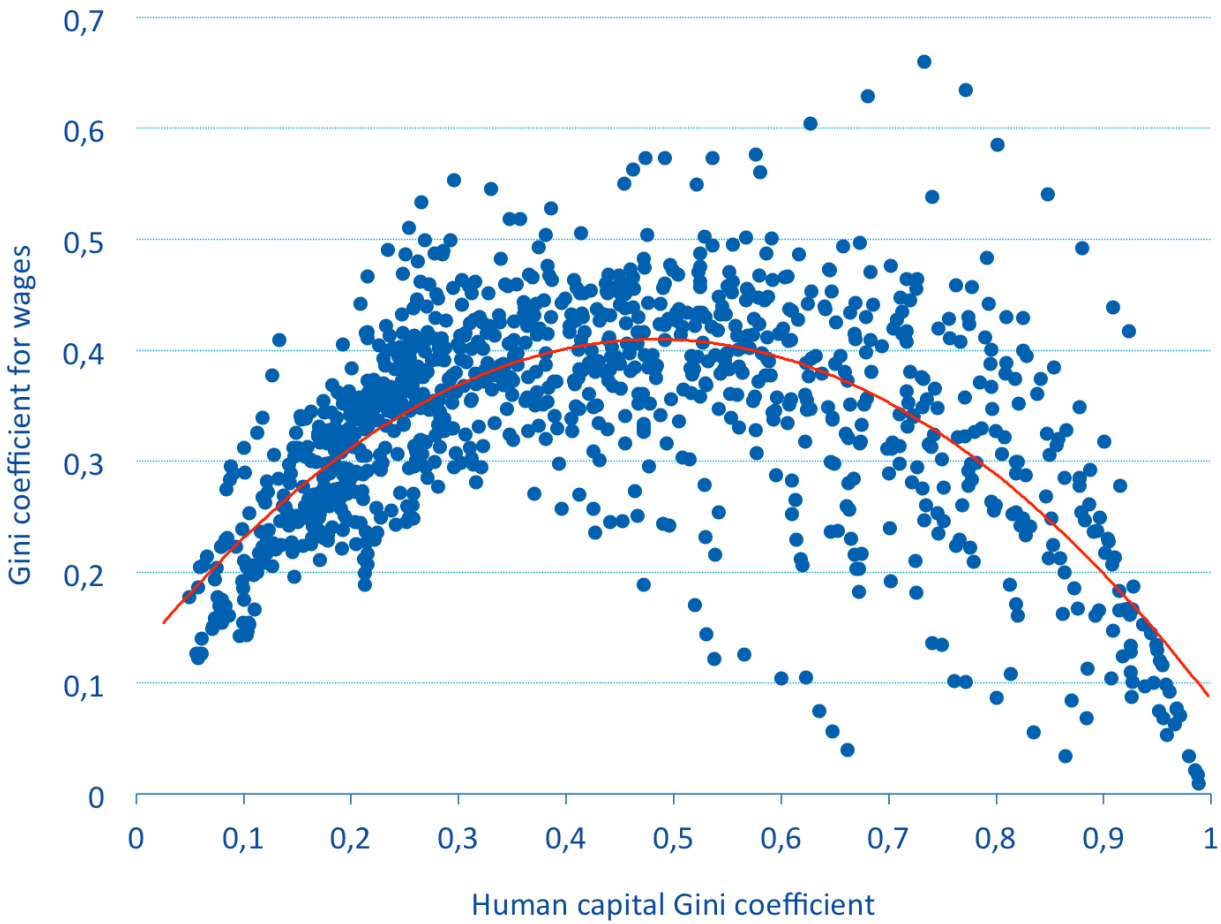
Wage inequality in dual economies

- Using the rates of return to years of schooling for 139 countries since the late 1950s estimated by Montenegro and Patrinos (2014), we compute wages for each level of education as:

$$
\begin{aligned}
\ln w_{NS,i} &= \alpha_i \\
\ln w_{IP,i} &= \alpha_i + 3r_{P,i} \\
\ln w_{CP,i} &= \alpha_i + 6r_{P,i} \\
\ln w_{IS,i} &= \ln w_{CP,i} + 3r_{S,i} \\
\ln w_{CS,i} &= \ln w_{CP,i} + 6r_{S,i} \\
\ln w_{IT,i} &= \ln w_{CS,i} + 2r_{T,i} \\
\ln w_{CT,i} &= \ln w_{CS,i} + 4r_{T,i}
\end{aligned}
$$

Wage inequality in dual economies

Gini coefficients for human capital and simulated wages, 139 countries, 1950-2010

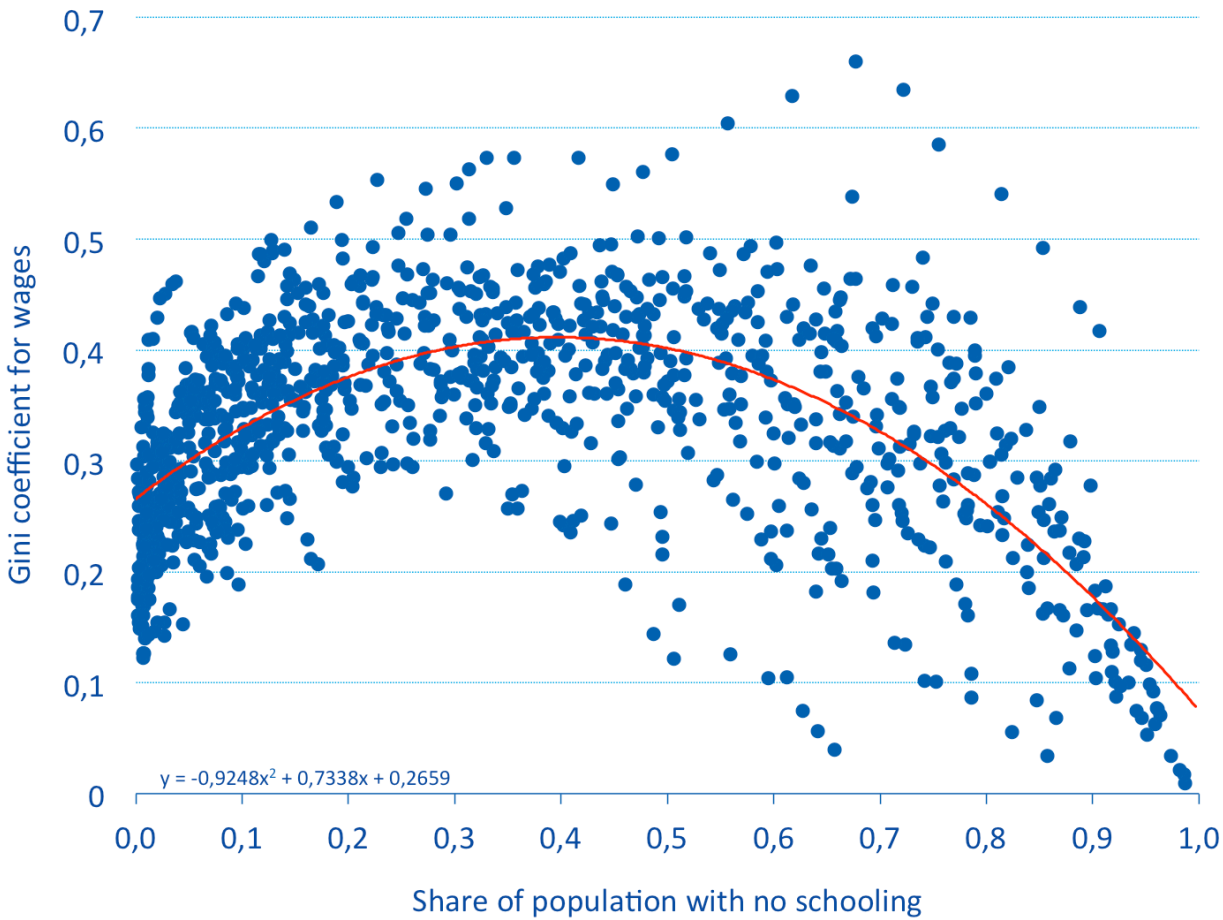


Wage inequality in dual economies

- A clear U-inverted relationship between the two Gini coefficients for 139 countries from 1950 to 2010, in a 5-year span.
- Main explanation: composition effect of the share of population with no schooling. In most countries the fall in the human capital Gini coefficient is explained by the fall of n_0
- The effect of the fall of n_0 on the Gini coefficient for wages is non linear by the same reason that Robinson (1976), Knight (1976), Knight and Sabot (1983), Anand and Kanbur (1993) or Fields (1993) have demonstrated
- In an economy with two-groups of population, a transfer of workers from the low to the high-education group raises the inequality of wages until the high-education group reaches a certain share.
- As in Anand and Kanbur (1993), the Gini coefficient for wages starts at zero when $n_0 = 1$, reaches an interior maximum and would fall to the Gini coefficient for the six groups with some education (with an average equal to 0.266) when $n_0 = 0$

Wage inequality in dual economies

Share of population with no schooling and Gini coefficient for simulated wages, 139 countries, 1950-2010



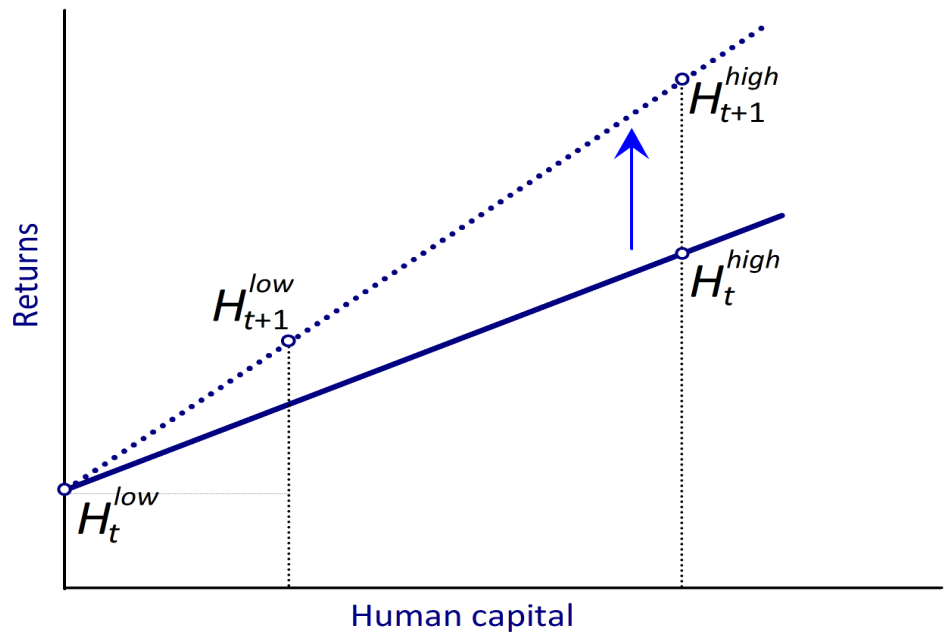
Wage inequality in dual economies

- Our results are similar to Lim and Tang (2008) from 1960 to 2000 (using seven levels of education from Barro and Lee, 2001, and the same world averages of social rates of returns for all 99 countries, taken from Psacharopoulos and Patrinos, 2004
- We have corroborated the inverted U-shape curve, but with a significantly higher level of average schooling years: 5.5 instead of the 4.2 years estimated by Lim and Tang (2008)
- Morrison and Murtin (2013) have also obtained a human capital Kuznets curve for 32 macro-countries over the period 1870--2010, imposing homogeneity of returns across countries and using only four levels of education.
- The increase of inequality is a transitory effect of a economic development process that is good in absolute income terms and that is reverted as n_0 falls sufficiently enough and more people is educated, completing at least primary schooling.

Sensitivity to SBTC and increasing returns

Intuition: Skill-biased technological changes may also have relevant distributional effects

Skill-biased technological change and human capital



Sensitivity to SBTC and increasing returns

- Canonical model of the race between education and technological change (e.g. Katz and Murphy, 1992; Card and Lemieux, 2001; Acemoglu and Autor, 2012):

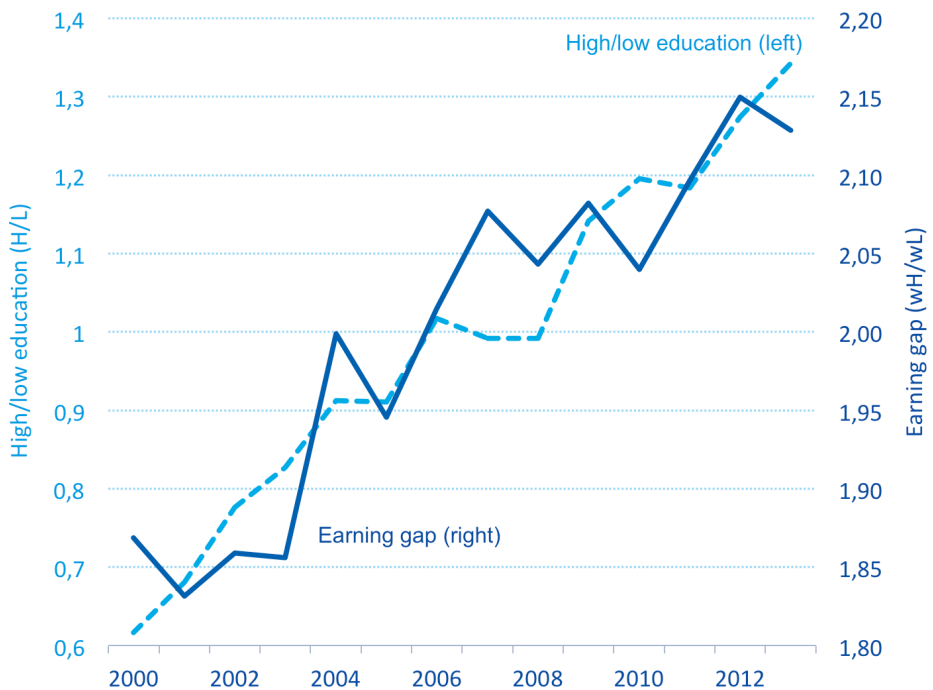
$$\ln \frac{w_{H_{it}}}{w_{L_{it}}} = \frac{\sigma - 1}{\sigma}\gamma_0 + \frac{\sigma - 1}{\sigma}\gamma_1 t - \frac{1}{\sigma}\ln \frac{H_{it}}{L_{it}}$$

- The evidence confirms that wages at the top are increasing due to skill-biased technological change

Sensitivity to SBTC and increasing returns

Evidence for a sample of 33 countries (from OECD EAG, with some emerging economies) shows that wages at the top (w_H) and at the bottom (w_L) have diverged despite the increase of H/L:

Wage gap and relative supply. OECD EAG average, 2000-2013



Sensitivity to SBTC and increasing returns

Table 4. Dependent Variable: $\ln \frac{w_H}{w_L}$

	(1)	(2)	(3)	(4)
$\ln \frac{H}{L}$	-0.117^a	-0.097^a	-0.154^a	-0.106^a
t	0.017^a	0.005^c	0.023^a	0.006^b
$\ln \frac{X^{high}}{X}$			0.105^a	0.036^a
R^2	0.155	0.324	0.211	0.337
Obs.	293	501	291	497
N	33	55	33	55

Notes: Regression from 2000 to 2013 with robust errors. a, b and c are 1, 5, and 10 percent significance levels.

Sensitivity to SBTC and increasing returns

- We have simulated to what extent the U-inverted relationship between the share of population with no schooling and the Gini coefficient for simulated wages is affected by the type of returns
- The shares of population for the different levels of education with some schooling (n_i, $i = 1, \ldots, 6$) have been simulated according to the fitted value obtained from regressing n_i on a quadratic function of $(1 - n_0)$:

$$\widehat{n}_i = \widehat{\alpha}_i(1 - n_0) + \widehat{\beta}_i(1 - n_0)^2$$

- Education returns vary from decreasing ($\overline{r_P} = 0.10$, $\overline{r_S} = \overline{r_P} - 0.05/2$, and $\overline{r_T} = \overline{r_P} - 0.05$) to increasing ($\overline{r_P} = 0.10$, $\overline{r_S} = r_P\text{`} + 0.05/2$, and $\overline{r_T} = \overline{r_P} + 0.05$).

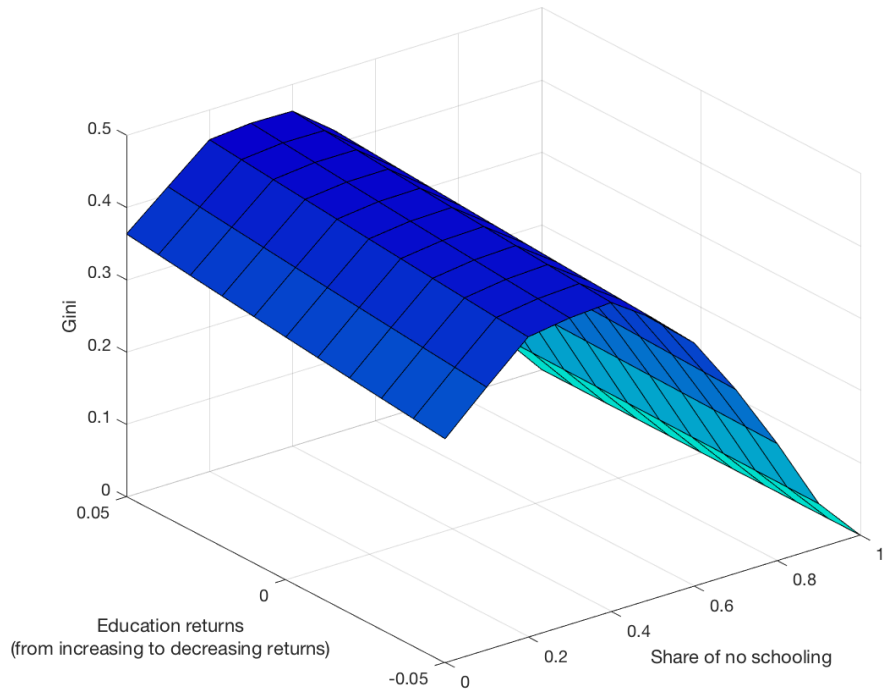
Sensitivity to SBTC and increasing returns

Three main results:

- The type of returns to years of schooling does not affect the inverted U-shape, which is dominated by the composition effects driven by n_0
- Increasing returns augments inequality, particularly when n_0 is equal to zero: $G(W^s)$ increases from 0.309 to 0.363. The effects of increasing returns to education on inequality are greater in advanced economies than in developing countries
- Going from decreasing to increasing returns reduces slightly the value of n_0 for which $G(W^s)$ reaches its maximum level

Sensitivity to SBTC and increasing returns

Sensitivity of $G(W^s)$ to changes in n_0 and the type of returns to years of schooling



Simulated wages and income inequality

- We complete the analysis with estimates of the contribution of the simulated wages inequality to total income inequality
- Some methods (see, for example, Cowell and Fiorio, 2011, Shorrocks, 1982, or Fields, 2003) compute the contribution of a particular component Y_j of income, factor or subgroup of population to income inequality $I(Y)$ according to a weight (s_j) such that

$$S_j = s_j I(Y)$$

and

$$\sum_j s_j = 1$$

- We use the alternative approach proposed by Fei, Ranis, and Kuo (1978) and Pyatt, Chen, and Fei (1980)

Simulated wages and income inequality

- In particular, the Gini coefficient of total income can be decomposed as:

$$G(Y) = \sum_j \phi_j R_j G(Y_j) \tag{4}$$

where $G(Y_j)$ is the Gini coefficient of income source Y_j, ϕ_j is the share of income from factor j in total income and R_j is the rank correlation ratio:

$$R_j = \frac{Cov(Y_j, F_y)}{Cov(Y_j, F_j)}$$

that is, the correlation coefficient between Y_j and the ranking of Y,where F_j and F_Y are the cumulative distribution of Y_j and Y respectively.

Simulated wages and income inequality

- In our case, there are two limitations in the implementation of this approach
  - We use simulated wages (W^s) instead than true wages (W):

$$W^s_{it} = W_{it} + \varepsilon_{it}$$

    where ε is a measurement error,
  - Both ϕ_j and R_j vary across countries (i) and years (t).
- Taking into account these limitation, we estimate the following approximation to the exact decomposition:

$$G(Y_{it}) = \alpha + \beta_t G(W^s_{it}) + \lambda_t G(W^s_{it}) \ln y_{it} + \delta_t + u_{it} \quad (5)$$

assuming that

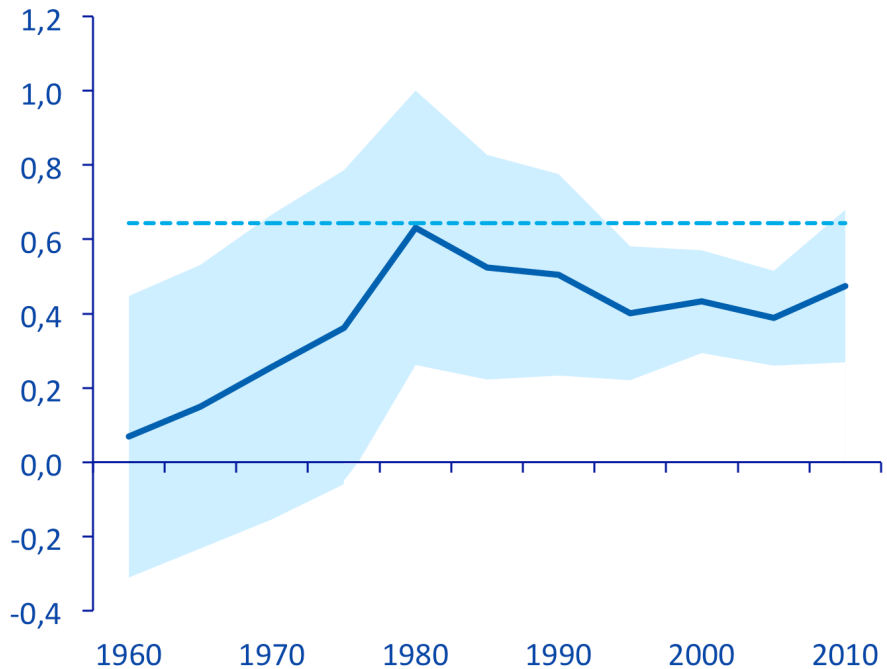
$$\phi_{wit} R_{wit} \simeq \beta_t + \lambda_t \ln y_{it} \quad (6)$$

Simulated wages and income inequality

- Assuming first that $\lambda_t = 0$, we estimate that β_t is statistically significant from 1980 onward and stable, with an average equal to 0.48, slightly below 0.64 in the sample of 23 countries of Deutsch and Silber (2004)
- In column (1) of Table 5 we allow for time dummies (δ_t) but we impose that β is the same for the whole sample. We estimate $\beta = 0.402$
- In column (2) we assume that $\lambda = 0.159$, as in Deutsch and Silber (2004). In this case β goes up to 0.582 on average (approaching to 1.0 (0.2) in high (low) income countries)
- In column (3) we add lny_{it} and lny_{it}^2
- Columns (4) to (6) assume that the rates of returns are constant over time, homogeneous across countries and the same for all education levels (0.1)
- The results corroborate that the Gini coefficient of simulated wages has a significant and relevant effect on income inequality

Simulated wages and income inequality

Estimated contribution of $G(W^s)$ to income inequality



Notes:Confidence interval at 95

Sensitivity to SBTC and increasing returns

Table 5

Dependent variable: income inequality $G(Y)$

	(1)	(2)	(3)	(4)	(5)	(6)
$G(W^s)$	0.402^a	0.582^a	0.216^a	0.420^a	0.608^a	0.219^a
$\ln yG(W^s)$		0.159^r	0.159^r		0.159^r	0.159^r
$\ln y$			0.188^a			0.151^a
$(\ln y)^2$			-0.015^a			-0.014^a
R^2	0.122	0.175	0.540	0.097	0.108	0.648
Obs.	652	627	627	1042	990	990
δ_t	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*

Notes: OLS regression with robust standard errors and t-ratios in parenthesis. a is significant at 1 per cent level and r a restricted (calibrated) coefficient. Regressions from 1960 to 2010 in a 5-year span.

Conclusions

- This paper have computed and analysed trends in human capital inequality from 1950 to 2010 using an improved data set on human capital
- The evidence shows that most countries have experienced a very significant drop in human capital inequality, mainly due to an unprecedented decrease in the share of illiterates, which has not been accompanied by a similar reduction of income inequality
- Increasing literacy is not a sufficient condition to reduce income inequality

Conclusions

- A clear U-inverted relationship between the Gini coefficient of years of schooling and of simulated wages for 139 countries from 1950 to 2010, in line with Lim and Tang (2008) and Morrison and Murtin (2013)
- We find a composition effect consistent to Robinson (1976), Knight (1976), Knight and Sabot (1983), Anand and Kanbur (1993) and Fields (1993): a transfer of workers from the low to the high-education group raises the inequality of wages until the high-education group reaches a certain share
- Maximum Gini coefficient for wages reached when $n_0 = 0.4$: to reduce inequality countries should ensure that all population has completed at least primary schooling (6 years on average)
- Returns to years of schooling do not affect the inverted U-shape. Increasing returns augments inequality, particularly when $n_0 = 0$ (advanced economies)
- The estimated average contribution of wage inequality to income inequality is statistically significant, relatively stable and economically relevant: approximately each point of change in the Gini coefficient of wages contribute to half a point in the change of the Gini coefficient for income.

Conclusions

- The evidence presented in this paper is relevant for development policies
- Our evidence does not imply that educational policies have not reduced poverty and improved wages and the standards of living of hundreds of millions with better education
- On the contrary, eradication of illiteracy and completing primary schooling are necessary conditions to ensure a simultaneous improvement of per capita income and inequality
- Better education is crucial to increase average earnings per worker, to avoid the effects of skill-biased technological progress and globalization and to offset other driving forces that may contribute to greater income inequality.