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Inequality in Income and Access to Education: A Cross-Country Analysis

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ABSTRACT

In the current debate on the relationship between inequality in income distribution and growth one of the possible link works through the access to education. After reviewing this debate, a formal model shows how the imperfection of financial markets makes educational choices dependent on the distribution of family incomes. This leads to two testable predictions in the analysis of aggregate data on school enrolments: a negative (linear) relation with the Gini coefficient on incomes distribution; and a positive dependence on public resources invested in education and/or on skill premium in the labour market. These predictions are then tested on a (unbalanced) panel of 102 countries for the period 1960-90. The main findings of this analysis are that, once we control for the degree of development with the (log of) per capita output, financial constraints seem mainly relevant in limiting the access to secondary education. However, when considering gender differences, there is evidence that female participation in education is more strongly conditioned by family wealth, starting from primary education. On the contrary there is no clear evidence of a relevant impact of invested resources, but at the tertiary level.

I INTRODUCTION

In recent years there has been a revival of interest in studying the relationship between inequality and growth. After the works by Kuznets (1955) in the 50s, where the stages of growth were shaping the degree of inequality in the society, the issue was neglected for almost 30 years, to reappear again at the beginning of the current decade.

Several studies have proposed alternative explanations of the negative relationship between inequality and growth of per capita income observed in different samples of countries in the last 30 years. Without any claim of completeness, one could group existing explanations into two main lines of research that are also represented in Figure 1.[1] The first one invokes political economy actions, in a context of asset markets completeness. Greater inequality raises the demand for fiscal redistribution, introduces distortions that hamper private investment decisions.[2] An empirical variant of the same idea is that (wealth) inequality makes turmoil more likely (e.g. the lack of land reform), increases political instability, makes investors' horizons more shaky and eventually reduces output growth.[3] In both cases it is the threat of reduction in the return of invested capital (or even the risk of expropriation), which is increasing with inequality, that reduces the agents willingness to invest in physical capital, thus depressing the potential for growth.

The second line of research considers the borrowing constraints in financing the access to education as the main explanation for the negative correlation between inequality and growth.[4] The poorest part of the population does not possess resources to access education, and they do not find financial markets where they can borrow these resources to send children to school.[5] In this case fiscal redistribution is efficient because it shifts resources from

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[1] A good survey of the recent literature is contained in Benabou (1996c).

[2] See Alesina and Rodrick (1994), Persson and Tabellini (1994), Perotti (1993), Bertola (1993, 1994).

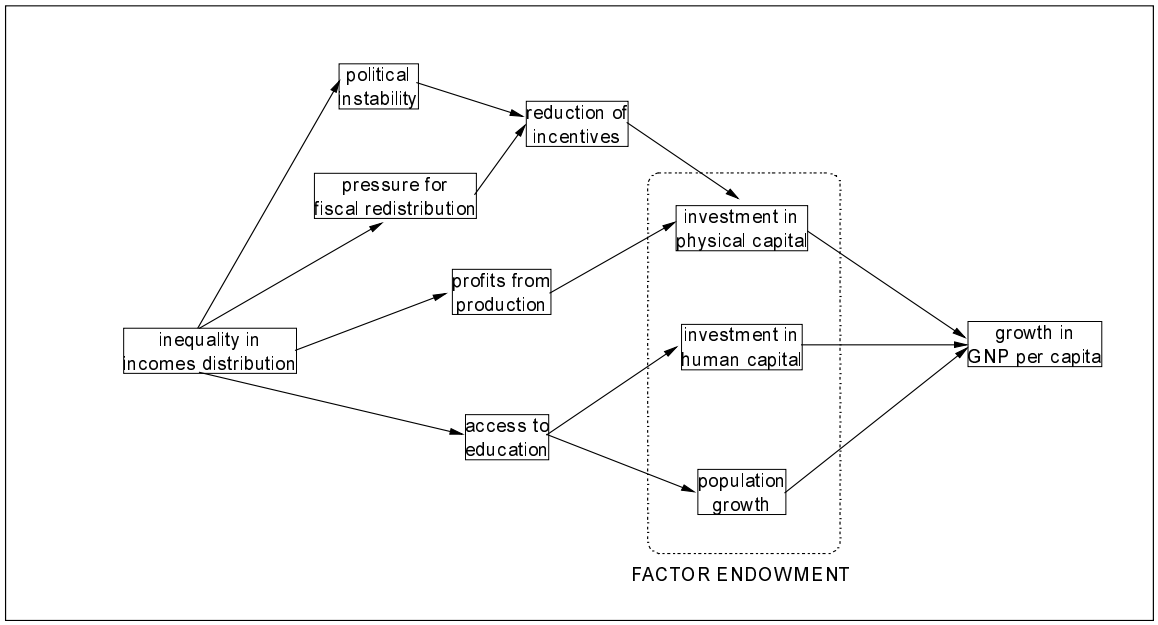
[3] An additional variant is Mauro (1995), where inequality fosters corruption and depresses investment.

[4] See Galor and Zeira (1993), Banerjee and Newman (1993), Torvik (1993), Benabou (1994, 1996a and 1996b).

[5] Piketty (1997) claims that it is impossible to create financial markets to finance education, since (future) work effort is unobservable and contracts contingent on it are not enforceable.

individuals with low rates of return to liquidity constrained agents with very high rates of return.[6]

FIGURE 1
THE POTENTIAL LINKS BETWEEN INEQUALITY AND GROWTH



Source: Author's elaboration.

Empirical tests of these two lines of research are still inconclusive. Almost everyone accepts the idea of negative correlation,[7] but it is not yet clear through which variables it operates. The political economy explanation suffers the lack of evidence of a negative relationship between redistribution and growth.[8] Alesina and Perotti (1996) find evidence of a negative relationship between inequality and growth via a variable measuring political instability (first principal component extracted from numbers of riots,

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6 Redistributing incomes among agents is not the only way to increase efficiency. A scheme of education subsidies financed through taxation of future incomes (intertemporal redistribution) recreates the missing market, and allows the achievement of the first best. See Banerjee and Newman (1993).

7 Benabou (1996c) states that one standard deviation reduction in inequality increase GNP per capita of about 0.5-0.7%. Perotti (1996) finds that a GNP 1% increase in middle incomes (proxied by 3° and 4° quartile in income distribution) yields an increase in GNP per capita growth rate in the order of 0.2%. Persson and Tabellini (1994) provide a higher estimate (in the order of 0.7%).

8 Which actually is positive and significant, as found in Perotti (1996). The same author, when acting as a discussant of Benabou (1996c), suggested a reverse causation: fast growing economies have more resources available for redistribution. Alesina (1998) points out that most of the redistributive policies in developing countries mainly benefit the middle-classes.

assassinations, coups); but their analysis has no predictive power, and the possibility of measuring political instability is questionable.[9]

It is more difficult to test the second line of research in the absence of information at the individual level about income and educational choices of the family. Using aggregate data Perotti (1994) finds that a subjective qualitative measure of credit market rationing is statistically significant in explaining growth only when interacted with income inequality. However the most convincing piece of evidence in this respect comes from the comparison between Far Eastern countries and Latin American ones. The former are characterised by lower inequality and greater access to school, whereas the latter exhibit the reverse situation; possibly for this different patterns, the first area experienced sustained growth during the 70s and the 80s, while the second area underwent stagnation.[10]

The present study provides additional support to this argument by showing that income inequality reduces school enrolment. The next section presents a formal model of educational choice, showing that when financial markets are absent (or imperfect) the desired amount of schooling is proportional to family income.[11] Under log-linearization and log-normality in the distribution of incomes, it is proved that school enrolment and Gini concentration index

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[9] The relationship between inequality and political instability can be read in a reverse way: harsh social conflict (for example during a coup) may cause high number of killings but, if successful, introduces regressive policies that increase income inequality (e.g. the Chilean case).

[10] Bourguignon (1994) finds an overall negative relationship between inequality and growth on a sample of 35 developing countries of small-medium size. His results are mainly driven by the sub-sample of Asian countries, which experienced early land redistribution and more compressed income distribution, combined with government effort to encourage higher education. He also points out that a positive relationship between inequality and growth could apply to Latin America countries, via financing of investment (more inequality implies greater profits and therefore more financing opportunities for investment). Brandolini and Rossi (1998) make an effort to strengthen data comparability in a sample of 17 countries, and do not find a persistent relationship between household incomes inequality and growth (even if they speak of *social institutions*, where the link could be either positive or negative depending on the country area).

[11] It is not clear whether one should speak of income or wealth inequality. Theoretical models tend to escape the question using two simplifying assumptions: Cobb-Douglas utility functions (savings become a constant fraction of earned income, and with identical return on invested capital in the long run wealth and income distributions coincide) and direct proportionality between earnings and human capital (the easiest way is to assume that earnings are a (log) linear function of invested human capital). Given the absence of fertility choices (in most overlapping generations models population is assumed to be constant), wealth, income and human capital distributions are identical in the long run.

on incomes are linearly related. Section 3 describes the dataset and section 4 presents the estimates of school enrolment rates at different level (primary, secondary and tertiary) in an unbalanced panel of 102 countries for the period 1960-90. The final section contains concluding remarks.

II A FORMAL MODEL

Let us introduce an overlapping generations model with constant population of *n* individuals. In the first period of her life, each agent allocates her total amount of time ($\overline{T}$) among going to school (S_t), working (L_t) and leisure (T_t). The amount spent in school increases the human capital of the agent, and consequently raises the wage in the second period. Thus

EQUATION 1

$$\overline{T} = S_t + L_t + T_t$$

In the second period she works, consumes (C_{t+1}) and leaves a bequest (X_{t+1}) to her offspring.[12]

2.1 Technology

This economy is populated with *n* small identical firms, each one producing a homogeneous commodity.[13] Their technology is given by

EQUATION 2

$$Y_t = \left(\sum_i H_t L_t \right)^{\beta} \overline{K}^{1-\beta}$$

Total output (Y_t) is net of capital depreciation, the stock of physical capital ($\overline{K}$) is fixed, and the labour input is given by the sum of human capital endowment (H_t) of existing workers (L_t). To avoid further complications required by saving decisions of different classes,[14] we assume that the ownership of fixed capital is external to this economy (for example, by foreign capitalist holding the control of the productive sector in a developing

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[12] Commodity consumption in the first period and leisure in the second period have been neglected for simplicity.

[13] This assumption can be easily relaxed, since each firm is paying the same wage rate per unit of human capital, and skilled and unskilled workers are perfect substitutes.

[14] See Bertola (1993, 1994 and 1998).

economy). This dispenses us from analysing financial savings decision, and focuses on human capital investment.

The firms face an infinitely elastic demand for the commodity at a given price ($\overline{P}$). Then profit maximisation induces the following labour demand

EQUATION 3

$$\left(\sum_i H_t L_t\right) = \overline{K} \cdot \left(\frac{\beta \overline{P}}{W_t}\right)^{\frac{1}{1-\beta}}$$

In each period total labour supply is given by the sum of the human capital supply from the young $\left(\sum H_t^y L_t^y\right)$ and the human capital supply of the old $\left(\sum H_t^o L_t^o\right)$, where $L_t^j, i = 0,1,....,\infty,\ j = y,o$ is the labour supply of an individual born in period *i* and appearing in the market in the first (*y*) or in the second (*o*) period of her life. If each person is born with a unitary capital endowment ($H_t^y = 1, \forall t$), leisure consumption is ruled out in the second period of life and the length of the working time is normalised to one ($L_t^o = 1, \forall t$), labour market equilibrium is given by

EQUATION 4

$$W_t = \beta \overline{P} \left(\frac{\overline{K}}{L_t + H_{t-1}}\right)^{1-\beta}$$

where, in order to simplify notation, L_t represents the labour supply of a young person and H_{t-1} is the human capital achievement of the (contemporaneous) old person.[15] Notice that H_{t-1} is predetermined, because it is based on decisions undertaken in the previous period; on the contrary, the labour supply decision of the young generation creates a negative externality on the earnings of the old generation. If working during her youth, an agent earns an income equal to

EQUATION 5

$$W_t L_t = \beta \overline{P} \left(\frac{\overline{K}}{L_t + H_{t-1}}\right)^{1-\beta} L_t$$

15 In each period there are 2*n* persons contemporaneously alive, half of which are young. Competition among *n* firms allocates 2 workers to each firm; competition among workers allocates one old person and one young person to each firm. Alternative allocations (for example 2 or more old persons within the same firm) would offer different wages (because of diminishing marginal productivity), and the worker would be attracted away by firms offering higher wages.

Human capital can be accumulated through spending some time during youth in school. The human capital producing technology is given

EQUATION 6

$$H_t = E_t^{\gamma} S_t^{\theta}$$

where E_t indicates total resources devoted to education and is intended to capture all the different aspects (public expenditure in education, social capital, family background). When old, a person earns an income equal to

EQUATION 7

$$W_{t+1} H_t = \beta \overline{P} \left(\frac{\overline{K}}{L_{t+1} + H_t} \right)^{1-\beta} E_t^{\gamma} S_t^{\theta}$$

Therefore education is rewarded in the labour market, and the return is increasing in the state of technology of production (as proxied by $\overline{K}$) and in the amount of resources invested in education (as proxied by E_t).

2.2 Preferences

Individuals are altruistic, and their preferences are defined over leisure when young, and consumption and bequest when they are old.

EQUATION 8

$$U(T_t, C_{t+1}, X_{t+1}) = (1+\rho)\lg(T_t) + \alpha \lg(C_{t+1}) + (1-\alpha)\lg(X_{t+1})$$

where C_{t+1} indicates the commodity consumption when old and X_{t+1} is the bequest left over to the next generation; ρ is the intertemporal discount rate.

2.3 Optimal choice of education

Education has a per unity cost of access equal to B_t (think of enrolment fees, textbooks, etc.), and therefore the cost of accessing education ($S_t B_t$) is proportional to the preferred amount of education. When financial markets are absent,[16] the budget constraints in the two periods are independent.

EQUATION 9

$$S_t B_t = W_t L_t + X_t$$

16 Financial markets for financing investment in education are very thin or in most cases absent. The imperfection of financial markets in this case can be explained by the impossibility to collaterise future effort on the job. See Piketty (1997).

EQUATION 10

$$C_{t+1} + X_{t+1} = W_{t+1} H_t$$

where X_t is the inherited wealth from the parents. The optimal choice of education is given by

EQUATION 11

$$S_t = \frac{X_t + W_t \overline{T}}{B_t + W_t + (1+\rho)\dfrac{W_t + B_t / \eta_{WL}}{\theta(\beta - \eta_{WL})}} = f\left(\underset{+}{X_t}, \underset{-}{B_t}, \underset{\pm}{W_t}, \underset{\pm}{\eta_{WL}} \right), \eta_{WL} = \frac{\partial W}{\partial L} \cdot \frac{L}{W}$$

Notice that when financial markets are absent, the optimal amount of education depends linearly on inherited wealth, whereas the cost of accessing education has a negative impact. The prevailing wage rate in the labour market has both an income and a substitution effect. The income effect (through the numerator) is positive because it raises the value of the agent's endowment. The substitution effect (through the denominator) is negative because attending school has the opportunity cost of foregone income. For the very same reasons the wage elasticity has an ambiguous effect.[17]

The alternative case to be considered is the existence of imperfect financial markets. The imperfection is modelled as a dependence of the interest rate on individual wealth. If we consider the possibility of debt default, the incentive to repudiate is proportional to the borrowed amount. If all the borrowers have

---

17 This is evident if we consider the first order conditions corresponding to the maximisation of utility (8) under the constraint given by equations (1)-(5)-(7)-(9)-(10). Solving initially for C_{t+1} and X_{t+1} and replacing these optimal choices we are left with the following problem

$$\max_{L_t, S_t} (1+r)\lg\left(\overline{T} - L_t - S_t\right) + \lg\left(W_{t+1}(S_t)\right) + \theta \lg(S_t) + \text{constant} + \mu\left[S_t B_t - W_t(L_t) L_t - X_t\right]$$

Equating the two first order conditions leads to

$$S_t = \frac{1}{\mu} \cdot \frac{\eta_{WS} + \theta}{W_t \eta_{WL} + B_t} = \frac{1}{\mu} \cdot \frac{\theta(\beta - \eta_{WL})}{W_t \eta_{WL} + B_t}$$

where

$$\eta_{WL} = \frac{\partial W_t}{\partial L_t} \cdot \frac{L_t}{W_t} = -(1-\beta)\frac{L_t}{L_t + H_{t-1}} \cong -(1-\beta)\delta,$$

$$\eta_{WS} = \frac{\partial W_{t+1}}{\partial S_t} \cdot \frac{S_t}{W_{t+1}} = -(1-\beta)\theta \frac{H_t}{L_{t+1} + H_t} \cong -(1-\beta)\theta(1-\delta) = -(1-\beta+\eta_{WL})\theta$$

μ = Lagrange multiplier $= \dfrac{dU}{dX_t}$

For a constant μ (i.e. when the income effect is excluded), we get $\dfrac{\partial S_t}{\partial W_t} < 0$ and $\dfrac{\partial S_t}{\partial \eta_{WL\,t}} < 0$.

the same probability of default (i.e. they belong to the same class of risk), the lender can ration the credit by setting an interest rate increasing with the requested loan. In the context of the present model, every agent would like to acquire the same amount of education, but someone can finance it with family wealth, whereas someone else has to go on the financial market. The poorer an agent, the higher the required loan, the higher the interest rate charged by the lender. In a reduced form, the interest rate is inversely related to family wealth.[18]

EQUATION 12

$$R = R(X_t), R' < 0$$

The intertemporal budget constraint now writes as

EQUATION 13

$$S_t B_t + \frac{C_{t+1} + X_{t+1}}{1 + R(X_t)} - W_t(S_t) L_t - X_t - \frac{W_{t+1} H_t}{1 + R(X_t)} = 0$$

and the optimal choice of education is

EQUATION 14

$$S_t = \left\{ \frac{[1 - (1 - \beta + \eta_{WL})\theta] W_{t+1}(S_t) E_t^{\gamma}}{(W_t \eta_{WL} + B_t)(1 + R(X_t))} \right\}^{\frac{1}{1-\theta}} = f\left(\underset{+}{X_t}, \underset{-}{B_t}, \underset{-}{W_t}, \underset{-}{\eta_{WL}}, \underset{+}{E_t} \right)$$

With the existence of financial markets the ambiguity of substitution and income effects disappears, and one is able to sign each partial derivative. Family wealth still favours the acquisition of education via a reduction in the relevant interest rate. An increase in the cost of education lowers its demand, but there can be a countervailing effect coming from total resources employed in education. Eventually, the current wage in the labour market works as an opportunity cost, thus reducing the demand for education.

2.4 Testable implications

Whether financial markets for education financing exist and/or work closely to the ideal of market perfection is an empirical issue to be judged case by

[18] An alternative explanation, leading to the same reduced form, is that a lender takes family wealth as collateral, and charges lower rates to people offering more valuable collaterals. Examples of the interest rate being dependent of family wealth can be found in Galor and Zeira (1993) or Banerjee and Newman (1993). Empirical evidence on the relevance of borrowing constraints in human capital investment can be found in Lillard (1998) and Gaviria (1998); different opinions are reported in Mulligan (1997).

case. Nevertheless, equations 11 and 14 provide us with testable predictions on the determinants of educational achievements:

- *Family income* (or wealth) exerts a positive effect, which declines when financial markets imperfections decline.
- The *cost of education* creates a barrier to accessing education, which can be lowered with an increase of *public resources invested in education*.
- *Wage differential in favour of educated workers*: a lower differential (i.e. a higher W_t for any given W_{t+1}) raises the opportunity cost of schooling and reduces education.

Moving towards empirical testing of these predictions, we can log-linearize equation 14 obtaining

EQUATION 15

$$\lg(S_t) = s_t = \text{constant} + \frac{1}{1-\theta}\lg(1 + R(X_t)) - \frac{1}{1-\theta}\lg(W_t\eta_{WL} + B_t) + \frac{\gamma}{1-\theta}\lg(E_t) + \frac{1}{1-\theta}\lg(W_{t+1}(S_t)) =$$

$$= \text{constant} + \frac{1}{1-\theta}\lg(1 + R(X_t)) - \frac{1}{1-\theta}\lg(W_t\eta_{WL} + B_t) + \frac{\gamma}{1-\theta}\lg(E_t) + \frac{1-\beta}{1-\theta}\lg(\overline{K}) - \frac{1-\beta}{1-\theta}\lg(L_{t+1} + E_t^{\gamma}S_t^{\theta})$$

and using first order approximation

EQUATION 16

$$\lg(S_t) = \alpha_0 + \alpha_1\lg(X_t) + \alpha_2\lg(W_t) + \alpha_3\lg(B_t) + \alpha_4\lg(E_t) + \alpha_5\lg(\overline{K})$$

or using small letters to indicate logarithms

EQUATION 17

$$s_t = \alpha_0 + \alpha_1 x_t + \alpha_2 w_t + \alpha_3 b_t + \alpha_4 e_t + \alpha_5 \overline{k}$$

with expected signs $\alpha_1 \geq 0, \alpha_2 < 0, \alpha_3 < 0, \alpha_4 > 0, \alpha_5 > 0$.

Given the assumption of identical individuals but inherited wealth, the distribution of s_t will reflect the distribution of x_t, all the other variables being shifting parameters for the entire distribution. Equation 17 can be re-expressed more concisely as

EQUATION 18

$$s_t = \overline{\alpha}_0 + \alpha_1 x_t,\ \overline{\alpha}_0 = \alpha_0 + \alpha_2\overline{w} + \alpha_3\overline{b} + \alpha_4\overline{e} + \alpha_5\overline{k}$$

If we accept the rather plausible assumption that family incomes X are log-normally distributed, then $x \sim N(\mu_x, \sigma_x^2)$ and $s \sim N(\overline{\alpha}_0 + \alpha_1\mu_x, \alpha^2\sigma_x^2)$. If we had individual information about education and family background, we could easily test the validity of the previous model by estimating equation 18 cross-

individuals.[19] Unfortunately, we only have this information available for a few countries and for very few years. On the contrary, we have more information available on their distribution. School enrolment rates can be thought as intervals of the cumulative distribution function:

EQUATION 19

$$P_1 = \text{primary school enrolment} = \int_{n_1}^{\infty} f(S)dS$$

$$P_2 = \text{secondary school enrolment} = \int_{n_2}^{\infty} f(S)dS$$

$$P_3 = \text{tertiary school enrolment} = \int_{n_3}^{\infty} f(S)dS$$

where n_1, n_2 and n_3 are respectively the number of years required to complete the primary, secondary or tertiary level of education, and $f(S)$ is the density function of *S*. In addition, the statistics on income distribution most widely accessible is the Gini concentration index[20]

EQUATION 20

$$G_X = 1 - 2\int_0^{\infty}\left[\frac{1}{\overline{X}}\int_0^{Y} Xg(X)dX\right]g(Y)dY$$

where $g(X)$ is the density function of *X* and the term in squared brackets is the proportion of total income received by the population with an income less or equal to *Y*.

Under the joint assumption of the validity of the model described by equation 18 and the log-normal distribution for *X*, school enrolment and Gini index are linked by a linear relationship. In fact, when $x \sim N(\mu_x, \sigma_x^2)$ its density function is given by

EQUATION 21

$$N(x;\mu_x,\sigma_x^2) = \frac{1}{\sigma_x\sqrt{2\pi}}\exp\left[-\frac{(x-\mu_x)^2}{2\sigma_x^2}\right]$$

and the associated Gini index[21] is

---

[19] The estimate of $\hat{\alpha}_1$ would obviously be biased if individuals are heterogeneous with respect to ability, and ability is correlated with family background. See Card (1994).

[20] See for example Cowell (1995: 141).

[21] See Zenga (1984).

EQUATION 22

$$G_X = 2\int_{-\infty}^{\frac{\sigma_x}{\sqrt{2}}} \frac{1}{\sqrt{2\pi}} \exp\left[-\frac{t^2}{2}\right] dt - 1 = 2\int_{-\infty}^{\frac{\sigma_x^2}{\sqrt{2}}+\mu_x} \frac{1}{\sigma_x\sqrt{2\pi}} \exp\left[-\frac{(x-\mu_x)^2}{2\sigma_x^2}\right] dx - 1$$

In addition, when $s \sim N(\overline{\alpha}_0 + \alpha_1\mu_x, \alpha^2\sigma_x^2)$, its density function is given by

EQUATION 23

$$N(s; \overline{\alpha}_0 + \alpha_1\mu_x, \alpha_1^2\sigma_x^2) = \frac{1}{\alpha_1\sigma_x\sqrt{2\pi}} \exp\left[-\frac{(s-\overline{\alpha}_0-\alpha_1\mu_x)^2}{2\alpha_1^2\sigma_x^2}\right] =$$

$$= \frac{1}{\alpha_1\sigma_x\sqrt{2\pi}} \exp\left[-\frac{(x-\mu_x)^2}{2\sigma_x^2}\right]$$

Enrolment rates can now be redefined as[22]

EQUATION 24

$$P_i = \int_{\log(n_i)}^{\infty} f(s)ds = 1 - \int_{-\infty}^{\log(n_i)} f(s)ds = 1 - \int_{-\infty}^{\frac{\log(n_i)-\overline{\alpha}_0}{\alpha_1}} \frac{1}{\alpha_1} f(x)\alpha_1 dx =$$

$$= 1 - \frac{1}{2}\left[2\int_{-\infty}^{\frac{\sigma_x^2}{\sqrt{2}}+\mu_x} f(x)dx + 2\int_{\frac{\sigma_x^2}{\sqrt{2}}+\mu_x}^{\frac{\log(n_i)-\overline{\alpha}_0}{\alpha_1}} f(x)dx\right] =$$

$$= \left[\frac{1}{2} - \int_{\frac{\sigma_x^2}{\sqrt{2}}+\mu_x}^{\frac{\log(n_i)-\overline{\alpha}_0}{\alpha_1}} f(x)dx\right] - \frac{1}{2}\left[2\int_{-\infty}^{\frac{\sigma_x^2}{\sqrt{2}}+\mu_x} f(x)dx - 1\right] = \gamma_i - \frac{1}{2}G_X, i = 1,2,3$$

The intuition underlying this relationship can be grasped by observing Figure 2. In the upper quadrant there are two normal density functions, the solid line corresponding to the case of $\mu_x = 0, \sigma_x^2 = 1$, and the dashed line to the case of $\mu_x = 0, \sigma_x^2 = 2$. This translates below into the corresponding cumulative distribution function (north-east quadrant). Assuming a linear combination of the type $s = 0.5 + 0.8 \cdot x$ (south-east quadrant), this maps the cumulative distribution function of $s \sim (0.5, 0.64)$ or $\sim (0.5, 1.28)$ (south-west quadrant). In the last (north-west) quadrant we have reported to Lorenz curve

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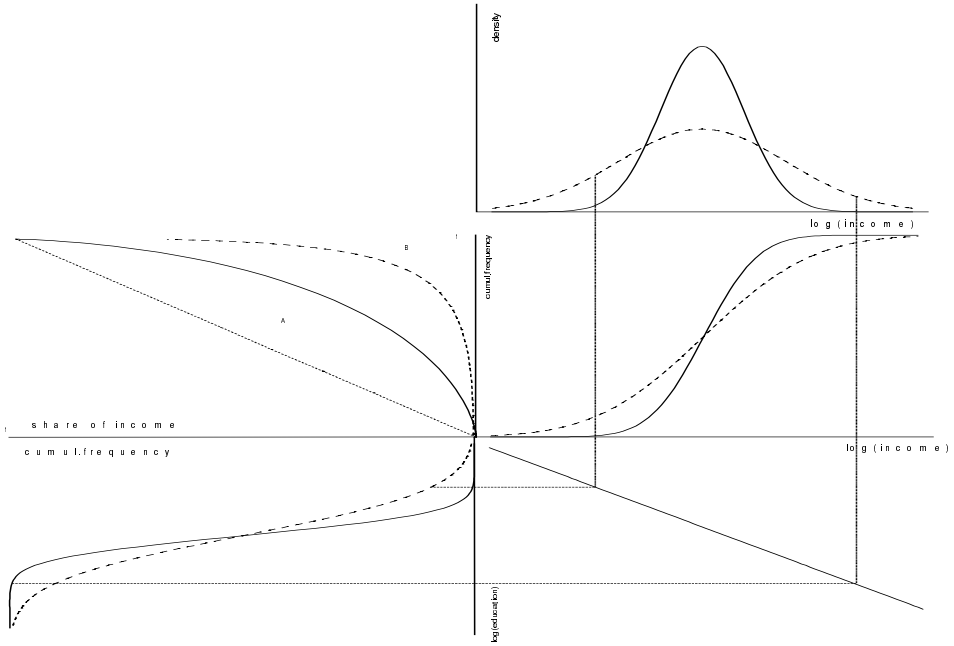
22 Whenever $\frac{\log(n_i)-\overline{\alpha}_0}{\alpha_1} < \frac{\sigma_x^2}{\sqrt{2}} + \mu_x$ one has to consider the opposite of an integral with inverted extremes of integration.

corresponding to the distribution of x.[23] Now let us consider an increase in the dispersion of incomes around a given mean (i.e. the passage from the solid to the dashed line). This implies an increase in the population share with an income below any given value, and correspondingly an increase in the population share that is unable to achieve the income threshold which is necessary to access a fixed amount of education.

FIGURE 2
THE EFFECT OF AN INCREASE IN INCOME DISPERSION

Figure 2 - The effect of an increase in income dispersion



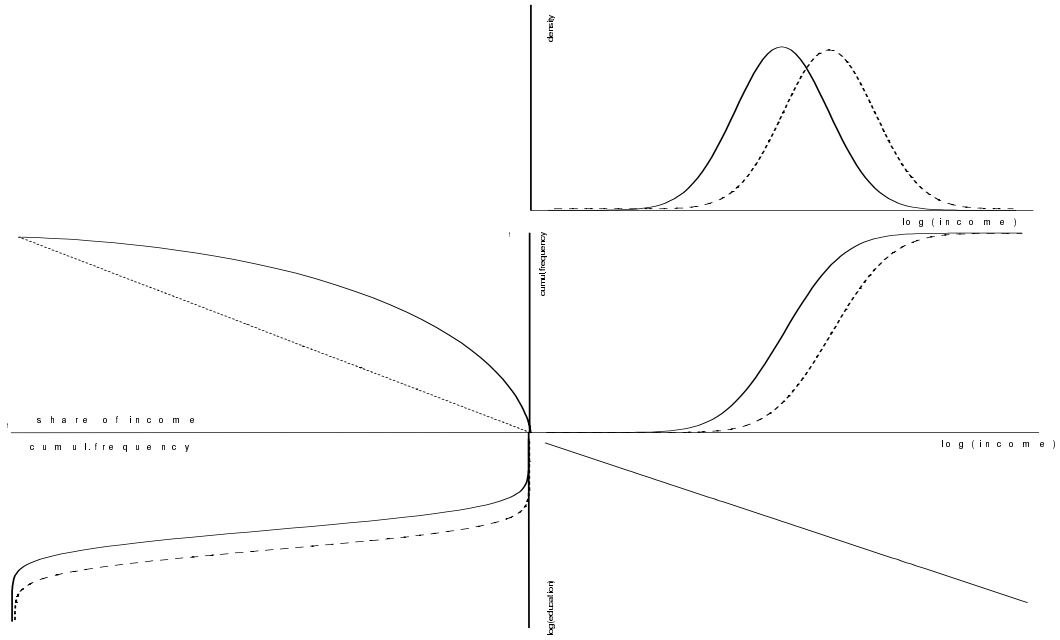
Source: Author's elaboration.

At the same time the Gini concentration index for incomes increases. We find corroboration of the negative association of Gini index for incomes and school participation rates. Figure 3 and 4 consider alternative cases where we have variation in the distribution of s independently of changes in income dispersion (as measured by the Gini concentration index). Figure 3 shows the case of an increase in mean income (from 0-solid line to 1-dashed line) for a given variance ($\sigma_x^2 = 1$). We obtain here an increase in the access to education for any level of income, given a constant Gini index.

FIGURE 3
THE EFFECT OF AN INCREASE IN MEAN INCOME

[23] It is known that the Gini concentration index corresponds to the ratio of the areas in the Lorenz graph: $G_X = \frac{A}{A+B}$.

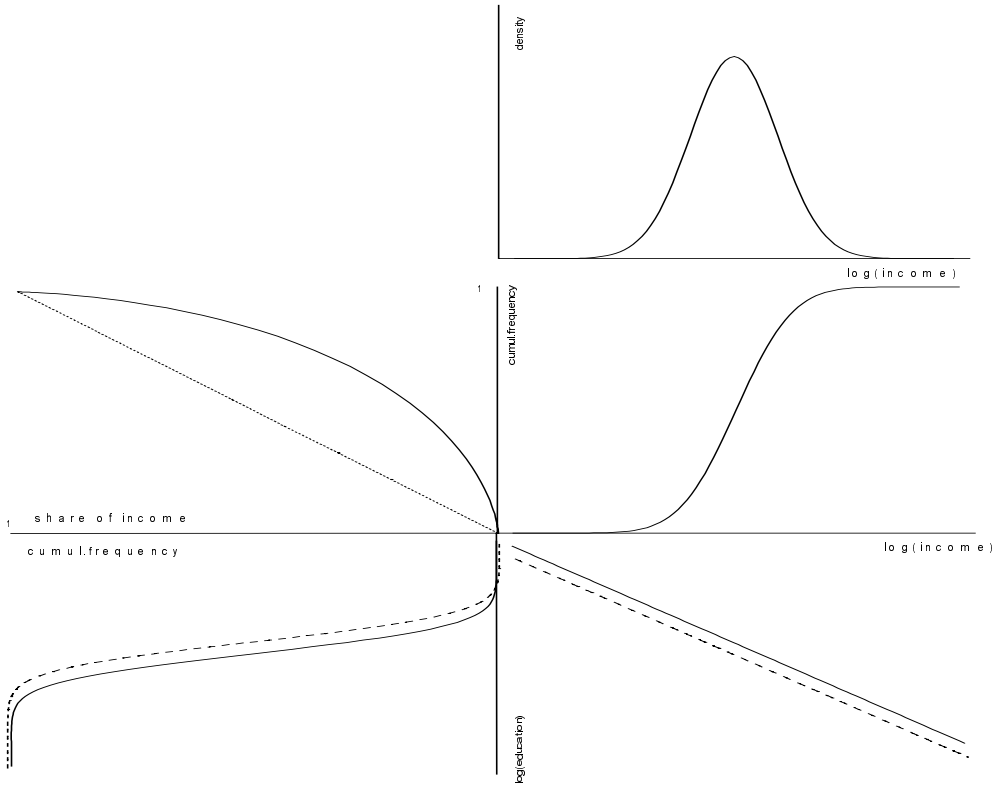
Figure 3 - The effect of an increase in mean income



Source: Author's elaboration.

FIGURE 4
THE EFFECT OF AN INCREASE IN PUBLIC SPENDING IN EDUCATION AND/OR IN THE DEMAND FOR SKILLS

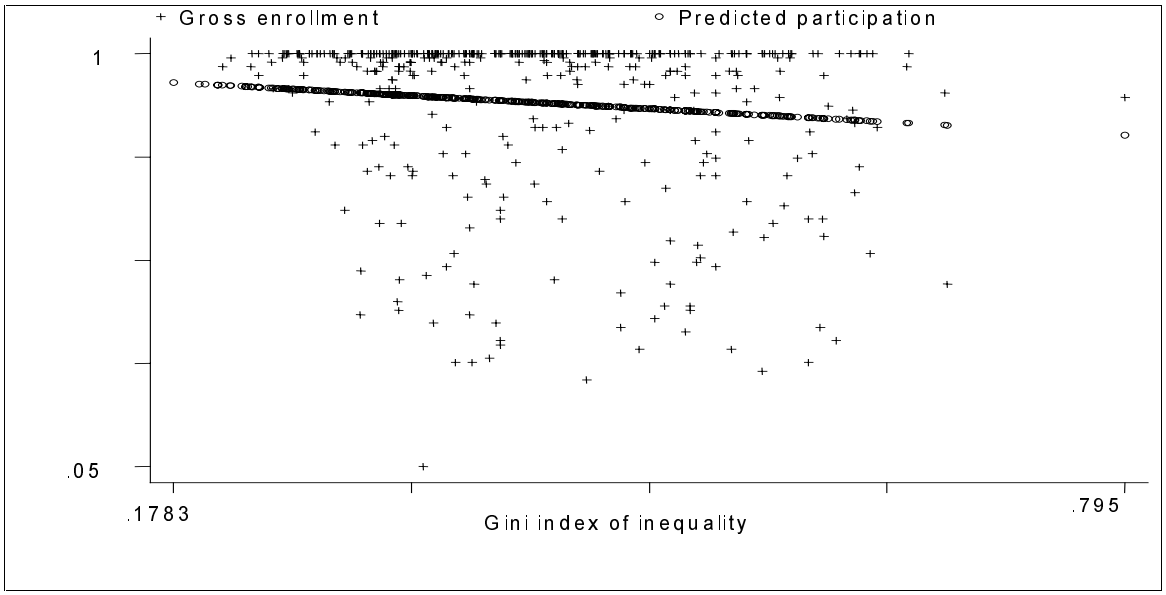
Figure 4 - The effect of an increase in public spending in education and/or in the demand for skills



Source: Author's elaboration.

Finally Figure 4 keeps income distribution constant and modifies the relationship between income and education (due to a change in the parameter $\overline{\alpha}_0$, that reflects educational expenditure, technology and returns to schooling). The solid line corresponds to the case of $s = 0.5 + 0.8 \cdot x$, whereas the dashed line depicts the case $s = 1 + 0.8 \cdot x$. Once again, we obtain an increase in educational achievements for any given level of income.

FIGURE 5
PRIMARY EDUCATION



Source: Author.

Summing up, in the context of an overlapping generation model with financial markets imperfections we have shown that the optimal investment in human capital depends, among others, on the family income. As long as one is able to control for the mean income and other variables affecting the educational choice in the aggregate (cost of accessing the school, public resources devoted to education, wage premium for educated workers in the labour market), we expect to find a negative relationship between the Gini concentration index on income distribution and enrolment rates at any level of education.

TABLE 1
DESCRIPTIVE STATISTICS - ENTIRE SAMPLE

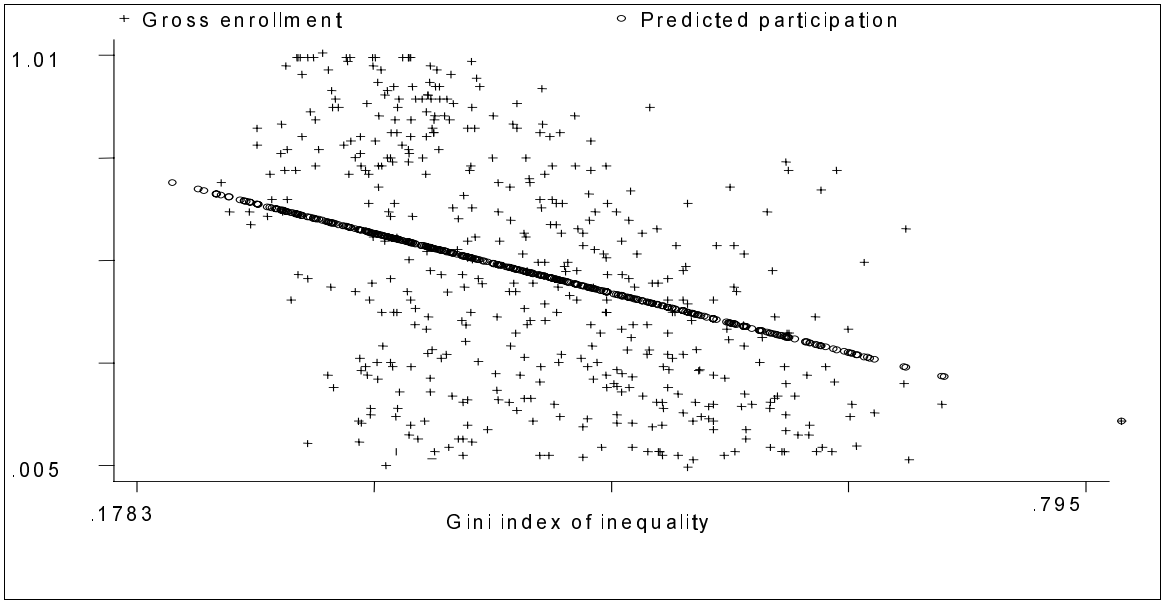
III DATA DESCRIPTION

The data utilized in this analysis come from different sources; data on educational achievements and school quality are from Barro and Lee (1994, 1996, 1997)[24]. Data on income inequality are from Deininger and Squire (1996); data on physical capital stocks are from Nehru and Dhareshwar (1993); finally, data on female fertility, children mortality and population growth have been extracted from World Bank (1998). Data refer to 102 countries for the period 1960-90 and report information at quinquennial intervals: therefore at best we have 7 observations for each country. However with a theoretical dimension of the dataset equal to 714 observations (102×7), missing information (mainly on income distribution) reduces it by more than one third, converting it in an unbalanced panel. For the main variables (income inequality indices, enrolment rates, gross national products and population) we rely on 420 observations (with an average of 4.1 observations per country), but in most cases when considering additional information this number has to be reduced even further. Descriptive statistics about these main variables are reported in Table 1 (entire dataset), whereas information on additional control variables available are reported in Table A2 in the Appendix. Regional averages are also reported in the Appendix (tables A1.a-A1.g).

On the whole, these data cover almost half of the 210 countries listed by the World Bank (1998), but account for 86.3% of the world population (as measured in 1990). Given the fact that this dataset is forcibly tailored according to the availability of income distribution data, one may suspect the possible introduction of sample bias. In order to check this possibility, using all the available information on a greater set of 126 countries, we have run a probit regression predicting the availability of data on income distribution (see Table A3 in the Appendix). The results are reassuring: there is only evidence of easier availability of data for bigger countries and for more recent years. In particular, availability of information on income distribution seems unrelated with information on school enrolment. Therefore we think that this dataset may provide a representative picture at the world level of the determinants of schooling participation.

[24] Barro and Lee (1994) is in turn based on Summers and Heston (1991).

FIGURE 6
SECONDARY EDUCATION



Source: Author.

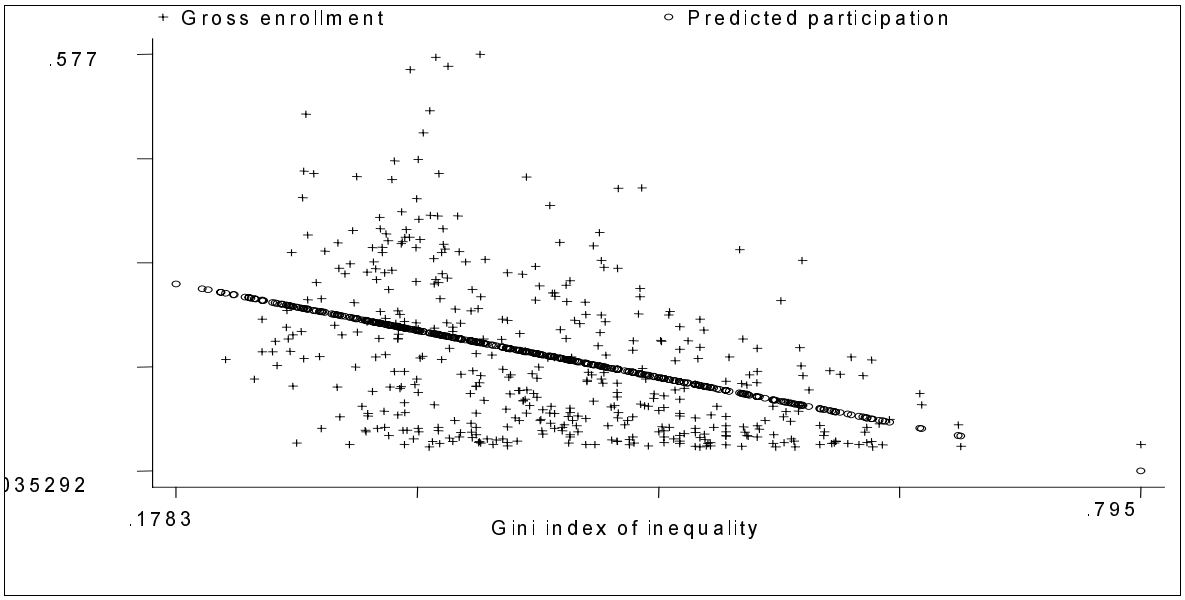
Looking at the descriptive statistics (Table 1), we find evidence of well-known stylised facts. In the aggregate data inequality in income distribution has declined during the 60´s and the 70´s, then showing an upward surge during the 80´s. However when looking at regional areas, we cannot find a uniform pattern, thus providing some support to the argument that inequality does not exhibit a specific trend in post-war period.[25] Inequality is highest in Sub-Saharan Africa and Latin America, and lower in industrialised countries and South Asia. Educational achievements were quickly rising during the first two decades, but this rise slowed down during the 80´s. By the beginning of the 90´s, many countries have succeeded in having all the population enrolled in primary education (OECD countries, Latin America, North Africa and East Asia). However, while OECD countries have almost reached the complete saturation also for the second stage of secondary education, all the other countries are still lagging behind, the worst situation being recorded for Sub-Saharan and South-Asian countries. Analogous picture emerges when looking at higher education.

Graphical inspection of the association between school enrolment and income inequality confirms that most of the countries have achieved full participation in education at the primary level, thus reducing the potential variation in the former variable (Figure 5). On the contrary, at the secondary and tertiary level of education, a negative correlation emerges clearly (Figures 6 and 7).

[25] See, for example, Grilli (1994), Jones (1997) or Li, Squire and Zou (1998).

However, at this stage we ignore whether this evidence is the result of spurious correlation (when for example inequality and school participation are both function of the stage of development) or it represent a genuine effect. To ascertain the nature of this effect we have to move to multivariate regressions.

FIGURE 7
HIGHER EDUCTION



Source: Author.

IV THE EMPIRICAL ANALYSIS

In the sequel we investigate the determinants of enrolment rates at different stages of education, and in particular we will concentrate on the effects of income distribution.[26] As the model presented in Section 2 should clarify, the observed enrolment rate is a reduced form incorporating elements describing household behaviour (demand for schooling) and government provision of

[26] Deininger and Squire (1996) provide data of different quality, according to the coverage of the sample, the inclusion/exclusion of non-labour incomes and information about the recipients (individuals or families). Using what they define 'high quality' data reduces the available observations to 277. However the results are not very different when extended to include the 'low quality' data, even if given their greater variability the estimates are less efficient. They also stress the different source of information (incomes or expenditures), but controlling with a dummy on this aspect (either unconstrained or interacted with the Gini variable) does not lead to statistically significant results. Estimates on a restricted sample including only 'high quality' data are available from the author. Finally, we have also added to the original Deininger and Squire 1996 dataset 5 additional observations on Gini concentration index—from Honkkila (1998) and World Bank (1998).

this public service (supply of schooling).[27] On the supply side, information about state spending and employed teachers is available; on the demand side, beyond information about income distribution, we will consider demographic factors (birth rates), family composition (fertility rates) and socio-cultural environment (proxied here by the mortality rates). Given that schooling is a stage-by-stage process (you cannot enrol at the university unless you have completed secondary school), the educational achievement at a certain stage is conditioned by the achievement obtained at the previous stage: given the absence of detailed information on schooling flows, we will proxy this effect with the average achievement of the entire population for that level of education. Finally, we will control for the stage of development by conditioning on the level of real GNP per capita.

Let us recall here that under the existence of financial markets for education financing, one should not find evidence of any effect of family income on educational choice for children. Otherwise, if we find a significant and negative effect (more income inequality reduces access to education), this can be taken as an additional piece of evidence for the existence of borrowing constraints preventing educational choice for the poorer segments of the population.

4.1 Primary education

Full enrolment for primary education has almost been completely achieved by all countries, especially in most recent years. The public push towards attending compulsory education has lowered any financial barrier to accessing education, at least at this stage. In fact, we do not find evidence of any significant effect of income distribution (as measured by Gini indices) on gross enrolment for primary education. Since the Gini index does not provide a complete ordering of income distributions (because of crossing of corresponding Lorenz curves) we have also experimented with the income share accruing to the poorest segment of the population, the lowest quintile.

[27] Information on the private provision of schooling are scattered, and therefore we cannot take into account information on the supply of private schooling. Arnove *et al.* (1997) report an impressive increase of private institutions providing education, especially at the university level, as a consequence of the decline in public expenditure in education: in Latin America the share of students enrolled in private universities raised from 5% in 1970 to approximately 30% in 1990.

Insert tabel 2

Even in this case, the variable is statistically non-significant. Columns 1 and 2 of Table 2 report the fixed effect OLS regressions, whereas random effect estimations are reported in the Appendix (Table A4). However financial barriers still exist for the female component of student population: Column 4 of Table 2 re-estimates Column 1 by restricting to female primary enrolment, and we find here a negative significant impact of income distribution. This is evidence that expansion of compulsory education has mainly benefited boys, independently of availability of financial resources from the family. It is interesting to note that the same effect does not carry over to the random effect estimation (Column 4 in Table A4 in the Appendix): this implies that there is something which is really country-specific in this effect. In other words, financial resources still preclude the access to primary education of girls from poor families in some countries. Why families are more available to afford educational expenditure for boys than for girls is strongly intertwined with cultural habits.[28] Some additional effect of income distribution can be found looking at mortality rates. If we take child mortality as a proxy for extreme poverty, we find a significant negative impact on enrolment into primary education.[29]

On the supply side, one finds evidence of a negative impact of population growth (as measured by the crude birth rate), because it necessarily implies a decline of per child resources. And it is also true that for many countries, limited resources available may prevent school attendance.[30] This could constitute the explanation of the rather counterintuitive result of the number of students per teacher exhibiting a significant and positive impact (instead of a negative one, as one would have expected thinking of greater resources and

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[28] And social structures, at least for the case of castes in India. In this country primary education is not compulsory, and child labour is legal. The huge variation in literacy rates (which is 74% among urban males and 20% among rural females) is supposedly explained by the following factors: 'The central proposition of this study is that India's low per capita income and economic situation is less relevant as an explanation than the belief systems of the state bureaucracy ... At the core of these beliefs are the Indian view of the social order, notions concerning the respective roles of upper and lower social strata, the role of education as a means of maintaining differentiations among social classes, and concerns that 'excessive' and 'inappropriate' education for the poor would disrupt existing social arrangements.'; see Weiner (1991: 5).

[29] Unfortunately children mortality proxies too many effects that interplay with primary education. For example, children mortality is negatively correlated with mother education and with health conditions (sanitation, doctors availability, etc.). For this reason we do not want to put excessive emphasis on an 'income distribution' interpretation.

[30] In the case of Tanzania, for example, where primary attendance was 0.34 in 1970, 0.70 in 1980 and 0.93 in 1990, class dimension can vary between 30 to 74 in rural areas. See Tibaijuka and Cormack (1998).

better quality being associated with lower values of this variable). In other words, a greater number of students per teacher would indicate a country's efforts to catch up with full attendance of primary education.[31] We were unable to find strong effects of educational expenditure on enrolment: using the (log of) governmental current expenditure on primary education per pupil, the ratio of its level with per capita income and the (log of) average salary for a primary school teacher exerted a negative but statistically insignificant effect.[32] Using the ratio of the latter variable with per capita income exerts a significant negative effect (column 5 in Table 2), which requires some discussion. Following Hanushek (1995) we would expect an insignificant effect of financial resources on enrolment rates, because of inefficient allocation of resources. On the contrary, in accordance to the previous model, we expect that an increase in public resources *coeteris paribus* should facilitate school attendance, and therefore increase school enrolment. However we do not measure here the total financial effort of the state in supporting primary education, but only the relative wage of teachers. Thus, for given resources, better paid teachers necessarily implies less teachers, less or more crowded classes, and consequently less availability of the educational service.[33] This is for example the explanation advanced for the decline in primary enrolment for sub-Saharan Africa in the last decade by Ridker (1994).[34] Should we take this evidence as supporting the idea of cutting teachers' wages as a measure to increase school participation? Not necessarily; and for at least two reasons. The first one is the limited size of this effect: with the estimated coefficient, in order to increase primary enrolment of 1% it would be necessary (at given GDP per capita) to almost half the existing wage level. Second, at least in the case of Africa, it is argued that given the already low level of pay a reduction in teachers' wages would induce a reduction in effort, in order to supplement their income with additional jobs.[35] We will return to this issue in the concluding section.

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31 That the number of students per teacher does not represent a good proxy for school quality has already pointed out—see for example Hanushek (1986, 1995, 1996).

32 The estimated coefficients for these variable, including all the variables reported in Column 1 of Table 2, are respectively -0.013 (0.96), -0.001 (0.89) and -0.015 (1.33), with associated number of observations 343, 337 and 315.

33 Which could possibly be of higher quality if the teachers wage reflects their unobservable ability in teaching.

34 He notices that the lack of locally trained manpower attracts expatriates, which have higher reservation wages and are often remunerated with grant aids, then crowding out local competencies even further. A negative effect of teacher wages onto primary and secondary enrolment is also found by Schultz (1988).

35 This argument is made by Tibaijuka and Cormack (1998). However in our dataset teacher wages in Africa are not extremely low, at least in relative terms: in 1990 the

On the demand side, family background seems to account for some variation. If we take the fertility rate[36] as proportional to the average number of children in a family, we could expect either negative or positive effects. The former case applies when resources are binding—the greater the number of the children in a family, the lower are the resources per capita, the greater is the opportunity cost of school attendance. On the contrary, the latter case applies when supportive effects could be accounted for; in this case, the greater the number of siblings, the higher is the probability that someone else has already had some schooling experience, and therefore the higher is the chance of getting some help at home.[37] The relevance of the cultural environment (the so-called social capital) is also witnessed by the positive effect played by the stock of people with some (but not completed) primary education. The positive effect could be explained on two grounds: on one side, some of the population (older than 15 years) with uncompleted primary education could re-enrol into primary education, thus raising the gross rate of enrolment; on the other side, it may be correlated with the effort of a country to overcome illiteracy, and therefore it describes the pressure put on children to enrol and complete primary education.[38]

The process of schooling (even primary one) is obviously related to the stage of development of a country. If we measure this stage with the (real) gross domestic product per capita, we find effectively that primary enrolment is positively associated with its logarithm. But exploiting a suggestion originally advanced by Sen (1976), and subsequently followed by international agencies

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average salary for primary school teacher (measured in 1985 US dollar, converted with PPP) was 5442 (17 countries; ratio to per-capita gdp=3.5) for Sub-Saharan Africa, 10324 (8 countries; gdp ratio=2.5) for North Africa and the Middle East, and 7770 (11 countries; gdp ratio=2) for Latin America and the Caribbean.

[36] The fertility rate indicates the number of potential children that an 'average' woman—i.e. following the average behaviour of the country in terms of marriage age, frequency of pregnancies, etc.—could give birth to during her fertility period.

[37] Similar results were obtained by Schultz (1988) on a sample of 155 countries over the period 1950-80, when he found a positive effect of the relative size of school aged population onto enrolment rates for primary education.

[38] Introducing the illiteracy rate as explanatory variable comes out statistically significant with a negative sign, but the number of observation drops to 195 (corresponding to 69 countries). Analogously, if using the number of daily newspapers for 1000 inhabitants, one obtains a mildly significant (t-ratio 1.18) and negative coefficient, but the number of observation reduces even further (173 observations, for 82 countries, all of them referred to the 1980-90 period).

as a starting point to measure the degree of human development,[39] we correct the level of per capita product Y with the contemporaneous Gini concentration index G, thus obtaining a measure of 'inequality-adjusted real income' Y_{adjust}

EQUATION 25

$$Y_{adjust} = Y \cdot (1 - G)$$

Notice that when using the logarithm of Y_{adjust}, a one-percent increase in Y is (approximately) equivalent to a one point reduction in the Gini index. The variable Y_{adjust} comes out highly significant, with a rather low semi-elasticity of 0.05 (column 3 of Table 2); it implies that in order to obtain an increase in primary enrolment of 1% one would require an increase in per capita income of 20%, maintaining constant the inequality in income distribution. All the other variables keep previous signs and significance, but there is an increase in the explanatory power of this specification.[40]

Secondary education

When passing to secondary education, we find significant evidence of financial barriers to accessing this level of education. The Gini index comes out significantly negative: a 1 per cent decline in the index (more equalitarian distribution) implies a 0.25% rise in secondary enrolment (columns 1 and 2 of Table 3). The same effect is obtained when considering 'inequality-adjusted real income' Y_{adjust}, with a somehow lower impact (column 3 of Table 3). Analogous measures obtain for the random effect model (Table A5 in the Appendix).[41] Also in this case we find evidence of persistent discrimination against girls: a significant increase in inequality (say a $\Delta Gini = +0.05$) reduces secondary school enrolment to 1% for boys and 1.8% for girls. Notice in addition that the coefficient measuring the impact of inequality for girls is

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[39] See various issues of the *UNDP Human Development Report*.

[40] In addition to an increase in F test and R2 within statistics, this is confirmed by the Hausman specification test in the random effect version: see Column 3 of Table A4 in the Appendix. Substantially, Column 3 corresponds (approximately) to imposing a restriction on the coefficients of log$Y$ and G in Column 1, which cannot be rejected by the data. Imposing the restriction $coefficient(\log Y) = -coefficient(G)$ in Column 1 of Table 2 has an F-test(1,305)=0.05 (p-value 0.82).

[41] In the estimation of the random effect model, the Hausman test indicates potential mispecification, which disappears when decomposing the GDP per capita effect into a *country mean* effect and a *deviation from country mean* effect. Given that the latter effect is significantly bigger than the former, this suggest that for secondary enrolment the growth rate is much more discriminating than the stage of development (as measured by *country mean* effect).

bigger than in the case of primary school (-0.36 against -0.16), thus financial constraints are more relevant at this stage of education. Finally, the income share of the lowest quintile presents a negative sign, but is not significantly different from 0.

TABLE 3
ESTIMATION OF SECONDARY EDUCATION ENROLMENT:
FIXED EFFECTS 1960-90

	Estimated co-Efficients	Estimated co-efficients	Estimated co-efficients	Estimated co-efficients
Dependent variable:	*Total*	*Total*	*Total*	*Female*
Gross enrolment rate in sec. ed.				
Gini index of income distribution	-0.2531	-0.2472	---	-0.3603
	(2.73)	(1.14)		(3.69)
Income share of the lowest	---	0.1486	---	---
Quintile in income distribution		(0.19)		
(Log of) Real GDP per capita	0.1499	0.1865	---	0.1701
	(6.05)	(6.59)		(6.30)
(Log of) inequality adjusted real	---	---	0.1412	---
GNP per capita			(6.76)	
Fertility rate (potential children	-0.0429	-0.0513	-0.0435	-0.0558
Per woman)	(4.30)	(4.45)	(4.34)	(5.21)
Average years completed	0.0812	0.0327	0.0823	0.0635
primary education in	(5.18)	(1.53)	(5.29)	(3.62)
corresponding pop. Over 15				
Ratio of physical capital stock	0.0448	0.0675	0.0475	0.0509
To GDP (1987 local prices)	(3.42)	(3.75)	(3.67)	(3.65)
Constant	0.3468	0.5230	0.2353	0.4975
	(3.48)	(3.34)	(2.49)	(4.62)
# of observations/# of countries	360/73	239/65	360/73	346/73
Corr. btw random component	0.03	0.30	0.06	0.11
And indv explanatory vrbl				
R2 overall	0.77	0.74	0.74	0.81
R2 within	0.67	0.71	0.67	0.70
F test	115.7	69.93	142.9	125.55
	(0.00)	(0.00)	(0.00)	(0.00)

Source: Author's calculations.
Note: T-statistics in brackets.

On the supply side we could not find any significant effect of resources invested in education; the (log of) governmental current expenditure on secondary education per pupil, the ratio of its level with per capita income, or even the number of pupils per teacher, all variables exert a statistically insignificant effect.[42] The only aspect related to the public supply of

[42] The estimated coefficients for these variables, including all the variables reported in Column 1 in Table 3, are respectively -0.0167 (1.14), -0.0001 (0.68) and 0.0006 (0.45),

secondary education has to do with the 'vertical integration' of this process; if we consider that a student can enrol in secondary school only if s/he has completed the primary level, it is evident that an increase in the completion of primary education provides additional inputs to the next stage of production. Effectively, we find that the average years of completed primary education in the population[43] play a significant positive effect; raising sample mean (3.94 years) by an additional year should induce an increase in secondary enrolment in the order of 3-8 percentage points, depending on the chosen specification.

On the demand side we find evidence of some effect given by the family composition, as proxied by the fertility rate. While this variable exhibits a positive effect at primary level (and was explained there as evidence of the effort of supportive effect within the family), in this case it presents a clearly negative impact, which can be interpreted as evidence of a family resource effect. If we consider that sending a child to secondary school (which in most countries exceeds the threshold of compulsory education) is a more requiring task (at least on the financial side); an increase in family size implies a reduction in resources per child (in terms of both income and time devoted to childcare by parents).

Family choices seem also to respond to the existing situation on the labour market, probably via differential returns for education and/or differential employment probability.[44] Under the assumption of complementarity between human and physical capital in production,[45] we can approximate the skill requirement in the economy with existing capital intensity (ratio of physical capital to output). In such a case, we observe that an increase in demands for skills in the labour market (i.e. an increase in capital/output ratio)

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with associated number of observations 295, 293 and 339. There is no information available on average salary of secondary school teachers.

43 The variable 'average years of primary education' (sample mean referred to the population over 15 is 3.96 years) is obtained by multiplying the variable 'share of the population with completed and uncompleted primary education' (sample mean referred to the population over 15 is 0.632) with the variable 'years of duration of primary education' (sample mean referred to 1965 is 6.31). Therefore an increase of one year in the average years of primary education can be obtained by increasing the primary attendance in the population by 0.158 (obtained as result of 1/6.31).

44 These two channels cannot be directly tested because of the lack of appropriate data. Estimates of returns to schooling for several countries (but limited to very few years) are reported in Psacharopulos 1994. Unemployment rates for educational attainments do not exist on such a long time span and for so many countries.

45 A rather plausible assumption: see Benabou (1996b, 1996c).

induces an increase in secondary school enrolment. However the size of the effect is not very high; a 10% increase in capital/output ratio (from an average of 2.58 to 2.84) would raise secondary enrolment just 0.4%.[46]

4.3 Higher education

Moving finally to higher education, as in the case of primary education, we do not find evidence of direct impact of either income inequality or first quintile shares on higher education enrolment (columns 1 and 2 in Table 4).[47] Given the fact that many authors stress that public finance of tertiary education has a regressive effect because the offspring of the middle-classes are over represented, we have also tested the possible existence of liquidity constraints within this group by using the income share of each quintile (taken either separately or jointly), but we could not detect any statistically significant effect. When we make use of the 'inequality-adjusted real income' Y_{adjust}, the variable is significant but the result is mainly driven by the underlying effect of output per capita.[48]

More surprising is the result that borrowing constraints seem to affect male enrolment more than female enrolment. The differences in sample averages between the enrolment rates of the two genders are not very pronounced (16.2% for men against 11.4% for women), and therefore we cannot explain it with a composition effect. we believe that the explanation lies in the fact that the daughters from financially constrained families have already abandoned school at earlier stages, and therefore the 11% actually enrolled in school belong to rich families. On the contrary, since financial constraints restrain male enrolment only starting from secondary level, the selection according to family resources has operated less hardly among them, and we can still find

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46 This evidence is confirmed by including another variable, the 'ratio of total worker to population' which Barro and Lee (1994) report as drawn from Summer and Heston (1991), and extends up to 1985. We have been unable to update this variable in a consistent way. However if we re-estimate the model reported in Column 1 of Table 3 over the period 1960-85 including this variable, it comes out significant with coefficient equal to 0.491 (1.96). This implies that an increase in the employment rate of 10% calls for an increase in secondary enrolment of almost 5%. This seems unrelated to the type of secondary education that is available: a variable measuring the share of vocational education in secondary one is statistically insignificant.

47 We have dropped two observation for the 1990 taken from World Bank 1998, because they seem rather unreliable, especially when compared to the corresponding value in 1985: they are Canada (0.947) and United States (0.752).

48 Here again, the data (using the specification of Column 1 in Table 4) do not reject the restriction $coefficient(\log Y) = -coefficient(G)$: F-test(1,224)=0.02 (p-value 0.89).

sons from middle-class families that are financially constrained when asked to afford the enrolment at university.

TABLE 4
ESTIMATION OF HIGHER EDUCATION ENROLMENT:
FIXED EFFECTS 1960-90

	Est. co-efficients	Est. co-efficients	Est. co-efficients	Est. co-efficients	Est. co Efficients
Dependent variable: Gross enrol. rate in higher ed.	*Total*	*Total*	*Total*	*Female*	*Male*
Gini index of income distribution	-0.0644 (1.03)	0.1676 (1.00)	---	-0.0703 (1.05)	-0.1341 (2.10)
Income share of the lowest quintile in income distribution	--- 	0.4531 (0.79)	---	---	---
(Log of) Real GDP per capita	0.0734 (4.16)	0.1224 (4.57)	---	0.0433 (2.24)	0.0779 (4.07)
(Log of) inequality adjusted real GNP per capita	--- 	--- 	0.0625 (4.29)	--- 	---
(Log of) Govt. current expend. in sec. ed. Per pupil (PPP-adjusted '85 intn.prices)	0.0178 (2.12)	0.0191 (1.57)	0.0203 (2.51)	0.0293 (2.87)	0.0075 (0.77)
Av. years of completed sec. ed. Iin corresponding pop. Over 15	0.0685 (7.033)	0.0484 (3.74)	0.0690 (7.11)	0.0783 (7.22)	0.0487 (4.88)
Ratio of physical capital stock to GDP (1987 local prices)	0.0123 (1.41)	0.0197 (1.42)	0.0153 (1.82)	0.0074 (0.71)	0.0247 (2.57)
Constant	-0.0696 (1.11)	-0.1840 (1.50)	-0.1202 (2.20)	-0.1608 (2.13)	0.0342 (0.47)
# of observations/# of countries	300/71	207/64	300/71	254/70	253/69
Corr. Btw random component And indv explanatory vrbl	0.08	0.15	0.07	-0.24	0.23
R2 overall	0.61	0.51	0.60	0.59	0.56
R2 within	0.63	0.66	0.63	0.60	0.61
F test	77.46 (0.00)	43.98 (0.00)	96.60 (0.00)	54.63 (0.00)	55.51 (0.00)

Source: Author's calculations.
Note: T-statistics in brackets.

As far as the supply of higher education is concerned, we do not have direct information about the resources invested at this stage of education. Nevertheless, there is evidence of a positive effect of public expenditure per pupil at the previous stage. If we take this variable as a proxy of the quality of education provided at secondary school, this evidence suggests that increasing the resources invested at one stage of education can be ineffective in raising student participation at that level (and effectively there is no evidence of significant impact of this variable onto secondary enrolment), but can be beneficial in favouring the transition to the next stage (for example by raising

the self-confidence of the students).[49] This impact is rather low; a 10% increase in public expenditure per student enrolled in secondary school (equal to 103 US dollars measured at 1985 prices) induces an increase of 0.16 percentage points in higher education enrolment. The interdependence between sequential stages of education emerges also by the positive effect exerted by the average years of secondary education achieved in the population aged over 15 years; an addition year (from a sample average of 1.4 years) induces an increase of almost 50% in higher education enrolment.

On the demand side, the only evidence comes from the demand for skilled workers, as proxied by the capital/output ratio. Even if the coefficient is lower than in the case of secondary education, the elasticities are of comparable magnitude (see the following Table 5). This is possibly indicative that the productive sector requires more technical training (mostly provided by secondary schools) than professional credentials provided by universities. Notice moreover the effect of this variable is significantly higher for men than for women.

V CONCLUSIONS

In this study we have examined some empirical evidence in support of the negative correlation between inequality and growth. After a short review of existing literature, we have proposed an overlapping generation model, where the individuals have the opportunity to invest part of their time in education, in exchange for higher income in the following period. Since education is costly, when financial markets are absent (or work imperfectly, charging interest rates that are inversely proportional to family wealth) the optimal choice of education is wealth constrained. This leads to two testable predictions in the analysis of aggregate data on school enrolments; a negative (linear) dependence on Gini concentration index on income distribution; and a positive dependence on public resources invested in education and/or on skill premiums in the labour market. These predictions are then tested on a (unbalanced) panel of 102 countries for the period 1960-90.

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[49] Empirical evidence on the role of self-confidence is limited. In a NLS sample Lillard (1998: 17) finds a significant effect of '... family dummy variables measuring whether or not the son expects 'much' help from his parents to pursue higher education and how much his parents encouraged him to pursue higher education'. These dummies are significant in predicting both school performance and earnings.

TABLE 5
COMPARATIVE ELASTICITIES OF ENROLMENT AT DIFFERENT EDUCATIONAL LEVELS

	Primary	Secondary	Higher
Gini index of income distribution (1st col. in tables 2, 3, 4)	-0.021	-0.220**	-0.206
(Log of) inequality adjusted real GNP per capita (3rd col. in tables 2, 3, 4)	0.058**	0.292**	0.477**
Average years of completed ed. at previous stage (1st col. in tables 2, 3, 4)	0.065**	0.661**	0.701**
Ratio of physical capital stock to GDP (1^{St} col. in tables 2-3-4)	---	0.093**	0.094*
Female only			
Gini index of income distribution (4th col. in tables 2-3-4)	-0.076**	-0.313**	-0.258*
Average years of completed ed. at previous stage (4th col. in tables 2, 3, 4)	0.028**	0.483**	0.535**

Source: Author's calculations.
Note: * statistically significant at 95%; ** statistically significant at 99%.

The main findings of this analysis are summarised in Table 5. Once we control for the degree of development with the (log of) per capita output, financial constraints seem mainly relevant in limiting the access to secondary education. However, when we consider gender differences, there is evidence that female participation to education is more strongly conditioned by family wealth, starting from primary education. On the contrary there is no clear evidence of a relevant impact of invested resources, but at the tertiary level. Some positive effect is also played by labour demand for skilled workers, which tend to raise enrolment in post-primary education. Other conditioning variables, at primary and secondary level, are fertility rates and mortality rates, which tend to capture other aspects of social development. Finally, the data show that increasing education at one stage raises the odds for following stages.

Income redistribution seems to matter for educational goals. The size of the effect is not impressive: lowering the Gini index by 5 percentage points, a sizeable change, produces a total increase in school participation of almost 2 percentage points.[50] However, if one is willing to believe in the conclusions of the present study, if a country wants to raise the educational level of its population, more than spending additional resources on building schools and hiring teachers, it should rather prefer to implement redistributive policies

[50] This incorporate the direct effect (first line of table 5) and the indirect effect (first line times third line lagged of one level).

(via taxes and/or subsidies). As long as these policies are effective in reducing income inequalities within the population, they are also capable to relax financial constraints faced by poorest families, and promote school enrolment.

In the light of statistical irrelevance of invested resources in promoting enrolment, any policy recommendation on expenditure reallocation (for example, from tertiary to primary, or vice versa) seems pointless, given the limited impact of resources on school enrolment.[51] But a similar argument applies to the idea of expanding a private provider of education. As long as school fees create an additional financial barrier to continuing education, we expect a reduction in total enrolment because it raises financial barriers against constrained families.[52]

[51] These policy advices are based on the comparison between private and social returns to education. Since the typical ranking of returns is primary > secondary > tertiary, there should be ground to claim an expenditure reallocation in favour of primary level. See Birdsall and James (1993).

[52] For this reason it is hard to accept the following statement: '...preliminary evidence suggests that the second pattern - restricted public sector capacity and a large private sector - is superior with respect to access, providing much higher overall enrolment ratios and thus higher rates of participation by lower-income groups.' See Birdsall and James (1993: 344).

APPENDIX

TABLE A1.a
DESCRIPTIVE STATISTICS: SUB-SAHARAN AFRICA

	Mean entire sample	Standard deviations	Mean year=60	Mean year=70	Mean year=80	Mean year=90
Gross enrolment rate in Primary ed.	0.604 (191)	0.285	0.437	0.536	0.720	0.709
Gross enrolment rate in Seconary. ed.	0.119 (184)	0.115	0.039	0.079	0.151	0.222
Gross enrolment rate in Higher ed.	0.011 (186)	0.015	0.002	0.007	0.014	0.025
Gini index of income distribution	0.493 (81)	0.099	0.517	0.540	0.485	0.456
Total population (thnds)	9554 (203)	14198	6116	8013	10701	13850
Real GDP per capita: US$ (1985 international prices)	1086.1 (196)	971.8	817	1013	1211	1304

Source: See Table 1.
Notes: Numbers in brackets report the number of non-missing observations in each sample (or sub-sample). It includes 29 countries: Botswana, Burkina Faso, Cameroon, Central African Republic, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Cote d'Ivoire, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mauritania, Mauritius, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Tanzania, Uganda, Zambia, Zimbabwe.

TABLE A1.b
DESCRIPTIVE STATISTICS: NORTH AFRICA AND MIDDLE EAST

	Mean Entire sample	Standard deviations	Mean year =60	Mean year =70	Mean year =80	Mean year =90
Gross enrolment rate in primary education	0.787 (62)	0.238	0.611	0.722	0.872	0.921
Gross enrolment rate in secondary education	0.382 (61)	0.257	0.192	0.276	0.474	0.637
Gross enrolment rate in higher education	0.075 (61)	0.086	0.021	0.045	0.111	0.136
Gini index of income distribution	0.414 (33)	0.073	0.472	0.436	0.404	0.376
Total population (thnds)	14032 (63)	14343	9032	11817	15311	20419
Real GDP per capita: US$ (1985 international prices)	2771.3 (61)	1975.2	1675	2370	3138	3662

Source: See Table 1.
Notes: Numbers in brackets report the number of non-missing observations in each sample (or sub-sample). It includes 9 countries: Algeria, Egypt, Morocco, Tunisia, Iran, Israel, Jordan, North Yemen, Cyprus.

TABLE A1.c
DESCRIPTIVE STATISTICS: EAST ASIA AND THE PACIFIC

	Mean entire sample	Standard deviations	Mean year =60	Mean year =70	Mean year =80	Mean year =90
Gross enrolment rate in primary education	0.958 (69)	0.072	0.907	0.947	0.994	0.991
Gross enrolment rate in Secondary education	0.514 (69)	0.257	0.283	0.455	0.631	0.663
Gross enrolment rate in higher education	0.116 (69)	0.100	0.046	0.084	0.134	0.205
Gini index of income distribution	0.403 (63)	0.071	0.439	0.397	0.389	0.397
Total population (thnds)	40700 (68)	46579	29328	36188	44058	54482
Real GDP per capita: US$ (1985 international prices)	3833.5 (70)	3333.5	1518	2738	4662	7136

Source: See Table 1.
Notes: Numbers in brackets report the number of non-missing observations in each sample (or sub-sample). It includes 10 countries: Hong Kong, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand, Fiji.

TABLE A1.d
DESCRIPTIVE STATISTICS: SOUTH ASIA

	Mean entire sample	Standard deviations	Mean year =60	Mean year =70	Mean year =80	Mean year =90
Gross enrolment rate in Primary education	0.662 (35)	0.254	0.486	0.584	0.734	0.874
Gross enrolment rate in Secondary education	0.256 (35)	0.161	0.144	0.230	0.270	0.390
Gross enrolment rate in higher education	0.034 (35)	0.024	0.010	0.031	0.040	0.046
Gini index of inc.distribution	0.355 (29)	0.059	0.377	0.335	0.362	0.298
Total population (thnds)	162765 (35)	247449	112602	142258	178410	221599
Real GDP per capita: US$ (1985 international prices)	1034.8 (34)	404.9	792	914	1123	1467

Source: See Table 1.
Notes: Numbers in brackets report the number of non-missing observations in each sample (or sub-sample). It includes 5 countries: Bangladesh, India, Nepal, Pakistan, Sri Lanka.

TABLE A1.e
DESCRIPTIVE STATISTICS: LATIN AMERICA
AND THE CARIBBEAN

	Mean entire sample	Stand. Devs.	Mean year =60	Mean year =70	Mean year=80	Mean year=90
Gross enrolment rate In prim. ed.	0.936 (158)	0.111	0.872	0.932	0.965	0.970
Gross enrolment rate in sec. ed.	0.382 (158)	0.195	0.195	0.323	0.475	0.521
Gross enrolment rate In higher ed.	0.105 (156)	0.085	0.029	0.064	0.138	0.186
Gini index of income distribution	0.488 (106)	0.078	0.489	0.504	0.493	0.493
Total population (thnds)	13337 (161)	25227	8848	11658	14889	18114
Real GDPpc: US$ (1985 internat. prices)	3082.4 (160)	1835.7	2261	2959	3787	3410

Source: See Table 1.
Notes: Numbers in brackets report the number of non-missing observations in each sample (or sub-sample). It includes 23 countries: Barbados, Costa Rica, Dominica, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Trinidad and Tobago, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Surinam, Uruguay, Venezuela.

TABLE A1.f
DESCRIPTIVE STATISTICS: OECD COUNTRIES

	Mean entire sample	Stand. devs.	Mean year =60	Mean year =70	Mean year =80	Mean year =90
Gross enrolment rate in primary education	0.985 (154)	0.036	0.981	0.974	0.988	0.990
Gross enrolment rate in Secondary education	0.723 (152)	0.219	0.485	0.690	0.807	0.904
Gross enrolment rate in higher education	0.217 (153)	0.144	0.089	0.164	0.249	0.387
Gini index of income distribution	0.352 (123)	0.075	0.432	0.359	0.331	0.323
Total population (thnds)	29039 (154)	45904	24833	27756	30142	33147
Real GDP per capita: US$ (1985 international prices)	9314.9 (154)	3720.3	5842	8355	10511	12793

Source: See Table 1.
Notes: Numbers in brackets report the number of non-missing observations in each sample (or sub-sample). It includes 22 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, (West) Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

TABLE A1.g
DESCRIPTIVE STATISTICS: CENTRALLY PLANNED ECONOMIES

	Mean entire sample	Stand. Devs.	Mean year=60	Mean year=70	Mean year=80	Mean year=90
Gross enrolment rate in Primary education	0.973 (27)	0.058	1.000	0.965	0.987	0.912
Gross enrolment rate in secondary education	0.600 (26)	0.177	0.365	0.530	0.692	0.680
Gross enrolment rate in Higher education	0.140 (20)	0.056	0.078	0.133	0.174	0.142
Gini index of inc. distribution	0.273 (25)	0.041	0.259	0.249	0.281	0.290
Total population (thnds)	363655 (18)	455315	337.947	425523	509219	298543
Real GDPpc: US$ (1985 internat. prices)	3571.1 (22)	1535.3	1953	2629	4099	4028

Source: See Table 1.
Notes: Numbers in brackets report the number of non-missing observations in each sample (or sub-sample). It includes China, Hungary, Poland, Yugoslavia.

TABLE A2
DESCRIPTIVE STATISTICS: 1960-90

Variable	Obs.	Mean	Std.Dev.	Min.	Max.
Gross enrolment rate in prim. ed.	420	0.897	0.180	0.050	1.000
Gross enrolment rate in sec. ed.	420	0.484	0.290	0.005	1.010
Gross enrolment rate in higher ed.	420	0.131	0.128	0.000	0.947
Gini index of income distribution	420	0.420	0.101	0.233	0.795
Inc. share of lowest quintile in i.d.	271	0.059	0.020	0.016	0.108
Fertility rate	410	4.26	1.93	1.44	8.256
Crude birth rate (per 1000)	414	29.33	12.79	10	57.2
Child mortality rate in 1st year (per 1000 births)	416	0.060	.0501	0.001	0.218
Government current expenditure in sec. ed. per pupil: US$ (PPP-adjusted 1985 intern.prices)	337	1029.5	951.8	32	4572
Student per teacher in prim. ed.	419	31.22	11.90	6.1	90.4
Real GDP per capita: US$ (PPP adjusted 1985 international prices)	420	4768.5	4123.1	308	18399
Ratio of physical capital stock to GDP (1987 local prices)	382	2.58	0.97	0.67	7.43
Share of the population over 15 with some primary education	394	0.445	0180	0.022	0.901
Average years of completed prim. ed. For over 15s	394	3.94	1.78	0.24	8.11
Average years of completed sec. ed. in the population over 15	394	1.34	1.00	0.03	5.15

Source: See Table 1.

TABLE A3
PROBIT REGRESSION FOR AVAILABILITY OF INCOME DISTRIBUTION DATA
RANDOM EFFECTS GEE REGRESSION 1960-90

Dependent variable: (1: income data available 0: income data not available)	Estimated Coefficients	Standard Errors	p-values
Real GDP per capita	0.000004	0.000	0.693
(Log of) population	0.1999	0.074	0.008
Growth rate of population	-0.2546	1.646	0.877
Gross enrolment rate in primary ed.	-0.0169	0.098	0.864
Gross enrolment rate in secondary ed.	0.0162	0.127	0.899
Gross enrolment rate in higher ed.	0.0645	0.293	0.826
Dummy for Asian countries	-0.6084	0.672	0.365
Dummy for African countries	-0.3077	0.635	0.628
Dummy for Latin-American countries	0.8643	0.754	0.252
Dummy for Australian countries	-0.4572	0.861	0.596
Dummy for OECD countries	0.7986	0.750	0.287
Dummy for year=1965	-0.0236	0.034	0.491
Dummy for year=1970	-0.0478	0.040	0.232
Dummy for year=1975	-0.0719	0.049	0.142
Dummy for year=1980	-0.0981	0.060	0.103
Dummy for year=1985	-0.1235	0.068	0.071
Dummy for year=1990	-0.1464	0.077	0.058
Constant	-0.6448	0.771	0.403
# of observations/# of countries		761/126	
χ2 test		16.22 (0.51)	

Source: Author's eloboration of data from Barro and Lee (1994, 1996, 1997); Deininger and Squire (1996); Nehru and Dhareshwar (1993).

TABLE A4
ESTIMATION OF PRIMARY ENROLMENT
RANDOM EFFECTS GLS REGRESSIONS 1960-90

	Est. co-effs.	Est. co-effs.	Est. co-effs.	Est. co-effs.	Est. co-effs.
Dependent variable:	*Total*	*total*	*total*	*female*	*Total*
Gross enrolment rate in prim. ed.					
Gini index of income distribution	0.0395	-0.0560	---	-0.0524	0.1009
	(0.59)	(0.42)		(0.69)	(1.46)
Income share of the	---	-0.1718	---	---	---
lowest quintile in i.d.		(0.36)			
(Log of) Real GPD per capita	0.0454	0.0514	**---**	0.0522	0.0214
	(3.00)	(3.22)		(2.94)	(1.27)
(Log of) inequality adjusted real	---	---	0.0374	---	---
GNP per capita			(2.64)		
Child mortality rate in the 1st year	-1.9182	-1.5304	-1.9487	-2.6023	-1.7867
(per 1000 births)	(7.61)	(6.07)	(7.71)	(8.98)	(6.51)
Fertility rate (potential children per	0.0512	0.0380	0.0520	0.0615	0.0494
woman)	(5.50)	(4.18)	(5.56)	(5.67)	(5.17)
Crude birth rate (per 1000	-0.0069	-0.0065	-0.0069	-0.0072	-0.0083
inhabitants)	(4.42)	(4.56)	(4.44)	(5.66)	(4.89)
Share of corresponding population	0.1437	0.0944	0.1456	0.2329	0.0827
over 15 with some primary ed.	(3.40)	(2.11)	(3.42)	(4.88)	(2.33)
Student per teacher in primary ed.	0.0013	0.0024	0.0013	0.0010	0.0017
	(2.01)	(3.50)	(1.94)	(1.37)	(2.33)
Average salary primary school	---	---	---	---	-0.0001
teacher/GDP per capita					(4.16)
Constant	Yes	yes	yes	yes	Yes
Regional dummies	Yes	yes	yes	yes	Yes
# of observations/# of countries	400/88	268/78	400/88	391/88	304/78
R2 overall	0.65	0.62	0.64	0.73	0.70
R2 within	0.37	0.42	0.38	0.42	0.36
χ2 test	419.35	276.1	395.7	110.85	28.34
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Hausman test	16.90	19.60	5.36	19.05	19.67
	(0.02)	(0.01)	(0.49)	(0.01)	(0.01)

Source: Author's eloboration of data from Barro and Lee (1994, 1996, 1997); Deininger and Squire (1996); Nehru and Dhareshwar (1993).

TABLE A5
ESTIMATION OF SECONDARY ENROLMENT
RANDOM EFFECTS GLS REGRESSIONS 1960-90

	Est. co-effs	Est. co-effs	Est. co-effs	Est. co-effs
Dependent variable:	*Total*	*total*	*total*	*Female*
Gross enrolment rate in sec. ed.				
Gini index of income distribution	-0.2393	-0.3380	---	-0.3148
	(2.76)	(1.67)		(3.48)
Income share of the lowest quintile	---	-0.2424	---	---
in income distribution		(0.33)		
(Log of) Real GDPpc	0.0382	0.0365	---	0.0512
(*country mean*)	(1.38)	(1.83)		(1.68)
(Log of) Real GDPpc	0.1848	0.1987	---	0.1997
(*deviation from country mean*)	(8.43)	(7.72)		(8.48)
(Log of) inequality adj. Real GNPpc	---	---	0.0485	---
(*country mean*)			(1.84)	
(Log of) inequality adjusted real GNPpc	---	---	0.1704	---
(*deviation from country mean*)			(8.84)	
Fertility rate	-0.0417	-0.0475	-0.0435	-0.0507
	(4.96)	(4.86)	(5.13)	(5.70)
Average years completed prim. ed. in the	0.0584	0.0381	0.0575	0.0531
corresponding population over 15	(5.76)	(2.94)	(6.66)	(4.99)
Ratio of physical capital stock to GDP	0.0347	0.0481	0.0355	0.0424
(1987 local prices)	(3.61)	(3.86)	(3.69)	(4.22)
Constant	yes	yes	yes	yes
Regional dummies	yes	yes	yes	yes
# of observations/# of countries	360/73	239/65	360/73	346/73
R2 overall	0.82	0.80	0.82	0.84
R2 within	0.67	0.71	0.66	0.70
$\chi 2$ test	907.70	634.32	889.12	152.90
	(0.00)	(0.00)	(0.00)	(0.00)
Hausman test	9.30	10.75	12.83	7.15
	(0.09)	(0.09)	(0.01)	(0.21)

Source: Author's eloboration of data from Barro and Lee (1994, 1996, 1997); Deininger and Squire (1996); Nehru and Dhareshwar (1993).

TABLE A6 ESTIMATION OF HIGHER EDUCATION ENROLMENT
RANDOM-EFFECTS GLS REGRESSIONS 1960-90

	Est. co-effs.	Est. co-effs.	Est. co-effs.	Est. co-effs.	Est. co-effs.
Dependent variable: gross enrol. Rate in high. ed.	*Total*	*Total*	*Total*	*female*	*male*
Gini index of income distribution	-0.0659	0.0383	---	-0.0669	-0.1240
	(1.18)	(0.25)		(1.14)	(2.18)
Income share of the lowest quintile	---	0.0416	---	---	---
In income distribution		(0.08)			
(Log of) Real gross domestic product per capita	0.0076	0.0304	---	-0.0130	0.0230
(*country mean*)	(0.45)	(1.45)		(0.77)	(1.31)
(Log of) Real gross domestic product per capita	0.0854	0.1260	---	0.0672	0.0897
(*deviation from country mean*)	(5.48)	(5.64)		(4.02)	(5.40)
(Log of) inequality adjusted real GNP per capita	---	---	0.0093	---	---
(*country mean*)			(0.61)		
(Log of) inequality adjusted real GNP per capita	---	---	0.0734	---	---
(*deviation from country mean*)			(5.57)		
(Log of) government current expenditure in	0.0139	0.0090	0.0164	0.0153	0.0052
secondary education per pupil (PPP-adjusted 1985 intn.prices)	(1.91)	(0.91)	(2.30)	(1.90)	(0.64)
Average years of completed secondary education	0.0639	0.0527	0.0647	0.0708	0.0501
In the corresponding population over 15	(8.12)	(5.58)	(8.23)	(8.51)	(6.31)
Ratio of physical capital stock to GDP	0.0077	0.0073	0.0088	0.0049	0.0130
(1987 local prices)	(1.27)	(0.89)	(1.48)	(0.76)	(1.97)
Constant	Yes	Yes	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes	Yes	Yes
# of observations/# of countries	300/71	207/64	300/71	254/70	253/69
R2 overall	0.67	0.65	0.67	0.64	0.69
R2 within	0.63	0.65	0.66	0.60	0.60
$\chi 2$ test	141.4	88.2	141.1	112.1	147.0
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Hausman test	3.50	8.51	6.93	7.65	3.26
	(0.62)	(0.20)	(0.14)	(0.17)	(0.66)

Source: Author's eloboration of data from Barro and Lee (1994, 1996, 1997); Deininger and Squire (1996); Nehru and Dhareshwar (1993).

Table 1
Descriptive statistics - entire sample

	Mean entire sample	Standard deviations	Restricted sample	Standard deviations	Mean year =60	Mean year =70	Mean year =80	Mean year =90
Gross enrolment rate in primary education	0.832 (696)	0.245	0.897 (420)	0.180	0.742 (99)	0.798 (101)	0.888 (100)	0.893 (98)
Gross enrolment rate in secondary education	0.402 (685)	0.293	0.484 (420)	0.290	0.231 (96)	0.348 (101)	0.474 (98)	0.553 (93)
Gross enrolment rate in higher education	0.100 (680)	0.117	0.131 (420)	0.128	0.036 (97)	0.071 (99)	0.122 (99)	0.181 (89)
Gini index of income distribution	0.416 (460)	0.103	0.420 (420)	0.101	0.460 (54)	0.433 (72)	0.400 (67)	0.408 (79)
Total population (thnds)	34833 (702)	113227	42860 (420)	114501	25407 (100)	31417 (100)	38047 (100)	44785 (101)
Real gross domestic product per capita – US dollars (PPP adjst. 1985 intern.prices)	3861.8 (697)	3870.4	4768.5 (420)	4123.1	2496.9 (96)	3406.4 (101)	4415.6 (102)	5327.0 (97)

Source: Author's eloboration of data from Barro and Lee (1994, 1996, 1997); Deininger and Squire (1996); Nehru and Dhareshwar (1993).
Notes: Numbers in brackets report the number of non-missing observations in each sample (or sub-sample).

TABLE 2
ESTIMATION OF PRIMARY EDUCATION ENROLMENT: FIXED EFFECTS 1960-90

	Est. co-effs.	Est. co-effs.	Est. co-effs.	Est. co-effs.	Est. co-effs.
Dependent variable: gross enrol. rate prim. ed.	*Total*	*total*	*total*	*female*	*total*
Gini index of income distribution	-0.0441	-0.1242	---	-0.1597	0.0627
	(0.61)	(0.90)		(1.90)	(0.40)
Income share of the lowest quintile	---	-0.2468	---	---	---
in income distribution		(0.50)			
(Log of) Real gross domestic product per capita	0.0604	0.0593	---	0.0624	0.0353
	(3.22)	(3.23)		(2.82)	(1.70)
(Log of) inequality adjusted real GNP per capita	---	---	0.0524	---	---
			(3.16)		
Children mortality rate in the 1st year	-1.9781	-1.394	-1.9885	-2.7472	-1.6928
(per 1000 births)	(6.78)	(5.04)	(6.82)	(8.08)	(5.24)
Fertility rate (potential children per woman)	0.0582	0.0342	0.0581	0.0709	0.0516
	(5.65)	(3.45)	(5.64)	(5.86)	(4.82)
Crude birth rate (per 1000 inhabitants)	-0.0066	-0.0056	-0.0067	-0.0066	-0.0073
	(3.93)	(3.80)	(4.00)	(3.27)	(3.97)
Share of the corresponding population over 15	0.1322	0.0552	0.1312	0.1976	0.0583
with some primary education	(2.55)	(1.05)	(2.54)	(3.22)	(1.05)
Student per teacher in primary education	0.0015	.0030	0.0014	0.0011	0.0011
	(1.88)	(4.02)	(1.82)	(1.19)	(1.26)
Average salary primary school teacher/GDP per capita	---	---	---	---	-0.0001
					(2.44)
Constant	0.3947	0.4712	0.4766	0.3729	0.658
	(2.11)	(2.41)	(3.00)	(1.70)	(3.13)
# of observations/# of countries	400/88	268/78	400/88	391/88	304/78
Corr. Btw random component + indv explanatory vrbl.	0.04	0.11	-0.06	0.11	0.25
R2 overall	0.58	0.53	0.58	0.66	0.64
R2 within	0.38	0.43	0.66	0.43	0.36
F test	27.04	17.24	31.42	31.99	15.90
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Source: Author's calculations.
Note: T-statistics in brackets.

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