Education Inequalities and the Kuznets Curves: 
A Global Perspective Since 1870*

Christian Morrissone - Fabrice Murtin†

March 13, 2007

Abstract

This paper presents a new dataset on educational attainment (primary, secondary and tertiary schooling) at the world level since 1870. Inequality in years of schooling is found to be rapidly decreasing, but we show that this result is completely driven by the decline in illiteracy. Then, we turn to inequality in human capital and focus on a Mincerian production function that accounts for diminishing returns to schooling. It explains the negative cross-country correlation between Mincer returns to schooling and average schooling contrary to other functional forms. As a result, we show that human capital inequality within countries exhibits an inverted U-shaped curve, namely a “Kuznets curve of education”. Next, we analyse the relationships between the national distributions of income and schooling. We find that the usual Kuznets curve of income inequality is significant both in pooled and fixed-effects regressions over the period 1870-2000, and is robust to the inclusion of other variables in the regression such as schooling and human capital inequality. However, the “Kuznets effect” associated to GDP per capita is 4 times smaller in magnitude than the externality of average schooling favouring the decrease of income inequality within countries since 1870.

JEL classification: D31, E27, F02, N00, O40.

Keywords: Inequality, human capital, economic history, Kuznets curve.

*We thank François Bourguignon for substantial improvements of the original paper. We would also like to acknowledge Daniel Cohen and Marcelo Soto for their data and insightful comments, Ximena del Carpio and Francisco Ferreira for their help with World Bank data. We are grateful for discussions with Anthony Atkinson, Jean-Claude Berthélémy, Marc Gurgand, Stephan Klasen, Francis Kramarz, Steve Pischke, John Van Reenen, as well as seminar participants at EUDN Paris conference, CREST, CSAE Oxford conference, LSE, and PSE.

†Morrison: Université Paris I ; address: 36 Chemin Desvallières, 92410 Ville d’Avray, France. Murtin (corresponding author): LSE, London, PSE (joint research unit CNRS-ENS-EHESS-ENPC) and CREST (INSEE), Paris; e-mail: fabrice_murtin@hotmail.com, address: 12 rue Godefroy, 75013 Paris, France.
1 Introduction

Education is recognized to be a key factor of economic development, not only giving access to technological progress as emphasized by the Schumpeterian growth theory, but also entailing numerous social externalities on long-term outcomes such as health improvement or political participation, that shape in turn the extent of redistributive policies. If the evolution of world distributions of income and longevity over the last two centuries have been described by François Bourguignon and Christian Morrisson (2002), changes in the world education distribution have remained unexplored until now, despite their major importance.

What has been education inequality at the world level over the twentieth century? How does it compare with income inequality? Up to now, the various studies on education inequality have had limited spatial coverage and time period. For example, Amparo Castello and Rafael Domenech (2002), Vinod Thomas et al. (2001) provide a descriptive analysis of years of schooling inequality for a broad panel of countries but only since 1960. Also, they remain at the country level and do not consider the world distribution of years of schooling, which takes into account educational differences both within and between countries.

In contrast, this paper depicts the world distribution of education over 130 years, on the basis of an original world dataset for years of schooling since 1870. It was not possible to elaborate longer series because we need enrolment series since 1820-1830 in order to estimate the average years of schooling in 1870. Even in Western European countries and the US there is no data before that date. This dataset allows us to infer the distribution of years of schooling sum up by four quantiles in each country, and to describe the average stocks of primary, secondary and tertiary schooling by region over more than a century. Then we estimate the world inequality in years of schooling, which has been dramatically reduced since 1870.

This paper also raises an important methodological issue on the measurement of education inequality. We show that a very large part of inequality in years of schooling has been mechanically explained between 1870 and 2000 by a single component of the education distribution, which is the population that has not attended school, subsequently called the illiterate population. Thus, the observed decrease of inequality in years of schooling over the century only captures the decline of illiteracy. We believe that this result, derived both theoretically and empirically, could be helpful to reconsider an empirical fact discussed in the literature on education inequality, which is the cross-countries negative correlation between average schooling and education inequality. This correlation is shown here to be spuriously driven by the mechanical correlation between average schooling and illiteracy.

Following the recent macroeconomic literature, we then turn to human capital as defined by Mincer because it is more pertinent than years of schooling for comparing education and income inequalities. We propose estimates of the world inequality in human capital, following a definition of human capital that accounts for the existence of diminishing returns to schooling. The functional form we retain is able to explain

---

1 individuals with no schooling, with only primary schooling, with primary and secondary schooling, and those having received higher education.
the negative cross-country correlation between Mincer returns to schooling and average educational attainment, contrary to any other functional form. Thus we believe that our definition of human capital is appropriate.

As a result, we find that world human capital inequality follows a clear-cut inverted-U curve with respect to schooling average attainment, what we call the “Kuznets curve of education”. Theoretically, we examine how this pattern could affect the variations of income inequality within countries. We find that the usual unconditional Kuznets hypothesis for income inequality is valid over the period 1870-2000, even after controlling for countries’ unobserved heterogeneity. This finding is robust to the inclusion of human capital inequality and a quadratic in schooling within the regressions. The quadratic in schooling turns out to be significant, suggesting that there are positive but marginally decreasing externalities of average schooling favouring the reduction of income inequality within countries over that period. Importantly, the magnitude of this externality is about for times higher in terms of variations in inequality than the effect associated to GDP per capita, the “Kuznets effect”.

In section 2 we present the methodology and the data. Section 3 concerns the overall distribution of world education since 1870. Section 4 focuses on inequality in education. Section 5 presents the functional forms tested for human capital, while the subsequent section exhibits the “Kuznets curve of education” and its relationship with income inequality. Last section concludes.

2 Methodology and data

We applied the same methodology as François Bourguignon and Christian Morrisson (2002), using 33 macro-regions or large countries for the sake of simplicity, as well as for comparability purposes with income inequality results. Before estimating average years of schooling, we updated the figures on GDP per capita and population, adding 2000 and using the last estimates of Angus Maddison (2003). For education, estimates of the mean number of years of schooling were assembled for 91 countries from 1870 to 2000, then averaged to build an educational attainment dataset for the 33 macro-countries. Each country or country group represents at least 1 per cent of world population or world GDP in 1950. All countries which are important are considered individually. To allow a simpler analysis, these countries or country groups were aggregated into 8 blocks, defined geographically, historically or economically: Africa, China, South Asia (composed of Bangladesh, Burma, India and Pakistan), other Asian countries excluding Japan, Korea and Taiwan, these 3 countries, Latin America excluding Argentina and Chile, Eastern Europe (which include all the countries of the ex-USSR), Western Europe (including Austria, Hungary and Czechoslovakia) and its offshoots in America (Canada, US, Argentine, Chile) and in the Pacific.

More precisely we associated two datasets, the first for 1870-1960 being a new one whereas the second (1960-2000) is given by Daniel Cohen and Marcelo Soto (2001).

\footnote{Our sample of countries represents more than 95% of the world population all over the period. Missing countries have been assumed to have the same educational level as the macro-country they belong to.}

\footnote{Eight countries not available in this dataset were taken from Robert J. Barro and Jong-Wha Lee (2001).}
It is impossible to estimate the years of schooling before 1870 because one needs enrolment data 50 years before in order to obtain the school attainment of the population aged between 15 and 65 years.

In Western European countries statistics of school enrolment are available since 1820-40 in Brian R. Mitchell (2003 a-b-c), but in other countries we cannot find any statistics before the end of the 19th century. For the less developed countries, the series concerning enrolment begin often in 1920 or later. In these countries we have assumed a steady growth of the enrolment rate starting from a minimum which is very low in 1820 (1 or 0.1%). We argue that is assumption is nevertheless innocuous with respect to the stock of average schooling, because the first observed enrolment rates are most of the time very low (typically under 1%). The absolute error on stocks of years of schooling will therefore be very low, without any significant incidence on the world education distribution. For more developed countries observations begin much earlier in time: as a whole, we can consider that in 1900 measurement errors due to initial condition assumptions are quite low.

We compute the average number of primary, secondary and tertiary years of schooling by inferring the enrolment rates for each cohort of age at each date. This is made possible because the series from Brian R. Mitchell (2003 a-b-c) provide the number of children in primary, secondary and tertiary schools as well as population by age. Usually age pyramids were available each ten years and missing data has been interpolated. To achieve the computation we also needed some information on schooling’s duration, dropout and repetition rates. While we used Unesco (2006) data for the two latter variables, completed primary and secondary were both assumed to last a maximum of six years\(^4\), while tertiary was assumed to last a maximum of four years. This insures comparability across time and countries of education distributions, in spite of the many worldwide reforms of schooling systems over the period.

In a companion appendix we describe in details the procedure used to infer average years of schooling in primary, secondary and higher education. We also provide a robustness analysis with respect to the underlying assumptions on repetition and dropout rates, maximal schooling durations, and initial enrolment rate, showing that they have quite a limited effect on the stocks of years of schooling.

These stocks are equal to the number of pupils having attended each grade multiplied by the amount of time they have done so. To infer the distribution of schooling, we need some additional information on either the number of pupils, or the mean durations. We observe the mean durations in primary, secondary and higher education in 2000 from Unesco (2006), and we have calibrated the corresponding values in 1870 with the help of a second database on illiteracy rates based on Unesco (1957) and specific historical studies\(^5\). Given the calculated stocks \(H_{P,S,H}\) of primary, secondary and

\(^4\)This assumption is a rough estimate that we can use because there is no detailed information on the lengths of primary and secondary schooling in each country from 1870 to 2000. The length varies according to the country and the period. For example in present day France the respective lengths are 5 (primary) and 7 (secondary); but until 1950, the two lengths were equal (the pupils engaged in secondary schooling left primary school after 5 years, but the others who represented a large majority remained in primary school 7 years).

\(^5\)We have retained seven groups of durations ranging from three years in primary and secondary for low-developed countries up to more than 5 years for Western Europe countries. The first level corresponds to a 20% annual dropout rate, the last to a rate of 2.5%. Importantly, these figures provide us with a correlation
tertiary schooling and their respective mean durations $h^{P,S,H}$, we can infer the percentage $p^P$ of the population displaying only primary schooling, the percentage $p^S$ of the population displaying primary and secondary schooling, the percentage $p^H$ of the population displaying primary, secondary and tertiary schooling, and the complementary part, the percentage $p^I$ of the population that has not attended school. In what follows we will denote the latter group as the "Illiterates", even if this definition could be ambiguous (literacy could require more than a few years of primary schooling and some individuals who have not attended schools could be literate). These percentages are given by

$$
\begin{align*}
H^P &= h^P p^P + 6 (p^S + p^H) \\
H^S &= h^S p^S + 6 p^H \\
H^H &= h^H p^H \\
p^P + p^S + p^H + p^I &= 1
\end{align*}
$$

Inequality indices are computed on the distribution of these 4 groups x 33 countries = 132 groups. All the groups are pooled and ranked according to the number of years of education and then the cumulative function and Lorenz curve of the world distribution of education is computed. We assumed no heterogeneity in years of schooling inside each group.

### 3 Trends in World Educational Achievement since 1870

Table 1 presents the distribution of years of schooling at the world level since 1870. In the mid twentieth century, the world is divided into two classes: those who have attended school, and those who have not. Over the whole period Figure 1 clearly shows a huge reversal: illiterates and educated individuals are in reverse proportions in 1870 and in 2000, around three to one. What explains this result is clearly the development of primary schooling, which attendance was 20% of the world population in 1870 and 75% in 2000. Moreover, 35% of the world population attended secondary education in 2000, but this development is quite recent since this proportion was only 15% in 1960. In a sense, higher education is today the exact equivalent of secondary schooling in 1960: 8% of the world population attained higher education in 2000, which means a third of that displaying only secondary education, while in 1960 the latter group represented 12% of the world population and a third of the population with only primary schooling. Last, the overall level of schooling has been multiplied by 6.7, this increase being inequally spread over the period: plus 3 average years of schooling between 1870 and 1960, and the same amount over the last forty years. Schooling attainment in fact accelerated after 1950, with a constant increase of 0.7 years every ten years.

Of more than 97% between our historical illiteracy rates and those deriving from subsequent formulas (1). Between 1870 and 2000 durations have been interpolated linearly, while an analysis provided in appendix suggests that other scenario of duration’s growth entail very minor changes.

As the number of grades used to describe the schooling distribution could influence the resulting inequality levels, we show in annex some results based on a smoothed schooling distribution. The main conclusions of the paper remain the same.
How this global increase has been distributed across countries? Table 2 provides a geographical overview of education attainment, with the average schooling by region: its total, its distribution in primary and secondary schooling, the difference being equal to the stock of higher education, as well as illiteracy rates. We observe three distinct groups in 1870: the highest with Western Europe and offshoots, which exceeds 3 years; an intermediary one with Latin America, Eastern Europe, Japan, Korea, Taiwan and China; the lowest, with less than 0.25 years, in Africa, South Asia and other Asian countries. The illiteracy rate is around 37% in the first group, 80% in the second one, and 95% in the third one. So there is a huge gap between Western Europe and the third group. An important point is the advance of China and Japan with respect to other Asian countries, including the India empire, and Africa. In those two countries average schooling was about one year (education was higher in Japan than in Korea and Taiwan); in fact this means that around 35% of men and 5% of women could read and write 1500 graphic signs, which demands about 3 or 4 years of schooling. A small minority knew several thousand signs after 6 or 8 years of schooling. As the average schooling in China and Japan was approximatively the same at the beginning of the eighteenth century, these countries were the only ones in the world which had the same average schooling than Western Europe three centuries ago.

In 2000, the third group is only composed of Africa and South Asia, because the average schooling in other Asian countries has increased much more than in India. The schooling is 4 years in this group instead of 11 years in Western Europe and the ratio has been reduced from 1:30 to 1:3, although absolute differences in average schooling have increased from 3 years up to 7 years. Moreover, Japan, Korea and Taiwan have caught up with Western Europe, as well as Eastern Europe to a lesser extent. In the intermediate group, we find Latin America, China, and other Asian countries who have caught up as well, with an average schooling around 6.6 years. The differences between Western Europe and this group are about four average years of schooling, consisting of one year of primary schooling, two and a half years of secondary schooling, and a half year of higher education. Figure 2 illustrates clearly the process at work: it is striking that mean absolute differences between groups have remained the same in the postwar period.

Illiteracy, which was the rule in 1870 with rates exceeding 80% everywhere except in Western Europe, is now a regional problem. It remains important only in Africa, more precisely in Sub-Saharan Africa, and South Asia (including India, Bangladesh, Burma and Pakistan) with rates around 45%.

In 2000, there is about a two years gap of secondary schooling between the leading group and the rest of the world. This fact is unexpected because we observe today the expansion of secondary schooling everywhere. But the average secondary schooling in 2000 depends on enrolment rates since 1950, so that one should not forget the low rates in the 1950s and the 1960s. Until 1980, secondary schooling was lower than 1 year everywhere except in the first group. From the early nineteenth century up to 1980, the differences in primary schooling have induced the main regional inequalities in schooling. But in the next years, the expansion of secondary schooling will become the key factor.

The decomposition of world population into 8 blocks is helpful to understand the changes in the world distribution of education since 1870. Table 3 shows the compo-
sition of 3 quantiles: the bottom 80%, the 9th and 10th deciles between the 8 blocks, the first line giving the population distribution. The main factors which explain the variations from one year to the other are the different rates of growth of average education and of population (the shares in world population of Latin America and Africa respectively, have been multiplied by 3 and 2 between 1870 and 2000, whereas the shares of Western Europe and Eastern Europe have decreased).

The two opposite blocks are Western Europe and Africa. In 1870, Western Europe and its offshoots had an edge on the rest of the world, which remained about the same until 1910. At that time the share of Western Europe in the top decile reached almost 60%. It was equivalent to the share of the same region in the top income decile, 64%. If we consider that secondary schooling is the condition of access to technology, in 1910, Western Europe had in some respect the quasi-monopoly of advance in knowledge and technology. Today this monopoly has disappeared. The share of Western Europe in the top decile is only 30%, less than the share of Asia, excluding Japan, Korea and Taiwan. If we include these 3 countries, the share of Asia reaches 42%. Extrapolating these trends, we can foresee that in a few years Asia will attain 50% and Western Europe less than 25%, which will entail important consequences in the world distribution of scientific and technological supremacy.\(^7\)

The African case is a counter-example. First, it is today the poorest region in the world, but this handicap is not new. In 1870, the share of Africa in the top decile was about 1%. Here is the legacy of the past: at the beginning of the 19th century nearly all African populations were illiterate, except the Arab population in the north of Africa, while in Asia nearly 40% of Chinese and Japanese men could read and write. Even if the situation remains unfavourable, Africa is slowly catching up with the rest of the world. We must remember the situation in the 19th century in order to understand better its current lag.

Of course the success story of world education is Japan, Korea and Taiwan. If we take into account the population effect, the share of these countries in the top decile was more or less similar to the share of Eastern Europe in 1870. In 2000, they are the same as Western Europe’s share. It is the only group of countries which has caught up completely with Western Europe. The situation of Latin America and Eastern Europe, given the population effect, has improved, particularly in Eastern Europe, but the gap with Western Europe has not disappeared.

4 Inequality in years of schooling

This section provides a first-step analysis of inequality in education around the world, where education is measured by the number of years of schooling. How much is inequality in years of schooling？

Table 4 reports the evolution of inequality in years of schooling for the coefficient

\(^7\)Moreover there is a significant contrast between the share of Western Europe in income top decile and education top decile. The income share is around 65%, the same than in 1910, whereas the education share is around 30% after a large decrease since 1910. So Western Europe has kept an important advantage in world income distribution in spite of losing its supremacy in education.
of variation, the Gini and the Theil indices\(^8\), and also recalls the inequality in income. We did not report the standard errors for the sake of clarity, but we did compute them by introducing a measurement error on stocks of schooling. The variance of these noises was calibrated so that the width of any stocks’ confidence interval amounts to 10% of stock’s value. The resulting standard errors on inequality levels were found to be small, never exceeding 7% of their value over the period. As a result, Table 4 shows an exceptional inequality in 1870 with a Gini coefficient reaching 0.82 and a Theil index of 1.61. The world in 1870 was characterized by a huge gap between the literate and illiterate populations which is unimaginable today. However throughout the period, years of schooling inequality has decreased steadily so that the Gini coefficient has decreased by 50%, and the Theil index is less than a quarter of what it was.

It is meaningful to draw a comparison between illiteracy rate and extreme poverty (less than 1 dollar a day). The illiteracy rate has decreased since 1870 from 79% to 24% and extreme poverty from 66% to 16%. Therefore, the evolutions of these two essential indicators, namely the percentages of people who don’t have any access to an education or to a minimum income are parallel and they show an improvement, which has never happened before in mankind history.

The decomposition of education inequality into two components is instructive: the within component of schooling inequality has decreased much more than the within component of income inequality: less 72% instead of less 12% for the Theil index. Moreover the between component has fallen rapidly: the Theil index in 2000 was only 0.08 instead of 0.56 in 1870. For the period 1960-2000 estimates are given by World Bank (2005) but it does not take into account the weighting by population. Despite this difference, we observe a comparable decrease of the Theil Index: -60% (World Bank 2005), -78% (Table 4). In total inequality, the contribution of the between component plays only a marginal part: 21% in 2000 for the Theil index, a figure in agreement with the World Bank estimate (less than 20%). It is the exact opposite for income inequality between countries, which represents two thirds of total income inequality in 2000, while the gap between the poorest region, Africa, and Western Europe for average schooling is only 1 to 3, instead of 1 to 12 for average income. This fall of inequality between countries is the result of the extension of primary schooling in a large majority of countries (except in Pakistan, the north of rural India and several sub-saharian African countries where enrolment rates of girls are often much lower than those of boys).

However, computing inequality in years of schooling raises a couple of comments and critics, that we enumerate now. First, we observe opposite trends in income and years of schooling inequalities, as mentionned before. How to reconcile those trends, if not by reconsidering the relevance of years of schooling as the appropriate educational productive factor ?

Second, inequality indices might be "excessively" sensitive with respect to individuals endowed with zero years of schooling\(^9\). As reported in Table 4, if we rule out the illiteracy group and compute a Gini index on educated individuals only, we will find a

\(^8\)The mean logarithmic deviation was not reported since it is only defined over strictly positive outcomes.

\(^9\)For instance, if we remember that the Gini index is twice the area situated below the Lorenz curve, then illiteracy will have a huge impact on this index by shifting away the origin of the curve from zero to the percentage of illiterates in the population.
Gini equal to 0.16 in 1870, 0.22 in 1960, and 0.23 in 2000. This is the exact opposite trend of inequality variations computed on the whole population, with inequality levels ranging from 20% to 50% of their original values when we include illiterates. It is somewhat disturbing that the bulk of inequality in years of schooling might only capture illiteracy, and variations of inequality only illiteracy decrease. Some authors such as Amparo Castello and Rafael Domenech (2002) or Jean-Claude Berthélemy (2005) have already pointed out the negative correlation between years of schooling inequality and average years of schooling, offering various explanations. The following proposition exhibits the mechanical link between illiteracy and years of schooling inequality. We present this proposition under its most general form since it will have applications in next sections as well.

**Proposition 1.** Let us call \( f \) the distribution of a random variable \( X \) taking values over a domain \([m, M]\) with \( 0 \leq m < +\infty \) and \( M \leq +\infty \). Assume that this distribution can be decomposed as the mixture

\[
f(x) = p\delta_{x=m} + (1-p)g(x)
\]

where \( \delta_{x=m} \) is a mass point in the minimum value and \( g \) the distribution of the population for which \( X > m \). We call \( \mu(f) \) the mean outcome for a distribution \( f \), \( G(f) \) the corresponding Gini index, and \( I_{GE}^\alpha(f) \) the Generalized-Entropy index. Then the Gini index decomposes into

\[
G(f) = p\frac{\mu(f) - m}{\mu(f)} + (1-p)\frac{\mu(f) - pm}{\mu(f)} G(g)
\]

and the Generalized-entropy indices \( I_{GE}^\alpha(f) \), for \( \alpha \neq 0 \)

\[
I_{GE}^\alpha(f) = (1-p)^{1-\alpha} \left( \frac{\mu(f) - pm}{\mu(f)} \right)^\alpha I_{GE}^\alpha(g) + \frac{1}{\alpha^2 - \alpha} \left( (1-p)^{1-\alpha} \left( \frac{\mu(f) - pm}{\mu(f)} \right)^\alpha + pm\alpha \mu(f)^{-\alpha} - 1 \right)
\]

**Proof.** see in annex

Regarding years of schooling we have \( m = 0 \), and the Gini index computed on the whole population is a linear combination of the illiteracy rate and the Gini index computed on the educated population. Formally \( G(f) = p + (1-p)G(g) \), and as a particular case, the Theil index decomposition is obtained when \( \alpha \to 1 \), so that \( \text{Theil}(f) = \text{Theil}(g) - \ln(1-p) \).

This shows that illiteracy variations explains almost all of years of schooling inequality variations over the period. Indeed, imagine that inequality in the educated population remains equal to 0.20, its grand mean all along the educational development process. According to the latter formula an illiteracy level of 79% should bring the Gini index for the whole population at a value of 0.83, while an illiteracy level of 24% would bring it at 0.39. These figures are extremely close to the current values of the Gini index calculated on the whole population (0.82 in 1870 and 0.41 in 2000),

\[10\text{the proposition is still valid for the Mean Logarithmic Index, i.e. when } \alpha = 0, \text{ if } m > 0.\]
which means that all of the decrease of the latter index between 1870 and 2000 is encompassed in illiteracy’s decline\textsuperscript{11}. This is important with respect to the literature on education inequality, that has often described and failed to interpret simply the cross-countries negative correlation between average schooling and education inequality: in fact, the latter only reflects the negative correlation between average schooling and illiteracy, which is mechanical.

Two other comments can be raised against the computation of inequality in years of schooling, and both have to do with the invariance properties of inequality indices. First, the between component of the Theil index, which is not subject to the illiteracy bias, might partly decrease because the Theil index is not invariant by translation contrary to the Gini index. Indeed, recall that the world evolution of schooling has been characterized, above all after 1940, by a translation of all average educational levels. Second, applying traditional inequality indices on years of schooling might be after all in contradiction with any invariance property (scale or translation), since the marginal cost of schooling increases as one comes closer to the highest grade, this comment being equally relevant for any upper bounded outcome, such as life expectancy\textsuperscript{12}. Therefore, the crucial issue in the measurement of inequality in education is certainly the search for an equivalence scale of years of schooling. This is what we propose now by focusing on human capital.

5 Inequality in Human Capital

5.1 Defining human capital

The macroeconomic literature has gradually moved away from considering average years of schooling as a factor of production, as in N. Gregory Mankiw et al. (1992), to focus on the Mincerian definition of human capital as proposed by Robert E. Hall and Charles I. Jones (1999). For an educational quantile $j$ in a country $i$ at date $t$ we have:

\[
h_{i,j,t} = e^{r_{i,j,t}S_{i,j,t}}
\]

where $S_{i,j,t}$ is average years of schooling of quantile $j$, $r_{i,j,t}$ the return to schooling, $h_{i,j,t}$ human capital.

As a first step, we believe that for the sake of simplicity it is useful to rule out any heterogeneity in the return to schooling across time, countries and quantiles. This will tell us how the exponential functional form modifies the results on years of schooling inequality. Thus, we first set $\forall i, j, t$, $r_{i,t} = r$, while considering an usual value for the return to schooling $r$: an average world return to schooling of 10% is selected following

\textsuperscript{11}Similarly for the Theil index, inequality computed on the educated population is small in comparison to the illiteracy component (less than 4% in 1870 up to one third in 2000). In any case, its variations over the period are negligible with respect to those of illiteracy: they represent 2.5% of it.

\textsuperscript{12}Derivation of an economic equivalent of years of schooling, such as educational public spending, might be an answer to this criticism. Unfortunately, there is a huge variance across countries and across time in the relative weight of primary, secondary and higher education in total educational spending, as well as in the latter volume measured as a percentage of GDP. Thus, computation of inequality indices in educational public transfers might not be an easy thing to do.
George Psacharopoulos and Harry A. Patrinos (2004), and inequality in human capital is computed.

As a second step, we would like to account for the following fact: international evidence shows that countries differ in the return to schooling, the poorest countries (Sub-Saharan Africa) exhibiting the highest returns to schooling (11.7%), while OECD average is 7.1%. Apparently, this suggests that returns to schooling decrease with economic development as a consequence of an enhanced supply of education\footnote{consequently, Robert E. Hall and Charles I. Jones (1999) as well as Francesco Caselli (2004) specify the return to schooling as a piece-wise linear decreasing function of average schooling in their analysis.}. But this implicitly means that the supply of education overcomes the demand for education on the long-term, either that the educational systems create too much knowledge relatively to existing productive technologies, or that technology is skill-remplacing. It is true that Claudia Goldin and Lawrence Katz (1999) show a decrease in the return to schooling in the US for the period 1914-1950. Indeed, in that period occurred a massive enrolment in secondary schooling with an inflexion point around 1930. But as depicted by the huge literature on skill-biased technological change, there has been an increase in the US return to schooling in the 80s following a slowdown of the increase in the supply of education. So we find unlikely the implicit assumption that returns to schooling decline because of a structural disequilibrium between supply and demand on the long-term. In practice, this means that returns to schooling should not be specified as decreasing functions of average schooling.

Instead, we argue that returns to schooling decline with the rise of average educational attainment because schooling has diminishing returns. As described extensively by George Psacharopoulos and Harry A. Patrinos (2004)\footnote{see Table 1 and 2 on returns to investments in education. As the latter include tuitions and taxes, they are slightly different from Mincer returns as emphasized by James J. Heckman et al. (2005), who point at the higher returns of some specific years of schooling such as graduation years. We could not include these refinements in our historical framework.}, the returns to schooling are higher for Primary schooling than for Secondary or Higher education, whatever the level of development and the geographical zone of the country. As a consequence, we follow Jacob Mincer (1974) and David Card (2001) among others and specify a quadratic function of schooling for each country $i$ at time $t$

$$\log y_{i,j,t} = a + \rho_{i,t}S_{i,j,t} - \frac{1}{2}k_{i,t}S_{i,j,t}^2 + u_{i,t}$$

where $y$ are earnings. Kevin Murphy and Gerry Welch (1992) show for the US that quadratic terms are significant and negative as expected\footnote{a quartic is even more appropriate.}. What about the rest of the world? For a schooling level $S_{i,j,t}$ the equation above entails a Mincer return to schooling equal to

$$r_{i,j,t} = \rho_{i,t} - k_{i,t}S_{i,j,t}$$

If the model is correct at the micro level - in particular if $k_{i,t}$ does not depend on $j$ - then in country $i$ at date $t$ the Mincer return to schooling is $\rho_{i,t} - k_{i,t}S_{i,t}$, with $S_{i,t}$ being average schooling. Estimates for the US suggest that $\rho_{i,t}$ is about 15% and $k_{i,t}$ about 0.3% on average. Matching the returns to schooling of 59 countries...
taken from George Psacharopoulos and Harry A. Patrinos (2004) with our data on average schooling attainment at corresponding dates, we estimated the following OLS regression:

\[ r_i = 0.1254 - 0.004 S_{i,t} + u_i \]

(0.0092) (0.001)

Those estimates are compatible with US estimates and suggest that most countries share the same characteristic of diminishing returns to schooling, with coefficients of the same magnitude. Figure 3 illustrates this telling result: from the shape of the scatterplot there is indeed no evidence of non-linearities. So our second and central definition of human capital is the following: given a schooling distribution \( S_{i,j,t} \) in country \( i \) at date \( t \), human capital of educational quantile \( j \) is equal to

\[ h_{i,j,t} = e^{0.1254 S_{i,j,t} - 0.002 S_{i,j,t}^2} \]

from which average human capital in country \( i \) can be deduced by averaging over quantiles. This definition has the drawback of necessitating the knowledge of the schooling distribution, and the advantage of being micro-funded and stable across countries.

We have to make the additional assumption that this relationship is constant over time. As we have discussed above, there have been periods during which technology was skill-replacing and others where it was skill-biased. Little knowledge is available on duration of those cycles. As a conservative assumption\(^\text{16}\), we assume that countries face technological shocks that are autocorrelated with a high degree of autocorrelation equal to 0.7. This value sets the half-life of a shock on return to schooling to a standard 20 years. So our third and last assumption on human capital of educational quantile \( S_{i,j,t} \) states that

\[ h_{i,j,t} = e^{0.1254 S_{i,j,t} - 0.002 S_{i,j,t}^2 + u_{i,t}} \]

\[ u_{i,t} = 0.7 u_{i,t-1} + 0.022 e_{i,t}, \quad e_{i,t} \sim \mathcal{N}(0, 1) \]

where the standard error of \( e_{i,t} \) is calibrated to match the variance of residuals from above regression. We draw a sequence of innovation for each country, compute human capital, and repeat this procedure to derive a bootstrapped confidence interval on human capital inequality. Those shocks are assumed to be idiosyncratic\(^\text{17}\).

Before showing the result in next subsection, let us mention that we have also examined another functional form commonly used in some theoretical studies\(^\text{18}\). This alternative form is the power function which states that for a quantile \( S_{i,j,t} \) human capital is equal to

\[ h_{i,j,t} = (\theta + S_{i,j,t})^{\alpha_{i,j,t}} \]

For comparability purposes with the Mincer function it is convenient to set \( \theta = 1 \) so that uneducated workers have one unit of human capital. This function has the nice property of naturally exhibiting diminishing returns to schooling equal to \( \alpha_{i,j,t}/(1 + \)

\(^{16}\)it is called conservative because it gives a plausible upper bound for human capital inequality, see below.

\(^{17}\)as noticed by Daron Acemoglu (2001), skill-biased technological change does not affect all countries similarly, particularly in Europe

\(^{18}\)e.g. Oded Galor and Omer Moav (2004), Matthias Doepke and David de la Croix (2003), Chales I. Jones (2006)
The problem with this functional form is that it entails a world distribution of returns to schooling that is not supported by the data. Common values of $\alpha$ provide either much too high returns on the right tail of the world distribution, or much too low on the left tail\(^{19}\).

### 5.2 Results

Table 5 provides estimates of human capital inequality for these three specifications ($r = 10\%$, diminishing returns with and without autocorrelated shocks)\(^{20}\). Let us mention the three main points we are going to focus on. First, the contrast between schooling inequality and human capital inequality is striking, since their trends appear to be opposite: human capital inequality increases, whereas inequality of schooling decreases in a large proportion. Second, the level of inequality is much lower: for instance in the first simulation the human capital Theil varies between 0.04 and 0.12 instead of 0.42 and 1.61 for schooling inequality. Third, there are few differences between the three definitions of human capital, though autocorrelated shocks logically increase human capital inequality.

As measured by the Theil index, human capital inequality has been multiplicated by respectively 3.5, 2.6 and 3.3. At first sight it could be counter-intuitive that inequality in human capital is increasing over time, while inequality in years of schooling is decreasing, and the return to schooling is kept constant in the first simulation, or is decreasing during the process of development in the second and third simulations. The interpretation is nevertheless straightforward: let us assume for illustrative purposes that schooling has a normal distribution with mean $m$ and coefficient of variation $s$\(^{21}\). Laplace transformation of a normal variable simply provides the coefficient of variation of human capital $h$ and a first-order approximation gives

$$s(h) = \sqrt{e^{r^2m^2s^2} - 1} \simeq rms$$

where $r$ stands for the return to schooling. Now it is clear that this coefficient of variation depends positively on inequality in years of schooling ($s$), positively on the return to education ($r$), and also positively on the average level of schooling ($m$). Due to the convexity of the exponential function, inequality in human capital increases across the century simply because countries become more educated in average. Moreover, this convexity effect overcomes the reduction in inequality entailed by decreasing returns to education and more equal distribution of years of education. Empirically, the average years of schooling has been multiplicated by 6.7 in 130 years, while the coefficient of variation of years of schooling has been divided by 2.6. The above formula entails

\(^{19}\)with $\alpha = 0.8$ the smallest equivalent Mincer return is the US with 5.5% and the highest is Bangladesh-Pakistan with 25.7%; with $\alpha = 1$ those values are respectively 6.8% and 31.5%. Most of the Mincer returns are smaller than 12% in Psacharopoulos and Patrinos (2004).

\(^{20}\)We did not report standard errors in the first two simulations. For the third simulation standard errors stem naturally from the Monte-Carlo framework. For the first two simulations we ran a simulation while introducing as before a measurement error on stocks of schooling, and as for years of schooling they were found to be small (not bigger than 3% of the inequality level).

\(^{21}\)In reality this distribution may rather be viewed as a mixture of normal distributions and a mass point in zero.
that inequality in human capital should have been multiplicited by 2.6 with constant returns, which is not not far from what we find in the first simulation given distributional patterns differences.

Although the Gini index of human capital inequality represents around 25% of income inequality over the period, there remains a question about the low levels of the Theil and MLD indices, which are about 6% of income inequality in 1870 and 12% in 2000. This stems from the fact that at any date, 95% of the world population has, relative to the world average, a human capital comprised between 0.5 (for the illiterates) and 2. Over this short segment, the dispersion is too small to generate high levels of inequality\(^{22}\). On the contrary, the income distribution is characterized by a wider domain over which the latter convexity approximations are no longer valid, since relative to the world average, income is comprised between 0.04 and 26.2.

What explains the differences between the three simulations? In the third simulation, there are large and persistent differences in the return to schooling. As a result, inequality in human capital is necessarily higher. On Figure 4, we reported the world human capital inequality according to the three simulations, as well the confidence interval that stems from the bootstrap experience. The evolutions diverge slightly in time, especially after 1970, but remain highly comparable and do not differ by more than half a standard error until 1970 and by one standard error in 2000.

What can be said about the impact of illiteracy on human capital? Intuitively, it might be much smaller since, if we consider the Gini index, the Lorenz curve should not be shifted away from the origin. We can use the former proposition in the particular case where \(m = 1\). Regarding human capital, the Gini index computed for the whole population is a linear combination of the illiteracy rate and the Gini index computed over the educated population. With former notations we have \(G(f) = G(g) + p[\mu(f) - 1 - G(g)(\mu(f) + 1 - p)] / \mu(f)\). This shows that the two Gini indices differ by a term which is equal in the first simulation to 0.009 in 1870 and 0.063 in 2000. Therefore the “excess sensitivity” of the Gini index with regard to illiteracy has disappeared, and the inequality indices now capture modifications from all parts of the human capital distributions. Considering the Theil index in the first two simulations, it is clear from Table 5 that inequality computed for the educated population represents at least 60% of total inequality, rather than 5% when considering years of schooling.

Until that point, the main results of the paper were to show, first, that inequality in years of schooling has declined dramatically because of illiteracy’s decline; that we can adopt a Mincer definition of human capital that explains the negative correlation between returns to schooling and average schooling across countries, providing that it exhibits diminishing returns; that the convexity effect associated to this definition dramatically modifies the results based on years of schooling, so that inequality in human capital has increased, but remains a low proportion of income inequality. For the rest of the paper, we would like to turn to the following question: what does our knowledge of the national distributions of education bring to the comprehension of the national distributions of income?

\(^{22}\)In fact, on this segment the mean of the log is almost equal to the log of the mean, so that \(MLD = \sum_i p_i \log \frac{h_i}{\bar{h}} \approx \log \left( \frac{\sum_i p_i h_i}{\bar{h}} \right) = 0\). The same idea applies for the Theil index.
6 The Kuznets Curves of Income and Human Capital Inequality since 1870

6.1 Description

What explains the global increase and decrease of income within inequality since 1870? If we refer to François Bourguignon and Christian Morrisson (2002), the surge of inequality within countries until 1910 is mostly concentrated in Western Europe and offshoots as well as in Eastern Europe. Then, a huge reduction in inequality took place in those geographical areas, as well as in China before the communist era and in India in a lesser extent. Factors explaining the decrease in inequality are the rise of redistribution and convergence of wealth across states in the most advanced areas, and half a century of economic stagnation in China and India. As it becomes evident on Figure 5, within inequality has gradually increased in Africa from 1930 and risen quickly in Latin America in the 60s. Over the last thirty years, inequality has increased within the most advanced countries, Eastern Europe, China and Africa.

Turning to human capital - second definition - in Figure 6, we find an overall increase of human capital inequality within countries since 1870, that has slowed down and been followed by a decrease in Western Europe from the 50s and in China from the 60s. In the remaining regions, inequality has stabilized from the 80s, which perhaps announces a global decrease in the forthcoming decades.

If Simon Kuznets’ (1955) hypothesis of an inverted U-shaped curve for income within inequality has been much discussed, what remained unknown until now is the existence of an inverted-U curve for human capital within inequality. Figure 7 plots both of them for the period 1870-2000. It is striking that the “Kuznets curve of human capital inequality” is so well defined and so clear-cut relatively to the Kuznets curve of income inequality. This is perhaps not surprising because many factors contribute to the differences across countries of the income distribution: human capital of course, but also age pyramids of the labour force, the extent of redistribution, macroeconomic shocks, and the historical path dependency in general. Daron Acemoglu et al. (2002) have precisely emphasized the importance of the legacy of the past in the building of institutions, that affect and are simultaneously the long-term product of the income distribution. In contrast, differences in human capital inequality only take into account differences in the distribution of schooling in Figure 7, which corresponds to the second definition of human capital. Figure 8 considers the third definition that includes autocorrelated shocks, which do not make any significant difference. To sum up, the existence of an educational Kuznets curve relies on the diminution of inequality in years of schooling within countries, on diminishing returns to schooling, and heterogeneity of returns to schooling does not perturbate this process.

Let us turn now to the key issue of the paper: what is the impact of education on the Kuznets curve? what is the link between income and human capital inequalities within countries? As shown by Figure 7, it is striking that the turning points of both curves are quite close, though that of the income inequality curve might come first. Indeed,

\footnote{Some macro-countries are the aggregation of several smaller countries, hence convergence of mean income translates into a diminution of within inequality in our framework.}
the turning point of the income Kuznets curve is about $\exp(7.5) = 2000$ dollars, and
that of the human capital Kuznets curve around 5.5 years. A look at Figure 9, which
plots the correlations between inequality and level variables, show that those turning
points almost match since countries with a GDP per capita of 2000 dollars have about
4 years of average schooling.

As human capital affects income, a possible explanation for the observed Kuznets
curve of income inequality would be that it reflects the clear-cut Kuznets curve of
human capital inequality. Indeed, the relationship between human capital inequality
and schooling could translate into the income dimension because as shown on Figure
9, income and schooling variables appear to be well correlated. Therefore, the Kuznets
curve of income inequality could simply be a by-product of the variations of human
capital inequality, a spurious correlation between income level and inequality.

In order to examine the validity of the Kuznets hypothesis, we introduce the fol-
lowing proposition. Although it has a true practical interest, we have never met this
formula before.

**Proposition 2.** Let $\mu(f)$ be the mean outcome for a distribution $f$ and $I_{GE}^{\alpha}(f)$ the
Generalized-Entropy index. For two independant random variables $X$ and $Y$ one has

$$I_{GE}^{\alpha}(f_{XY}) = I_{GE}^{\alpha}(f_X) + I_{GE}^{\alpha}(f_Y) + (\alpha^2 - \alpha)I_{GE}^{\alpha}(f_X)I_{GE}^{\alpha}(f_Y) \quad (6)$$

Taking $\alpha = 1$ and $\alpha = 0$ for respectively the Theil Index and the Mean Logarithmic
Deviation index, one has

$$\text{Theil}(f_{XY}) = \text{Theil}(f_X) + \text{Theil}(f_Y)$$

$$\text{MLD}(f_{XY}) = \text{MLD}(f_X) + \text{MLD}(f_Y)$$

**Proof.** see in annex

Now, if income is the product of human capital and another independant residual,
than human capital inequality should affect income inequality on a one-for-one basis.
This proposition is likely to lead to a rejection of the spurious correlation hypothesis
simply because variations in human capital inequality are generally too small to explain
the larger variations of income inequality within countries. For instance, in the group of
the most advanced countries income within inequality has decreased by 0.20 points of
Theil, while human capital within inequality has not varied by much than 0.01 point.
Also, variations in income and human capital inequality are often of opposite sign.
There is only one geographical area in which human capital inequality could explain
income inequality entirely: Africa. Indeed, their respective variations match perfectly:
+0.04 points of Theil for the period 1870-1960, and +0.04 points for the period 1960-
1980.

Moreover, there is a priori no reason to believe that the above proposition can be
applied in practice. Education could have some externalities on the income distribu-
tion and the residual in the above decomposition might not be independant from the
schooling distribution. For instance, this residual could encompass a progressive tax rate, IQ, positive or negative spillover effects from the educational distribution and so forth. Although we believe that this proposition has the virtue of proposing a benchmark for the assessment of the impact of education on the Kuznets curve, we need to test the Kuznets hypothesis within a more sophisticated framework that accounts for education spillovers. This is what is done in next subsection.

### 6.2 A test of the conditional Kuznets hypothesis

To conclude this paper, we propose to test whether the Kuznets hypothesis still holds given that we control for human capital inequality and potential externalities of education.

Testing for the existence of an inverted-U curve for income inequality has been a much discussed issue in the literature. It has raised many problems linked to the data, to the functional form retained to conduct the test, and to the statistical model. To sum up, the most two prominent studies have been conducted by Klaus Deininger and Lynn Squire (1998) and Robert J. Barro (2000). Both find a Kuznets curve in pooled regressions, but in the first study its significance disappears when the authors control for fixed-effects. In contrast, the Kuznets curve is always significant in the second study, even with fixed-effects. This difference stems from the fact that the data slightly differ between both studies, and that the functional forms are not the same (GDP per capita $Y$ and $1/Y$ in the first study, $\log(Y)$ and $\log(Y)^2$ in the second).

As emphasized by Garth Frazer (2006), there has been important heterogeneity in income inequality trajectories across countries since 1960. A simple look at Figure 7 shows clearly that country-period cells are quite dispersed around the quadratic trend. Christian Morrisson (2000) has showed that the Kuznets hypothesis was valid for some countries over the last two centuries, but not for some others. As a sum, the Kuznets hypothesis is far from being the “iron law” of economic development.

Still, it has never been examined on such a long period and at a global level. A reason could be that the data on income distributions taken from Francois Bourguignon and Christian Morrisson (2002) are necessarily affected by measurement errors in the distant past. Even for the post-war period, Anthony Atkinson and Brandolini (2002) have shown that the use of secondary data on inequality could be problematic. These are limitations inherent to the exploration of economic mechanisms on the long-term. Also, many countries are aggregated into larger macro-countries, which makes the comparison with other studies quite delicate.

Nevertheless, we do find similar results as former authors for the period 1960-2000 with our dataset. Table 7 reproduces the analysis of the above two studies, both for pooled regressions and fixed-effects panel models. As reported by Columns 1 to 4, we do find that the Kuznets curve is significant in OLS and fixed-effects regressions with a log specification, but disappears with fixed-effects and the other specification, which seems clearly to have a smaller explanatory power. But interestingly, the Kuznets curve disappears when we control for a quadratic in schooling as well as human capital inequality\(^{24}\) as shown in Column 5.

\(^{24}\)we obtain the same result by adding only a quadratic in schooling.
What happens over more than a century? First, the Kuznets curve is always significant, with both specifications and both statistical models, as shown by Columns 6 to 9. So what occurred to the Kuznets curve in Klaus Deininger and Lynn Squire (1998)'s study is plausibly linked to data's too short time span. Second, Column 10 shows that controlling for the a quadratic in schooling and the Theil of human capital does not eliminate the significance of the quadratic function of log-income. Hence, as expected the “Kuznets curve of income” is not the by-product of the “Kuznets curve of human capital”. But what was less obvious is the fact that the Kuznets curve is jointly driven by the variations of income and education. Third, we find a coefficient of 0.96 in front of the human capital Theil, when a coefficient of 1 is expected for all education externalities being taken into account. This suggests that a quadratic in schooling is a good functional form in our setting.

As a sum, we can conclude that Kuznets hypothesis is valid over the period 1870-2000, both unconditionally and conditionally on the distribution of education; that education has two impacts on income inequality within countries: a direct one embodied in the human capital Theil, and an indirect one passing through education externalities. Given the magnitude and the sign of the coefficients of the quadratic in schooling, this externality is positive: the higher average schooling, the lower human capital inequality. The positive sign of the quadratic term shows that this externality has diminishing marginal returns.

Importantly, this externality is found to be very large: everything else equal, income inequality falls by 0.10 points of Theil (resp. 0.04) when average schooling goes from 0 to 2 (resp. 10 to 12). When schooling goes from 0 to 12, the total effect of this externality is a diminution of more than 0.4 points of Theil. In comparison, the “Kuznets effect” linked to the quadratic function in log-income is an increase of less than 0.10 points of Theil when a country moves from a GDP per capita around 1000 dollars - e.g. Haiti or Kenya in 2000 - to a GDP per capita around 5000 or 6000 dollars - Brazil or Russia in 2000 -, and an equal decrease until this country reaches 20 000 dollars - France in 2000.

Although we have not reported the result of this fixed-effects regression, human capital inequality is found to be well explained by a quadratic in schooling. Interestingly, a quadratic in log income is not significant when included in this regression. It turns out that the impact of education on income inequality going through human capital inequality is first a negligible increase, and then a decrease of 0.10 points of Theil. It brings the total impact of education on income inequality to a reduction of more than 0.50 points of Theil when average schooling goes from 0 to 12. So the “Kuznets effect” does exist, but its magnitude represents at most 20% of education’s total impact.

Education’s externality remains to be explained: if Kuznets hypothesis is an ‘iron law”, the “golden rule” is still to be discovered. Still, we believe that this educational externality can be interpreted in a simple way. As suggested by Roland Benabou (2000), it could be that the rank of the median voter depends on her educational level, and that consequently redistributive policies arise with educational development. This mechanism is strongly emphasized by François Bourguignon and Thierry Verdier (2000), who focus on the economic incentives of political actors to invest into education, possibly leading to a reduction of their political power some years after. Such a mechanism has been widely documented by Acemoglu et al. (2000, 2001,2002).
However, the reverse causality from redistribution to schooling attainment cannot be excluded. Following Oded Galor (2006), a long-term acceleration of technological progress might have increased the demand for human capital, making education the central engine of growth. In that context, redistributive policies might alleviate the credit constraint faced by households, who can start investing in children education, which in turn increases the pace of technological progress and income growth. As fixed-effects models do not control for a reversal causality, we believe that a more structural approach would be useful to analyse the long-term relationships between inequality and growth of income and schooling.

7 Conclusion

This article presents the first estimates of the world distribution of years of schooling and of human capital over a long period, 130 years. We have shown that the educational comparative advantage of Western Europe has decreased rapidly since the beginning of the century. As a consequence the context of the two globalization processes, the first in 1860-1914, the second starting in the late 70s, are very different. In world economic competition, education is a crucial advantage at least because it enables access to technological progress. The situation has completely changed in a century. In 1910, 70% of individuals who achieved secondary schooling lived in Western Europe and offshoots. In 2000, among people who have received higher education, only 36% come from Western Europe, and an equal proportion come from Asia. So there is a discrepancy between the advantage of Western Europe in the world income distribution and the weight of Asia in world education.

Furthermore, we have shown that computing inequality in years of schooling raises to some important problems. From a practical and empirical perspective, we advise disentangling in a systematic way the impact of illiteracy from that of education inequality among educated individuals; otherwise, the former will cancel the latter if both are aggregated into a single index of education inequality. In the context of growth regressions for instance, it will lead clearly to misinterpretation of the results.

In response to that criticism, we have studied human capital inequality. Evidences on diminishing returns to schooling at the micro-level have led us to choose a convenient functional form for human capital. This property of diminishing returns with respect to educational level explains the negative cross-countries correlation between Mincer returns to schooling and average schooling. As a result, we find that human capital inequality has increased, but does not exceed 15% of income inequality.

Turning to the link between income and human capital inequality within countries, we find an inverted-U pattern of human capital inequality along educational development - “the Kuznets curve of human capital”. We have shown that the Kuznets hypothesis for income within inequality could be validated over the period 1870-2000, even after controlling for the direct and indirect impacts of education. Education has a positive though marginally decreasing externality on income inequality, which explains two thirds of the observed decrease in income inequality within countries. We argued that a political economy mechanism can account for this empirical fact, though an usual reduced-form framework might be unable to restitute the complex dynamics.
of income and education. As suggested by Fabrice Murtin (2007), a more structural approach is fruitful because it explicitly models the joint dynamics of inequality and growth of income and schooling, as well as other variables such as technology, fertility, mortality, the extent of voting rights and so forth. Estimating such a framework, those “unified growth empirics”, is the next step in our research agenda.
References


## Table 1 - The World Distribution of Years of Schooling

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Illiteracy Rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>78.9</td>
<td>73.6</td>
<td>67.0</td>
<td>59.7</td>
<td>51.2</td>
<td>44.9</td>
<td>39.1</td>
<td>33.3</td>
<td>27.7</td>
<td>23.6</td>
</tr>
<tr>
<td>Proportion Having only Primary</td>
<td>19.9</td>
<td>24.2</td>
<td>29.1</td>
<td>33.8</td>
<td>38.4</td>
<td>40.1</td>
<td>39.9</td>
<td>41.3</td>
<td>41.0</td>
<td>40.8</td>
</tr>
<tr>
<td>Proportion Having only Secondary</td>
<td>0.7</td>
<td>1.7</td>
<td>3.2</td>
<td>5.5</td>
<td>8.6</td>
<td>12.2</td>
<td>16.6</td>
<td>20.1</td>
<td>25.1</td>
<td>27.6</td>
</tr>
<tr>
<td>Proportion Having Higher Education</td>
<td>0.4</td>
<td>0.4</td>
<td>0.6</td>
<td>0.9</td>
<td>1.8</td>
<td>2.8</td>
<td>4.3</td>
<td>5.2</td>
<td>6.1</td>
<td>8.0</td>
</tr>
<tr>
<td>Average Years of Schooling</td>
<td>1.0</td>
<td>1.4</td>
<td>1.8</td>
<td>2.4</td>
<td>3.2</td>
<td>3.9</td>
<td>4.7</td>
<td>5.3</td>
<td>6.1</td>
<td>6.7</td>
</tr>
<tr>
<td>Average Years of Schooling in Primary</td>
<td>4.5</td>
<td>4.7</td>
<td>4.8</td>
<td>5.0</td>
<td>5.1</td>
<td>5.2</td>
<td>5.3</td>
<td>5.3</td>
<td>5.4</td>
<td>5.4</td>
</tr>
<tr>
<td>Average Years of Schooling in Secondary</td>
<td>10.5</td>
<td>10.8</td>
<td>11.1</td>
<td>11.2</td>
<td>11.3</td>
<td>11.3</td>
<td>11.4</td>
<td>11.5</td>
<td>11.6</td>
<td>11.7</td>
</tr>
<tr>
<td>Average Years of Schooling in Higher Education</td>
<td>14.8</td>
<td>15.0</td>
<td>15.2</td>
<td>15.4</td>
<td>15.5</td>
<td>15.6</td>
<td>15.6</td>
<td>15.6</td>
<td>15.7</td>
<td>15.7</td>
</tr>
</tbody>
</table>
Table 2 - Average Years of Schooling and Illiteracy Rates, 1870-2000

<table>
<thead>
<tr>
<th>Year</th>
<th>Region</th>
<th>Average Years of Schooling</th>
<th>Illiteracy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Africa</td>
<td>Japan Korea</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>Primary</td>
</tr>
<tr>
<td>1870</td>
<td></td>
<td>0.13</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Primary</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Secondary</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Illiteracy</td>
<td>0.25</td>
</tr>
<tr>
<td>1910</td>
<td></td>
<td>0.27</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Primary</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Secondary</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Illiteracy</td>
<td>0.25</td>
</tr>
<tr>
<td>1950</td>
<td></td>
<td>0.79</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Primary</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Secondary</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Illiteracy</td>
<td>0.11</td>
</tr>
<tr>
<td>1970</td>
<td></td>
<td>1.71</td>
<td>1.41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Primary</td>
<td>1.41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Secondary</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Illiteracy</td>
<td>0.27</td>
</tr>
<tr>
<td>1980</td>
<td></td>
<td>2.37</td>
<td>1.93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Primary</td>
<td>1.93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Secondary</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Illiteracy</td>
<td>0.41</td>
</tr>
<tr>
<td>1990</td>
<td></td>
<td>3.18</td>
<td>2.49</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Primary</td>
<td>2.49</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Secondary</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Illiteracy</td>
<td>0.64</td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td>4.02</td>
<td>3.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Primary</td>
<td>3.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Secondary</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Illiteracy</td>
<td>0.86</td>
</tr>
<tr>
<td>Year</td>
<td>Region</td>
<td>Africa</td>
<td>Japan</td>
</tr>
<tr>
<td>------</td>
<td>-----------------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>1870</td>
<td>Total</td>
<td>6.6</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>Bottom 80</td>
<td>8.1</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>Decile 9</td>
<td>1.4</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>Decile 10</td>
<td>0.9</td>
<td>2.3</td>
</tr>
<tr>
<td>1910</td>
<td>Total</td>
<td>6.3</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>Bottom 80</td>
<td>8.4</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>Decile 9</td>
<td>1.5</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>Decile 10</td>
<td>1.0</td>
<td>5.3</td>
</tr>
<tr>
<td>1960</td>
<td>Total</td>
<td>9.1</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td>Bottom 80</td>
<td>10.6</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Decile 9</td>
<td>4.7</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>Decile 10</td>
<td>4.2</td>
<td>5.3</td>
</tr>
<tr>
<td>1980</td>
<td>Total</td>
<td>10.6</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>Bottom 80</td>
<td>14.0</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Decile 9</td>
<td>6.6</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>Decile 10</td>
<td>3.5</td>
<td>2.9</td>
</tr>
<tr>
<td>2000</td>
<td>Total</td>
<td>13.2</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>Bottom 80</td>
<td>18.6</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Decile 9</td>
<td>10.3</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>Decile 10</td>
<td>5.3</td>
<td>7.5</td>
</tr>
</tbody>
</table>
Table 4 - The World Marginal Distributions of Income and Education

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient of Variation</td>
<td>1.786</td>
<td>1.919</td>
<td>2.021</td>
<td>1.915</td>
<td>1.771</td>
<td>1.725</td>
<td>1.676</td>
<td>1.739</td>
<td>1.815</td>
<td>1.838</td>
</tr>
<tr>
<td>Coefficient of Gini</td>
<td>0.553</td>
<td>0.586</td>
<td>0.614</td>
<td>0.635</td>
<td>0.648</td>
<td>0.644</td>
<td>0.652</td>
<td>0.665</td>
<td>0.664</td>
<td>0.646</td>
</tr>
<tr>
<td>Theil Index</td>
<td>0.669</td>
<td>0.762</td>
<td>0.833</td>
<td>0.813</td>
<td>0.775</td>
<td>0.788</td>
<td>0.780</td>
<td>0.854</td>
<td>0.853</td>
<td>0.876</td>
</tr>
<tr>
<td>between country group</td>
<td>0.188</td>
<td>0.251</td>
<td>0.324</td>
<td>0.403</td>
<td>0.482</td>
<td>0.485</td>
<td>0.492</td>
<td>0.529</td>
<td>0.528</td>
<td>0.494</td>
</tr>
<tr>
<td>within country group</td>
<td>0.481</td>
<td>0.511</td>
<td>0.509</td>
<td>0.410</td>
<td>0.293</td>
<td>0.303</td>
<td>0.288</td>
<td>0.325</td>
<td>0.325</td>
<td>0.382</td>
</tr>
<tr>
<td>Mean Logarithmic Deviation</td>
<td>0.527</td>
<td>0.605</td>
<td>0.678</td>
<td>0.749</td>
<td>0.800</td>
<td>0.798</td>
<td>0.825</td>
<td>0.883</td>
<td>0.852</td>
<td>0.793</td>
</tr>
<tr>
<td>between country group</td>
<td>0.162</td>
<td>0.217</td>
<td>0.299</td>
<td>0.381</td>
<td>0.471</td>
<td>0.508</td>
<td>0.518</td>
<td>0.577</td>
<td>0.517</td>
<td>0.472</td>
</tr>
<tr>
<td>within country group</td>
<td>0.365</td>
<td>0.388</td>
<td>0.379</td>
<td>0.368</td>
<td>0.329</td>
<td>0.290</td>
<td>0.307</td>
<td>0.306</td>
<td>0.335</td>
<td>0.321</td>
</tr>
<tr>
<td>Mean Income (PPP $ 1990)</td>
<td>890</td>
<td>1113</td>
<td>1453</td>
<td>1768</td>
<td>2145</td>
<td>2759</td>
<td>3774</td>
<td>4483</td>
<td>4922</td>
<td>6035</td>
</tr>
</tbody>
</table>

Years of Schooling

| Coefficient of Variation | 2.118 | 1.842 | 1.601 | 1.396 | 1.213 | 1.094 | 0.992 | 0.896 | 0.803 | 0.744 |
| Coefficient of Gini | 0.822 | 0.779 | 0.727 | 0.673 | 0.613 | 0.571 | 0.533 | 0.489 | 0.445 | 0.414 |
| Coefficient of Gini, educated population | 0.159 | 0.164 | 0.174 | 0.188 | 0.207 | 0.222 | 0.233 | 0.234 | 0.233 | 0.234 |
| Theil Index | 1.615 | 1.392 | 1.178 | 0.986 | 0.805 | 0.688 | 0.591 | 0.500 | 0.416 | 0.361 |
| between country groups | 0.559 | 0.519 | 0.450 | 0.381 | 0.331 | 0.260 | 0.179 | 0.128 | 0.101 | 0.076 |
| Theil Index, educated population | 0.059 | 0.062 | 0.069 | 0.076 | 0.087 | 0.092 | 0.095 | 0.094 | 0.092 | 0.092 |
| Average Years of Schooling | 1.03 | 1.38 | 1.85 | 2.44 | 3.21 | 3.95 | 4.71 | 5.35 | 6.07 | 6.71 |
| Illiteracy Rate | 78.9 | 73.6 | 67.0 | 59.7 | 51.2 | 44.9 | 39.1 | 33.3 | 27.7 | 23.6 |
| Population (millions) | 1267 | 1451 | 1722 | 2044 | 2507 | 3021 | 3663 | 4419 | 5314 | 6071 |

¹source: Bourguignon-Morrisson (2002)
Table 5 - The World Marginal Distributions of Income and Human Capital

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>With r = 10%</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coefficient of Gini</td>
<td>0.104</td>
<td>0.130</td>
<td>0.160</td>
<td>0.191</td>
<td>0.224</td>
<td>0.247</td>
<td>0.267</td>
<td>0.272</td>
<td>0.272</td>
<td>0.273</td>
</tr>
<tr>
<td>educated population</td>
<td>0.094</td>
<td>0.104</td>
<td>0.119</td>
<td>0.137</td>
<td>0.161</td>
<td>0.181</td>
<td>0.198</td>
<td>0.203</td>
<td>0.205</td>
<td>0.211</td>
</tr>
<tr>
<td>Theil Index</td>
<td>0.035</td>
<td>0.047</td>
<td>0.062</td>
<td>0.079</td>
<td>0.100</td>
<td>0.113</td>
<td>0.125</td>
<td>0.126</td>
<td>0.123</td>
<td>0.123</td>
</tr>
<tr>
<td>between country</td>
<td>0.010</td>
<td>0.016</td>
<td>0.024</td>
<td>0.032</td>
<td>0.044</td>
<td>0.047</td>
<td>0.045</td>
<td>0.041</td>
<td>0.040</td>
<td>0.034</td>
</tr>
<tr>
<td>educated population</td>
<td>0.030</td>
<td>0.034</td>
<td>0.040</td>
<td>0.048</td>
<td>0.060</td>
<td>0.067</td>
<td>0.073</td>
<td>0.074</td>
<td>0.073</td>
<td>0.076</td>
</tr>
<tr>
<td>Mean Logarithmic Deviation</td>
<td>0.029</td>
<td>0.039</td>
<td>0.052</td>
<td>0.068</td>
<td>0.087</td>
<td>0.103</td>
<td>0.117</td>
<td>0.121</td>
<td>0.122</td>
<td>0.125</td>
</tr>
<tr>
<td>between country</td>
<td>0.009</td>
<td>0.015</td>
<td>0.022</td>
<td>0.030</td>
<td>0.042</td>
<td>0.045</td>
<td>0.043</td>
<td>0.039</td>
<td>0.038</td>
<td>0.033</td>
</tr>
<tr>
<td>educated population</td>
<td>0.024</td>
<td>0.028</td>
<td>0.034</td>
<td>0.041</td>
<td>0.052</td>
<td>0.060</td>
<td>0.068</td>
<td>0.070</td>
<td>0.071</td>
<td>0.075</td>
</tr>
<tr>
<td>Average Human Capital</td>
<td>1.14</td>
<td>1.19</td>
<td>1.27</td>
<td>1.36</td>
<td>1.50</td>
<td>1.63</td>
<td>1.79</td>
<td>1.92</td>
<td>2.07</td>
<td>2.21</td>
</tr>
<tr>
<td><strong>With Diminishing Returns</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coefficient of Gini</td>
<td>0.118</td>
<td>0.145</td>
<td>0.175</td>
<td>0.203</td>
<td>0.230</td>
<td>0.248</td>
<td>0.263</td>
<td>0.263</td>
<td>0.259</td>
<td>0.256</td>
</tr>
<tr>
<td>educated population</td>
<td>0.089</td>
<td>0.098</td>
<td>0.110</td>
<td>0.124</td>
<td>0.144</td>
<td>0.160</td>
<td>0.173</td>
<td>0.177</td>
<td>0.179</td>
<td>0.182</td>
</tr>
<tr>
<td>Theil Index</td>
<td>0.041</td>
<td>0.054</td>
<td>0.068</td>
<td>0.083</td>
<td>0.099</td>
<td>0.108</td>
<td>0.116</td>
<td>0.114</td>
<td>0.110</td>
<td>0.107</td>
</tr>
<tr>
<td>between country</td>
<td>0.012</td>
<td>0.019</td>
<td>0.028</td>
<td>0.036</td>
<td>0.047</td>
<td>0.048</td>
<td>0.043</td>
<td>0.038</td>
<td>0.035</td>
<td>0.030</td>
</tr>
<tr>
<td>educated population</td>
<td>0.023</td>
<td>0.027</td>
<td>0.032</td>
<td>0.037</td>
<td>0.045</td>
<td>0.050</td>
<td>0.054</td>
<td>0.055</td>
<td>0.054</td>
<td>0.056</td>
</tr>
<tr>
<td>Mean Logarithmic Deviation</td>
<td>0.035</td>
<td>0.046</td>
<td>0.059</td>
<td>0.074</td>
<td>0.091</td>
<td>0.102</td>
<td>0.114</td>
<td>0.115</td>
<td>0.114</td>
<td>0.113</td>
</tr>
<tr>
<td>between country</td>
<td>0.011</td>
<td>0.018</td>
<td>0.026</td>
<td>0.034</td>
<td>0.044</td>
<td>0.046</td>
<td>0.042</td>
<td>0.036</td>
<td>0.034</td>
<td>0.029</td>
</tr>
<tr>
<td>educated population</td>
<td>0.019</td>
<td>0.023</td>
<td>0.027</td>
<td>0.033</td>
<td>0.040</td>
<td>0.046</td>
<td>0.051</td>
<td>0.053</td>
<td>0.054</td>
<td>0.056</td>
</tr>
<tr>
<td>Average Human Capital</td>
<td>1.16</td>
<td>1.22</td>
<td>1.31</td>
<td>1.41</td>
<td>1.56</td>
<td>1.69</td>
<td>1.85</td>
<td>1.98</td>
<td>2.12</td>
<td>2.25</td>
</tr>
<tr>
<td><strong>With Autocorrelated Shocks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coefficient of Gini</td>
<td>0.124</td>
<td>0.154</td>
<td>0.189</td>
<td>0.220</td>
<td>0.255</td>
<td>0.281</td>
<td>0.300</td>
<td>0.304</td>
<td>0.311</td>
<td>0.312</td>
</tr>
<tr>
<td>standard error</td>
<td>0.017</td>
<td>0.020</td>
<td>0.024</td>
<td>0.027</td>
<td>0.027</td>
<td>0.026</td>
<td>0.027</td>
<td>0.026</td>
<td>0.024</td>
<td>0.025</td>
</tr>
<tr>
<td>Theil Index</td>
<td>0.051</td>
<td>0.067</td>
<td>0.088</td>
<td>0.107</td>
<td>0.132</td>
<td>0.152</td>
<td>0.165</td>
<td>0.164</td>
<td>0.167</td>
<td>0.166</td>
</tr>
<tr>
<td>standard error</td>
<td>0.015</td>
<td>0.019</td>
<td>0.028</td>
<td>0.033</td>
<td>0.036</td>
<td>0.034</td>
<td>0.034</td>
<td>0.032</td>
<td>0.030</td>
<td>0.030</td>
</tr>
<tr>
<td>Mean Logarithmic Deviation</td>
<td>0.040</td>
<td>0.054</td>
<td>0.071</td>
<td>0.089</td>
<td>0.112</td>
<td>0.131</td>
<td>0.147</td>
<td>0.150</td>
<td>0.157</td>
<td>0.158</td>
</tr>
<tr>
<td>standard error</td>
<td>0.011</td>
<td>0.013</td>
<td>0.018</td>
<td>0.022</td>
<td>0.024</td>
<td>0.025</td>
<td>0.025</td>
<td>0.027</td>
<td>0.024</td>
<td>0.026</td>
</tr>
<tr>
<td>Average Human Capital</td>
<td>1.17</td>
<td>1.24</td>
<td>1.32</td>
<td>1.43</td>
<td>1.59</td>
<td>1.74</td>
<td>1.91</td>
<td>2.04</td>
<td>2.23</td>
<td>2.36</td>
</tr>
<tr>
<td>standard error</td>
<td>0.027</td>
<td>0.035</td>
<td>0.048</td>
<td>0.063</td>
<td>0.074</td>
<td>0.086</td>
<td>0.114</td>
<td>0.126</td>
<td>0.159</td>
<td>0.171</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log Y</td>
<td>1.165**</td>
<td>0.169**</td>
<td>-0.099</td>
<td>0.901**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.198)</td>
<td>(0.077)</td>
<td>(0.122)</td>
<td>(0.116)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(log Y)^2</td>
<td>-0.074**</td>
<td>-0.011**</td>
<td>-0.006</td>
<td>-0.059**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.004)</td>
<td>(0.007)</td>
<td>(0.007)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y/10^4</td>
<td>0.191**</td>
<td>-0.021</td>
<td>-0.196**</td>
<td>-0.096**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.261)</td>
<td>(0.013)</td>
<td>(0.020)</td>
<td>(0.018)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Y/10^4)^2</td>
<td>-0.015**</td>
<td>-0.003</td>
<td>-0.008**</td>
<td>-0.012**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>0.010</td>
<td></td>
<td>-0.063**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td></td>
<td>(0.010)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S^2</td>
<td>-0.000</td>
<td></td>
<td>0.002**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td></td>
<td>(0.001)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theil(HC)</td>
<td>-0.003</td>
<td></td>
<td>0.964**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.285)</td>
<td></td>
<td>(0.269)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed-Effects</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>165</td>
<td>165</td>
<td>165</td>
<td>165</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R^2</td>
<td>28.3</td>
<td>32.2</td>
<td>25.2</td>
<td>17.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>165</td>
<td>165</td>
<td>165</td>
<td>165</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
B Figures

Figure 1: The World Distribution of Years of Schooling 1870-2000

Figure 2: Average Years of Schooling by Region 1870-2000
Figure 3: The Return to Schooling and Average Schooling in 59 Countries around 1990

Figure 4: World Human Capital Inequality 1870-2000 - Theil Index
Figure 5: Inequality in Income Within Countries by Geographical Zone 1870-2000 - Theil Index

Figure 6: Inequality in Human Capital Within Countries by Geographical Zone 1870-2000 - Theil Index
Figure 7: The Kuznets Curves of Income and Human Capital Inequality 1870-2000 - Theil Index
Figure 8: The Kuznets Curve of Bootstrapped Human Capital Inequality 1870-2000 - Theil Index

Figure 9: Income vs Human Capital Inequality and Log-GDP per capita vs Schooling
C The impact of illiteracy on education inequalities

We consider here a continuous outcome $x$ that can take values greater or equal to $m$. For a fraction $p$ of total population we have $x = m$. Then the distribution $f$ of the outcome can be viewed as the mixture

$$f(x) = p\delta_{x=m} + (1 - p)g(x)$$

where $\delta_{x=m}$ is a mass point in $m$ and $g$ the distribution of the outcome in the population with an outcome strictly greater than $m$. For the Gini index we use its mean-differences definition. Writing $\mu(f)$ as the mean outcome for a distribution $f$ and $G(f)$ the corresponding Gini index we have

$$G(f) = \frac{1}{2\mu(f)} \int \int |x - x'| f(x)f(x')dxdx'$$

$$= \frac{p^2}{2\mu(f)} \int \int |x - x'| \delta_{x=m}\delta_{x'=m}dxdx' + \frac{p(1-p)}{\mu(f)} \int \int |x - x'| \delta_{x=m} g(x')dxdx'$$

$$+ \frac{(1-p)^2}{2\mu(f)} \int \int |x - x'| g(x)g(x')dxdx'$$

by symmetry. The first term cancels out. Since $m$ is the minimum value of the outcome the above expression simplifies into

$$G(f) = \frac{p(1-p)}{\mu(f)} \left( \int \int x' \delta_{x=m}g(x')dxdx' - \int \int x \delta_{x=m} g(x')dxdx' \right)$$

$$+ \frac{(1-p)^2}{2\mu(f)} \int \int |x - x'| g(x)g(x')dxdx'$$

$$= \frac{p(1-p)}{\mu(f)} (\mu(g) - m) + \frac{(1-p)^2}{\mu(f)} \mu(g)G(g)$$

The means $\mu(f)$ and $\mu(g)$ are simply related by $\mu(f) = pm + (1-p)\mu(g)$, which provides

$$G(f) = p \frac{\mu(f) - m}{\mu(f)} + (1-p) \frac{\mu(f) - pm}{\mu(f)} G(g)$$

or alternatively

$$G(f) = G(g) + \frac{pm}{\mu(f)} \left[ \frac{\mu(f)}{m} - 1 - G(g) \left( \frac{\mu(f)}{m} + 1 - p \right) \right]$$
Similarly, the GE-index is given by

\[
I_{GE}^\alpha(f) = \frac{1}{\alpha^2 - \alpha} \int \left[ \left( \frac{x}{\mu(f)} \right)^\alpha - 1 \right] f(x) dx
\]

\[
= \frac{1}{\alpha^2 - \alpha} \left[ \int \left( \frac{x}{\mu(f)} \right)^\alpha f(x) dx - \frac{1}{\alpha^2 - \alpha} \right]
\]

\[
= \frac{p}{\alpha^2 - \alpha} \int \left( \frac{x}{\mu(f)} \right)^\alpha f(x) dx + \frac{1 - p}{\alpha^2 - \alpha} \left[ \int \left( \frac{x}{\mu(f)} \right)^\alpha g(x) dx - \frac{1}{\alpha^2 - \alpha} \right]
\]

\[
= \frac{(1 - p)^{1 - \alpha}}{\alpha^2 - \alpha} \left( \frac{\mu(f) - pm}{\mu(f)} \right)^\alpha \left[ I_{GE}^\alpha(g) + \frac{1}{\alpha^2 - \alpha} (\alpha^2 - \alpha) + \frac{pm^\alpha}{\alpha^2 - \alpha} \mu(f)^{-\alpha} - \frac{1}{\alpha^2 - \alpha} \right]
\]

which achieves the decomposition. Let us examine now the case when \( \alpha = 1 \) (for the Theil index). We use Taylor expansions

\[
A = \frac{1}{\alpha^2 - \alpha} \left[ (1 - p)^{1 - \alpha} \left( 1 - \frac{pm}{\mu(f)} \right)^\alpha - \left( 1 - \frac{pm^\alpha}{\mu(f)^\alpha} \right) \right]
\]

\[
\approx \frac{1}{\alpha^2 - \alpha} \left[ (1 - \frac{pm}{\mu(f)})^\alpha + (1 - \frac{pm}{\mu(f)})^{\alpha - 1} (1 - p) \log(1 - p) - \left( 1 - \frac{pm^\alpha}{\mu(f)^\alpha} \right) \right]
\]

\[
= -\frac{1}{\alpha} \log(1 - p) \left( 1 - \frac{pm}{\mu(f)} \right)^\alpha + \frac{1}{\alpha^2 - \alpha} \left[ (1 - \frac{pm}{\mu(f)})^\alpha - \left( 1 - \frac{pm^\alpha}{\mu(f)^\alpha} \right) \right]
\]

\[
A \approx -\frac{1}{\alpha} \log(1 - p) \left( 1 - \frac{pm}{\mu(f)} \right)^\alpha
\]

\[
+ \frac{1}{\alpha^2 - \alpha} \left[ (1 - \frac{pm}{\mu(f)}) + \left( 1 - \frac{pm}{\mu(f)} \right) (\alpha - 1) \log \left( 1 - \frac{pm}{\mu(f)} \right) - \left( 1 - \frac{pm^\alpha}{\mu(f)^\alpha} \right) \right]
\]

\[
= -\frac{1}{\alpha} \log(1 - p) \left( 1 - \frac{pm}{\mu(f)} \right)^\alpha + \frac{1}{\alpha} \left( 1 - \frac{pm}{\mu(f)} \right) \log \left( 1 - \frac{pm}{\mu(f)} \right) - \frac{1}{\alpha^2 - \alpha} \frac{pm}{\mu(f)} \left( 1 - \left( \frac{m}{\mu(f)} \right)^{\alpha - 1} \right)
\]

\[
\approx -\frac{1}{\alpha} \log(1 - p) \left( 1 - \frac{pm}{\mu(f)} \right)^\alpha + \frac{1}{\alpha} \left( 1 - \frac{pm}{\mu(f)} \right) \log \left( 1 - \frac{pm}{\mu(f)} \right) + \frac{1}{\alpha} \frac{pm}{\mu(f)} \log \left( \frac{m}{\mu(f)} \right)
\]

Then taking the limit \( \alpha \to 1 \) we have

\[
\text{Theil}(f) = \text{Theil}(g) + A - \frac{pm}{\mu(f)} \text{Theil}(g)
\]

where

\[
A = -\log(1 - p) \left( 1 - \frac{pm}{\mu(f)} \right) + \left( 1 - \frac{pm}{\mu(f)} \right) \log \left( 1 - \frac{pm}{\mu(f)} \right) + \frac{pm}{\mu(f)} \log \left( \frac{m}{\mu(f)} \right)
\]
D The decomposition of inequality in the product of two independant variables

Let \(X\) and \(Y\) be two random variables, \(f_X\) and \(f_Y\) their respective probability density function, \(f_{XY}\) that of their product, and \(\mu_X, \mu_Y, \mu_{XY}\) the corresponding means. If \(X\) and \(Y\) are independant then \(f_{XY} = f_X f_Y, \mu_{XY} = \mu_X \mu_Y,\) and we have

\[
I_{\alpha}^{\alpha}(f_{XY}) = \frac{1}{\alpha^2 - \alpha} \int \int \left[ \left( \frac{xy}{\mu_{XY}} \right)^\alpha - 1 \right] f_{XY}(xy) \, dx \, dy
\]

\[
I_{\alpha}^{\alpha}(f_X) = \frac{1}{\alpha^2 - \alpha} \left[ \int \left( \frac{x}{\mu_X} \right)^\alpha f_X(x) \, dx \int \left( \frac{y}{\mu_Y} \right)^\alpha f_Y(y) \, dy - 1 \right]
\]

\[
I_{\alpha}^{\alpha}(f_Y) = \frac{1}{\alpha^2 - \alpha} \left[ (1 + (\alpha^2 - \alpha)I_{\alpha}^{\alpha}(f_X)) (1 + (\alpha^2 - \alpha)I_{\alpha}^{\alpha}(f_Y)) - 1 \right]
\]

\[
I_{\alpha}^{\alpha}(f_{XY}) = I_{\alpha}^{\alpha}(f_X) + I_{\alpha}^{\alpha}(f_Y) + (\alpha^2 - \alpha)I_{\alpha}^{\alpha}(f_X)I_{\alpha}^{\alpha}(f_Y)
\]
Complementary information on the building of average years of schooling
(Not to be included in the final version)

This dataset on human capital for 1870-2000 is based on two datasets. The first for 1870-1960 is a new one, the second for 1960-2000 has been published by D. Cohen and F. Soto (2001), quoted hereafter as Cohen-Soto. Several countries such as Poland or USSR/Russia were missing on the list and have been taken from Barro and Lee (2001). The Cohen-Soto database has been chosen because it provides very reliable estimates as proved by a comparison of these data with the datasets published by R. Barro and J-W Lee (2001), V. Nehru et al. (1995), A. De La Fuente and R. Domenech (2000). Cohen-Soto has systematically used as sources the national censuses which give the school attainments of population (usually aged 15 to 64). The long series of B. Mitchell (2003 a-b-c) on primary, secondary and high school enrolments were used only to fill missing cells.

Estimating the average years of schooling in 1870 or before is difficult because information on school enrolments before 1870 are needed. Mitchell provides series for European countries, US, Canada, Australia before 1870, but in Latin America, in Eastern Europe, in some Asian countries, the series begin only around 1870 or 1880. Moreover for African countries, other Asian countries, Mitchell gives no data before 1930 or 1950-60. So we estimated the average years of schooling in all countries where series are not available by interpolation. We assumed an enrolment rate in primary school of 1% in 1820 (Europe, North America, Oceania) or 0.1% (Asia, South America, Africa) and a constant rate of increase between 1820 and the first year of Mitchell’s series.

We believe this assumption to be inocuous, because most of the time the first observed enrolment rate is very low, and close to the latter values. Robustness analysis illustrates below the weight of the latter assumption, as well as those underlying the construction of Mitchell’s series that we describe below.

At a given period, the educational situation of a country can be assessed directly by census data, provided that it exists, or can be derived from demographic and educational information over the past generations. The latter procedure estimates the mean educational attainment of cohorts of $i$ years-old individuals at date $t$ by computing the enrollment rate in the primary school at date $t-i+6$, and by relying on an estimate of duration at school. Such a procedure introduces much uncertainty than census data, but enables us to recover educational data over very long periods for which census data does not exist.

Some problems have been recognized to arise from this enrollment-based procedure. First, the population’s structure in year $t$ is not necessarily the outcome of year $t-T$ given a mortality rule between those two periods, because migrations can affect a substantial proportion of population. Between the 19th and the 20th century, countries from the Commonwealth, Latin America, North-America, and some of Europe have had intense periods of migrations. Depending on the human capital of the migrants relatively to their compatriots, the net impact of migration can be positive or negative.
A second problem is that the intake rate, i.e. the ratio of new entrants in primary school to the six-years population, is subject to measurement errors due to the presence of repeaters and dropouts. We derive human capital measurement by ignoring the migration problem.

Let \( P_{i,t} \) be the population of age \( i \) at time \( t \), \( E_t \) and \( N_t \) be respectively the total number of pupils at school and the number of intakes - those attending their first year of school in year \( t \). Given a cohort of age \( i \) at time \( t \), the probability to have been an intake at the age of 6 is simply

\[
N_t - i + 6 \quad \frac{P_{6,t} - i + 6}{P_{6,t} - i + 6}
\]

As in Cohen and Soto (2001) we consider the impact of repeaters and dropouts by assuming that a pupil can repeat a maximum of three years during her scolarity, which lasts \( P \) years. Let \( d \) and \( r \) be the dropout and repeating rates, and \( g \) the growth rate of intakes. The expression linking total enrollment \( E_t \) to first-year enrollment \( N_t \) is

\[
E_t = N_t \sum_{j=0}^{P-1} (1 - d - r)^j \left[ \frac{1}{(1 + g)^j} + \frac{r^j}{(1 + g)^{j+1}} + \frac{r^2(j+1)}{(1 + g)^{j+2}} + \frac{r^3(j+1)^2}{(1 + g)^{j+3}} \right] = N_t \mu(d, r, g, P)
\]

This formula simply decomposes each grade at school between students who have repeated 0, 1, 2 or 3 times before. Our data provides total enrollment \( E_t \), from which is deduced the number of intakes \( N_t \) from 1870 to 1960. Then a cohort \( i \) at time \( t \) displays a mean number of schooling equal to

\[
\frac{N_{t-i+6}}{P_{6,t-i+6}} \left( \sum_{j=0}^{P-1} j (1 - d)^j \cdot d + P (1 - d)^P \right) = \frac{N_{t-i+6}}{P_{6,t-i+6}} \lambda(d, P)
\]

In this equation the \( \lambda(d, P) \) term is the mean duration of primary school which is held constant over time and does not take into account repeated years. From (2) and (3), human capital \( H_{i,t} \) of cohort \( i \) at time \( t \) is given by

\[
H_{i,t} = \frac{E_{t-i+6}}{P_{6,t-i+6}} \frac{\lambda(d, P)}{\mu(d, r, g, P)}
\]

In the case where \( d = r = g = 0 \), one simply has \( H_{i,t} = E_{t-i+6}/P_{6,t-i+6} \) since \( \lambda(d, P) = \mu(d, r, g, P) = P \). Furthermore human capital does not depend on any assumption on the duration \( P \) of schooling, since there is a perfect trade-off between the mean number of years at school (\( \lambda \)) and the mean number of pupils at each grade \( (E/\mu) \).

The data consists in demographic and enrolment files beginning in various years. The demographic files present the structure of the population by age group. The number of countries for which age pyramids are available in 1820 is scarce. For the others, we postulate that the distribution of mortality \( F \) is Weibull \( (\alpha, \beta) \), which parameters are calibrated on the life expectancy of the population and the survival rate after 60
years (taken equal to 10% in 1820). Life expectancy is corrected from children mortality, equal to \( m_0 = 20\% \) at birth and to \( m_1 = 7\% \) the following 4 years. Formally life expectancy \( LE \) is given by

\[
LE = m_0 + m_1(2 + 3 + 4 + 5) + (1 - m_0)(1 - m_1)^4 \sum_{k \geq 6} p_k k, \quad p_k \sim \text{Weibull} (a, b)
\]

Once calibrated, the survival function \( 1 - F \) gives the relative weight of each cohort of age inside each age group

\[
\frac{p(Age = i)}{p(Age = j)} = \frac{1 - F(Death \leq i)}{1 - F(Death \leq j)}
\]

Age pyramids for the subsequent years are then interpolated with the first observation for the country, or if not available, with a rescaled age pyramid derived from a neighbour country.

The initial enrolment assumptions might bias human capital estimates in early years. We provide hereafter two figures that indicate that in 1900 differences might be very low with respect to the retained value in 1820; in the first one, we assumed that the enrolment rate in France was equal to 0, while in the second it is equal to its first observed value in 1852, 50%. We did the same for India, with a value of 0% or 1% (that of 1851) in 1820. Both examples show minor differences in 1900.
Importantly, some countries exhibited enrolment rates in primary that were higher than 100% given our benchmark assumption $P = 6$. Those were most of the time western countries. We adopted the rule to select the maximal duration $P$ for which the enrolment rate was the closest to 100% in 1950, but still being below this level. The average years of schooling over 6 years were then reported as secondary schooling rather than primary schooling. Next figure illustrates the procedure with France. Notice that years of primary schooling in 1950 on the bottom right are still below 6 years because repeated years are not taken into account and the dropout rate is non-null. Anyway, this procedure should only marginally modify total years of schooling in a given country.
Robustness analysis with respect to dropout and repeating rates

Dropout and repetition rates are derived from Unesco data (1957, 1965, 1970, 1999) and are used to adjust the illiteracy rate stemming from Mitchell’s series with that of Unesco when available. In average, the repeating rate was taken equal to 0.05% per year in Europe and North America in 1870, and 10% elsewhere. The dropout rate was comprised between 1 and 8% in the former two continents, was about 15% in South America and Asia, and 20% in Africa. This latter figure is below the lowest survival rates at the world level in 2000, which were about 15% for Rwanda and Madagascar.

Sensibility with respect to those two parameters was found to be reasonable, if not very low for repeaters. Next figure describes, from left to right and top to bottom, average number of primary schooling with respect to maximum duration $P$, repeating rate $r$, and dropout rate for Brazil in 1910 and 1929. All of them seem to display a variation less than 15% for reasonable values of the parameters. Importantly, the kink in the two upper graphs are explained by the report of years of primary schooling over six years to secondary schooling.
Robustness of inequality indices with respect to duration and classes

We test the sensitivity of major results (inequality in schooling, inequality in human capital) with respect to our main duration assumption, i.e., that durations have raised continuously until 2000, and with respect to the number of classes used to describe the schooling distribution.

For the latter point we estimate years of schooling inequality with a continuous education distribution, which is obtained by smoothing the stepwise cdf of years of schooling. In practice we use the trapeze method to conserve equal stocks of schooling in primary, secondary and higher education after numerical integration. Notice that as schooling is not likely to be scattered continuously, the real inequality is probably closer to estimates of Table 4, which constitutes nevertheless a lower bound.

For durations we consider the alternative scenario where durations have raised continuously until the levels of 2000 but attained them in 1960. That scenario provides an upper bound of fast convergence, since it is not likely that emerging countries have displayed the same duration at school for 40 years.

The first simulation provides mixed results since inequality levels are quite different from their benchmark counterparts, especially for years of schooling; the decrease of inequality between 1870 and 2000 is similar, even if the trend might be somewhat different (the inequality differences between the smoothed and the benchmark distributions are not constant over time). The same comments apply for human capital.

The last simulation presents negligible differences with the benchmark case: the timing of the convergence towards current values does not seem to matter a lot, providing that it is the same for all countries.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benchmark</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Schooling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gini</td>
<td>0.822</td>
<td>0.727</td>
<td>0.613</td>
<td>0.533</td>
<td>0.489</td>
<td>0.445</td>
<td>0.414</td>
</tr>
<tr>
<td>Theil</td>
<td>1.615</td>
<td>1.173</td>
<td>0.805</td>
<td>0.591</td>
<td>0.500</td>
<td>0.416</td>
<td>0.361</td>
</tr>
<tr>
<td>Human Capital(^1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gini</td>
<td>0.127</td>
<td>0.173</td>
<td>0.210</td>
<td>0.249</td>
<td>0.255</td>
<td>0.244</td>
<td>0.242</td>
</tr>
<tr>
<td>Theil</td>
<td>0.053</td>
<td>0.072</td>
<td>0.086</td>
<td>0.113</td>
<td>0.113</td>
<td>0.100</td>
<td>0.098</td>
</tr>
<tr>
<td><strong>Smoothed Distribution</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Schooling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gini</td>
<td>0.856</td>
<td>0.793</td>
<td>0.697</td>
<td>0.650</td>
<td>0.589</td>
<td>0.508</td>
<td>0.479</td>
</tr>
<tr>
<td>Theil</td>
<td>1.715</td>
<td>1.341</td>
<td>0.963</td>
<td>0.828</td>
<td>0.672</td>
<td>0.502</td>
<td>0.449</td>
</tr>
<tr>
<td>Human Capital(^1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gini</td>
<td>0.164</td>
<td>0.205</td>
<td>0.248</td>
<td>0.283</td>
<td>0.300</td>
<td>0.292</td>
<td>0.288</td>
</tr>
<tr>
<td>Theil</td>
<td>0.090</td>
<td>0.102</td>
<td>0.121</td>
<td>0.150</td>
<td>0.156</td>
<td>0.141</td>
<td>0.137</td>
</tr>
<tr>
<td><strong>Faster Duration Growth</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Schooling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gini</td>
<td>0.822</td>
<td>0.734</td>
<td>0.628</td>
<td>0.542</td>
<td>0.496</td>
<td>0.448</td>
<td>0.415</td>
</tr>
<tr>
<td>Theil</td>
<td>1.615</td>
<td>1.210</td>
<td>0.858</td>
<td>0.620</td>
<td>0.519</td>
<td>0.425</td>
<td>0.361</td>
</tr>
<tr>
<td>Human Capital(^1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gini</td>
<td>0.127</td>
<td>0.176</td>
<td>0.217</td>
<td>0.254</td>
<td>0.259</td>
<td>0.246</td>
<td>0.242</td>
</tr>
<tr>
<td>Theil</td>
<td>0.053</td>
<td>0.074</td>
<td>0.092</td>
<td>0.118</td>
<td>0.117</td>
<td>0.102</td>
<td>0.098</td>
</tr>
</tbody>
</table>

\(^1\)using a piecewise return to schooling
Sources

ASIA


Thailand. 1870-1910: Mitchell ; 1920-1960: Series of Mitchell adjusted on the
basis of literacy rates in 1937, 1950, 1960 and of the census in 1947 which gives school
attainments (Unesco 1957, 1965), 1970-2000: Cohen-Soto’s estimates adjusted on the
basis of the literacy rate in 1980.

Indonesia. 1870-1950: series of Mitchell adjusted on the basis of the literacy rates

Turkey. 1870-1920: from A.Kazamias (1966), 1930-1950: series of Mitchell ad-
justed on the basis of literacy rates in 1935, 1950 (Unesco 1957), 1960-2000: Cohen-
Soto.


Bangladesh. 1870-1950: data of India ; 1960: interpolation between 1950 and


Korea. 1870-1950: series of Mitchell adjusted on the basis of the literacy rates in

Taiwan. 1870-1960: series of Mitchell adjusted on the basis of the data of China
and of the literacy rates in 1950, 1956 and the enrollment rates in 1935 (Unesco 1957,

Other countries

Irák. 1870-1960: series of Mitchell adjusted on the basis of the literacy rates in

Iran. 1870-1960: series of Mitchell adjusted on the basis of the literacy rates in

Malaysia. 1870-1960: series of Mitchell adjusted on the basis of the literacy rates


Vietnam. 1870-1960: series of Mitchell adjusted on the basis of the literacy rates

NORTH AND SOUTH AMERICA

Canada.1870 : series of Mitchell adjusted on the basis of data in other developed
Mexico. 1870-1950: series of Mitchell adjusted on the basis of national censuses
Argentina, Brazil, Chile, Colombia, Peru, Venezuela: 1870-1950: series of Mitchell
adjusted on the basis of the literacy rates in several years (S.Engerman et al. 2000).
Other countries
Bolivia, Cuba, Guatemala, Jamaica, Nicaragua, Paraguay, Salvador: 1870-1950:
Costa-Rica. 1870-1960: series of Mitchell adjusted on the basis of the literacy rates
Dominican Republic 1870-1960: series of Mitchell adjusted on the basis of the
Ecuador. 1870-1960: series of Mitchell adjusted on the basis of the literacy rates
Honduras. 1870-1950: series of Mitchell adjusted on the basis of the literacy in
Panama. 1870: figure of Uruguay in 1870 instead of Mitchell estimate which seems
debatable
1880-1930: interpolation between 1870 and 1940; 1940-1960: Mitchell. 1970-
Uruguay. 1870-1950:series of Mitchell adjusted on the basis of the literacy rates
in several years (S.Engerman et al. 2000, Unesco 1957) ; 1960: interpolation between
AFRICA
Morocco: 1870-1950: series of Mitchell adjusted on the basis of the literacy rates
Ghana, Kenya and Nigeria. 1870-1950: series of Mitchell adjusted on the basis of
the literacy rate in 1950 (Unesco 1957) ; 1960-2000: Cohen-Soto.
Other countries.
Cohen-Soto.
Benin. 1870-1950: series of Mitchell adjusted on the basis of the literacy rate in
Ethiopia. 1870-1950: series of Mitchell adjusted on the basis of the literacy rate in
1950 (Unesco 1957) ; 1960-1980: Cohen-Soto estimates adjusted on the basis of the
Madagascar and Malawi. 1870-1960: series of Mitchell adjusted on the basis of the
literacy rates in several years (Unesco 1957, 1965), 1970: interpolation between 1960


**EUROPE**

Ireland and United-Kingdom.


Portugal and Spain.


Benelux and Switzerland.


Scandinavian countries.


Austria, Czechoslovakia and Hungary.


Bulgaria, Greece, Romania and Yugoslavia.


**OCEANIA**

New-Zealand: estimates of Australia.
References


