INEQUALITY OF OPPORTUNITY?
CROSS COUNTRY EVIDENCE ON THE DETERMINANTS OF EDUCATIONAL INVESTMENT AND RETURNS

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October 11, 2004

Abstract:
This paper develops a simple model of the market for human capital, and tests the implications of the model using data from a cross-section of countries. Using data on the distribution of educational attainment and returns, this paper is able to offer a more direct test of the hypothesis that credit constraints help to explain variation in inequality across countries than previous work using aggregate income inequality statistics. Mixed evidence is found for the effect of private credit on educational attainment, however; expected lifespan appears to be a much more important factor in explaining investment patterns. International trade emerges as a significant factor contributing to higher returns to education in developing countries.

I. Introduction

The most apparent manifestation of social inequity in most countries is the differences in standard of living between rich and poor. Some have questioned the assertion that income inequality should be an issue of concern to economists, however, since many factors contributing to measured levels of income inequality – such as compensating wage differentials, the age-earnings profile, or even pure luck – have no clear normative significance.[1]

There is less disagreement surrounding the goal of equality of opportunity. While the meaning of the phrase "equality of opportunity" is somewhat ambiguous, education stands out as a particularly important investment decision from the standpoint of both income inequality and intergenerational mobility. In an environment where equal access to educational investment opportunities exist, agents may be expected to invest in schooling until the marginal rate of return equals its opportunity cost, the real interest rate.[2] The inalienability of human capital may present special contracting difficulties that make arbitrage between physical and human capital difficult, however. In countries where such human capital market imperfections exist, educational investment choices may be constrained by wealth, generating inequality in the distribution of human capital endowments, incomes, and consumption. Galor and Zeira [1993] show that when these investments are non-convex (discrete investments involving fixed costs), the dynamics of the wealth distribution are non-ergodic. Loury [1981] argues that, because we care about our offspring, such reductions in mobility have clear social welfare implications.

In short, the social welfare implications of high levels of income inequality in a country are far more apparent when they can be linked to inequality in individuals' human capital investment decisions, which suggests that educational attainment data may provide a better indicator of inequality of opportunity across countries than income inequality statistics. Inequality in the distribution of educational attainment alone is insufficient to identify the effect of credit market imperfections, however, as it is very likely that countries with less well-developed credit markets are poor countries in which there is also relatively less demand for educated labor. The standard solution to such an identification problem is to examine the determinants of educational rates of return jointly with those of educational attainment.

Existing data on educational rates of return, compiled by Psacharopoulos [1994] and levels of educational attainment, compiled by Barro and Lee [2000], are summarized for in 72 countries in Table I. In most of these countries, Psacharopoulos notes, educational rates of return are well in excess of 8%, a reasonable estimate of the long-run rate of return to physical capital. Absent substantial aversion to the schooling process itself, this suggests that individuals should optimally invest in education to the maximum extent possible before investing in physical assets.[3]

The facts are startling. The Barro and Lee data suggest that, in the year 2000, one-quarter of the world's population over age 25 had received no formal education, while nearly one-half had received no more than primary education. If this is because large segments of the population have been unable to capitalize on their potential productive talents, a substantial inefficiency may exist. Indeed, the fact that the estimates of educational attainment and returns are negatively correlated presents a *prima facie*

case that, on average, it is variance in the educational costs and/or level of constraints across countries (which shift the supply curve for skilled labor) rather than variance in skilled labor demand that is largely responsible for variance in educational attainment.

This paper explores more deeply how poverty, credit constraints and economic and demographic variables affect the pattern of educational investment choices. To account properly for the fact that in general equilibrium educational investment decisions and educational returns are jointly determined, equations for both the household supply and firm demand for skilled labor are estimated. The supply equation is rooted in a formal model of household investment decisions in which the equilibrium distribution of education depends on educational returns, life expectancy, and the distribution of assets when credit constraints are present. Firms' demand for educated labor is assumed to depend on the state of technology, the sectoral composition of economic activity, and openness to global markets through international trade and investment flows.

II. The Distribution of Education Across Countries

Comparing inequality of education across countries requires both a metric for education and some method of distributional comparison. The most commonly used scalar measure of education in cross-country applications is years of schooling. Data on the average years of primary, secondary and higher education provide information on the cumulative distribution function for years of schooling. An alternative approach to measuring educational inequality across countries is to construct a summary statistic such as the Gini coefficient to the distribution of years of schooling.

$$G(s) = \frac{2}{n^2 \bar{s}} \sum_{i=1}^{n} \left(i - \frac{n+1}{2} \right) s_i$$

where s_i = years of schooling of individual i, n is the population of the country. Although household level data on schooling is not available for a wide-cross section of countries, the educational attainment data from Barro and Lee can be used in conjunction with data on length of schooling cycles from UNESCO to achieve an approximation using the following formula (Hopkins, 2002): [4]

(1) $$G(s) = \sum_{m=0}^{7} \frac{s_m}{\bar{s}} p_m \left[F_{m-1} - (1 - F_m) \right]$$

where s_m = years of schooling at level m, $\bar{s}$ = average years of schooling in the country, p_m = the share of the population with schooling level m, F_{m-1} = the share of the population with schooling less than level m, and $F_m = p_m + F_{m-1}$.

One problem of using a Gini coefficient for years of schooling to measure human capital investment, however, is that the resulting measure is increasingly dominated by the share of the population with no reported education as that share rises. This is problematic if one believes that the factors involved in an individuals' decision to attain their first year of education differ fundamentally from those involved in their decision to attain less than the maximum level of education. Noting that $s_0 = 0$, however, the formula in equation (1) can be decomposed as follows:

$$G(s) = p_0 + (1 - p_0) G(s \mid s > 0)$$

where $G(s)$ represents the Gini coefficient for years of schooling, p_0 the share of the population with no education, and $G(s \mid s > 0)$ the Gini coefficient among the population with any years of schooling above zero. In countries where the share of the population

with no education is quite large, $G(s) \approx p_0$, so that any information about the distribution of education across primary, secondary and higher education is relatively insignificant by comparison. As a result, it is necessary to examine both the Gini coefficient for years of schooling among the entire population and the Gini among just the educated population to achieve a complete picture of trends in educational inequality.

Figure I displays patterns in both Gini coefficients over time. Average educational inequality by geographical region is shown in the left column and average inequality by per-capita income level in the right column. Although educational inequality appears to have fallen between 1960 and 1995 in all regions and at all income levels, the bottom rows reveal that in much of the developing world this is mostly due to a reduction in the share of the population with no education – inequality in years of schooling among those with some education has been rising over time.[5] This suggests that the expansion of the educational franchise in these countries has succeeded more in raising the population included in introductory levels of education than in furthering progress up the educational ladder.

III. Preliminary Evidence on the Causes of Educational Inequality

Human capital market imperfections are a central feature of much of the theoretical inequality literature. In their evaluation of the role of capital markets imperfections on inequality, Li, Squire and Zou [1998] report a negative coefficient on a broad measure of financial depth (M2/GDP) and a positive coefficient on land inequality in regressions using cross-country data on income Gini coefficients. They argue that

these findings support the hypothesis that credit constraints underlie income inequality. Since in many models the specific channel by which credit constraints affect inequality is through the distribution of educational attainment, however, it is of particular interest to examine whether the data support this argument.

Regressions of the Gini coefficient for years of schooling reported in Table II test the impact of the stock of private credit as a percent of GDP, a measure of credit market imperfections suggested by Levine, Loyaza and Beck [2000]. While the stock of private credit does not capture the exact theoretical quantity of interest, it is arguably a more appropriate measure of credit constraints than the money supply.[6]

In the simplest specification, presented in column (1), private credit appears to have a more ambiguous role than the GDP share of government educational expenditures, which has a strong negative correlation with inequality in years of schooling. This effect disappears after controlling for the share of the population with no education, however, suggesting that the expansion of government educational expenditures may have succeeded primarily in reducing the share of the population with no education rather than promoting additional years among those with some education. Controlling for the share with no education, the stock of private credit (as a share of GDP) does appear to have a negative and significant impact on educational inequality. This provides some support for the hypothesis that investment in human capital may be hampered by weak credit markets.

The level of asset inequality, measured using a Gini coefficient for distribution of land as suggested by Deininger and Olinto [2000], does not appear to play a significant role in explaining educational inequality. This result contrasts strongly with the

conclusion of Li, Squire and Zou [1998], who consider the strong correlation of land inequality and the income Gini coefficient to be evidence for the existence of credit constraints. Because of the natural accounting relationship between income inequality and land inequality created by land rents, the results presented should be a more accurate and convincing test of the role of land inequality on educational investment decisions. It can be argued, of course, that land inequality is not an appropriate proxy for asset inequality in testing the hypothesis, since land is rarely sold to finance education. Nevertheless, asset inequality does appear to have some role in mobility. Figure II reveals that the average decline in educational inequality has been most rapid in the countries with the most egalitarian distribution of land.

The evidence above suggests two trends. First, government spending may help reduce the share of those with no formal education, but it is the level of credit market development that best serves to explain the distribution of education among the educated. Second, although asset inequality does not appear to figure in the static distribution of educational attainment across countries, there is some possibility that it plays a role in increasing the persistence of that inequality. These issues are explored in the remainder of the paper through a more detailed characterization of the educational distribution.

IV. A Model of Human Capital Investment

The analysis above provides some insight into trends in the distribution of education across countries but fails to capture nuances of the distributional composition of educational attainment, which should, in theory, be determined jointly with

educational returns. Shocks to the supply curve for educated labor occur with changes in the opportunity cost of education as a vehicle for household investment. Positive shocks may occur from the relaxation of credit constraints, declines in the attractiveness of capital market savings as a substitute investment vehicle or increases in government educational funding. Demand curve shocks, driven by changes in the derived demand for skill in firms hiring decisions, may occur through technological change, the structure of industry demand, and/or the effects of international trade.

On the surface, changes in educational attainment appear broadly similar in both developed and developing countries: the share of the population with no education or only primary education has on average decreased over time in both groups, while the share completing secondary and/or higher education has risen. However, trends in educational returns appear to have varied much more, falling in some countries and rising in others [Gottschalk and Smeeding, 1997, and World Bank, 1995]. These facts are consistent with supply and demand curves for educated labor shifting to the right at differing rates among countries.

Given data on the distribution of educational attainment and the returns to education across countries, a system of educational supply and demand equations can be estimated using three stage least squares to uncover the role of credit constraints and other variables potentially contributing to educational inequality. The set of relevant variables and a general specification of the supply curve are motivated in the discussion below. The role of credit constraints and asset inequality on the distribution of education are shown to be somewhat subtle in a formal model, requiring the use of appropriate distributional measures.

A. The Characteristics of Human Capital

There are at least four ways in which human capital investment can be distinguished from standard capital investment. These ideas are formalized in the model that follows, which will motivate the specification of educational attainment decisions used in the empirical framework adopted later.

1. The investment technology for human capital is non-convex, entailing an up-front fixed cost of investment in education with an annuity return in the form of higher wages over the remainder of the working life. In addition to the possibility of generating a non-ergodic income distribution demonstrated by Galor and Zeira [1993], this implies to that the present value an educational investment may be correlated with life expectancy, which would constrain years in the labor market.
2. The inalienability of human capital makes it difficult to write enforceable contracts against the value of one's human capital. As a result, opportunities for arbitrage between human and physical capital may be limited. Individuals may be limited in their own ability to borrow physical capital against the returns on their future human capital, as third parties with physical capital seeking profitable investments in (others) human capital are unable to secure property rights on their investments. Empirically, the implication is that economies with more well developed financial markets and greater contract enforcement should have more equal rates of educational investment. The inalienability of human capital also suggests that, as a store of wealth, education will be more attractive in countries

prone to expropriation of physical assets, and less so in countries with high rates of violence.

3. The number of children in a family and the education bestowed by parents may be correlated through the family budget constraint (the familiar argument that parents face a trade-off in the "quantity" vs. "quality" of their children). It is worth noting, however, that this argument relies on assumptions about capital market imperfections: the trade-off exists only if parents are constrained from borrowing against the value of their children's future human capital.
4. The structure of education costs is such that one-off investments in education (e.g. through individual tutoring) are less efficient than cooperative investments (through the provision of public or private schools teaching multiple pupils). A role for government may exist in coordinating and facilitating educational investment, in addition to lowering average costs and alleviating the impact of credit constraints. Low levels of public investment in education may itself pose a constraint upon private educational investment choices.

B. A Model of Household Educational Choice

Consider an economy in which workers live through two discrete periods, each lasting some fixed length of continuous time. In the first period, each worker inherits a certain level of assets, a. In the second period these individuals work, earn wages and choose a level of consumption.[7] Two investment technologies exist for children in their first period: direct savings placed in the capital market and an educational investment in human capital, h, which determines a second period flow wage $\tilde{w}(h)$. The net capital

market investment may be positive or negative depending on whether the individual is a net lender or borrower in the first period. The cost of acquiring human capital level h is given by $e(h)$. It is assumed that $e(0)=0$, so that no education at no cost is always an option, although some positive wage will result, or $w(0) > 0$.[8]

The initial period of life is assumed to be of a given fixed length (say, 21 years), and over this entire period capital receives the fixed gross rate of return R. The second period is assumed to be of specific length T, over which capital receives a continuous net rate of return r. At the start of the second period, the net present value of education is

$$\int_0^T \exp(-rt)\left[\tilde{w}(h) - \tilde{w}(0)\right] dt = \phi(r,T)\, w(h),$$

where $\phi(r,T) = \frac{1-\exp(-rT)}{r}$ a present-valuing factor, and $w(h) \equiv \left[\tilde{w}(h) - \tilde{w}(0)\right]$ is the flow return to human capital level h.

It is clear that $\partial\phi/\partial r < 0$ and $\partial\phi/\partial T > 0$, so the value of educational investments is decreasing in the real interest rate and increasing in the life expectancy. The exposition that follows will refer simply to ϕ, with the arguments r and T suppressed for simplicity, since neither will directly influence educational choices. Thus, the individual investment decision can be characterized as

$$\max_h \phi\left[w(h)\right] - R\left[e(h)\right]$$

C. Transaction Costs and Credit Market Imperfections

When individuals are allowed both to borrow and lend physical capital in the first period at rate R we should expect the rates of return between investments to be

equalized by arbitrage activity. As discussed in the introduction, however, estimates of educational returns appear to be in excess of long-run returns on capital in most countries. This suggests that something is preventing the arbitrage of physical for human capital. The inverse correlation between educational rates of return and levels of educational attainment across countries also suggests that differences in attainment reflect differences in constraints rather than incentives.

In keeping with the evidence, we will focus on the case in which educational returns are sufficiently high that all workers would choose to invest completely in education before acquiring capital savings, were they able. Since capital markets may not work perfectly where human capital investment is concerned, however, the cost of borrowing to finance an individual's human capital is assumed to exceed the first period lending return R by some amount δ reflecting contract enforcement costs or other transaction costs of going to formal loan markets.[9] When $\delta>0$, the overall cost of financing educational investment will be decreasing in the individual's wealth whenever educational costs exceed initial assets.

Nothing so far has been said about the particular investment technology for human capital. Although human capital itself may be a continuous quantity, the formal schooling process is typically segmented into a number of discrete levels, which we will index as $m = 0,..., M$. For notational simplicity, we can denote the net surplus received by choosing education level m relative to the capital market $S_m \equiv \phi w(h_m) - R\left[e(h_m)\right]$, and let $s_m \equiv S_m - S_{m-1}$ denote the net *marginal* surplus of receiving an extra unit of education.

D. The Distribution of Education Under Credit Constraints

The first period choice between investment technologies is made to maximize total net worth $Q(h)$ in the second period or

$$\max_{\{h\}} Q(h \mid a) = \begin{cases} \phi w(h) + \left[a - e(h)\right] R & \text{if } a \geq e(h) \\ \phi w(h) + \left[a - e(h)\right](R + \delta) & \text{if } a < e(h) \end{cases} \tag{2}$$

The education distribution can be characterized as follows.[10] Since all individuals are assumed homogenous other than assets (an assumption relaxed later), borrowers choosing $h_m > h_{m-1}$ requires that $Q(h_m \mid a) \geq Q(h_{m-1} \mid a)$ or, for δ>0,

$$a \geq \left[e(h_m) - \frac{s_m}{\delta} \right] \equiv a_m^* . \tag{3}$$

Similarly, for lenders *not* choosing $h_{m+1} > h_m$ it must be the case that

$$a \leq \left[e(h_{m+1}) - \frac{s_{m+1}}{\delta} \right] \equiv a_{m+1}^* . \tag{4}$$

If assets are distributed over the population according to the cumulative distribution function (c.d.f.) $F(a)$, then the share of the population p_m with education level m can be expressed as

$$p_m = F\left(a_{m+1}^*\right) - F\left(a_m^*\right). \tag{5}$$

The prediction embodied in equation (5), is that the distribution of human capital will depend on the distribution of assets, $F(a)$, given educational costs, $e(h)$, and the marginal surplus received by each education level, s_m, as modified by the presence of credit constraints, δ. A higher (lower) skill premium for a given level of education will lead to a larger (smaller) share of the population choosing that particular level of education. An increase in the credit market interest rate wedge (δ) will reduce overall

education attainment for any given distribution of assets, but may increase or decrease the share with an intermediate level of education.

Lacking data of the exact distribution of assets $F(a)$ across countries, equation (5) cannot be implemented directly in an empirical application. However, if we assume that assets are distributed log-normally, however, so that $\ln(a) \sim N(\mu, \sigma^2)$, then it follows from equation (5) that the c.d.f. of the educational distribution is equal to

$$P_m = \sum_{j=0}^{m} p_j = \Phi\left(\frac{\ln\left(a^*_{m+1}\right) - \mu}{\sigma} \right)$$

where $\Phi(\cdot)$ represents the standard normal c.d.f.. Although μ and σ are parameters of the distribution of wealth, on which there is no cross-country data, these can be proxied using data on the income distribution (i.e., log per-capita income and the Gini coefficient).[11]

E. Allowing for Additional Sources of Individual Heterogeneity

It has been assumed that every level of education is profitable for all individuals. A more general statement is that agents for whom

$$0 < S_m < \delta\left[e(h_m) - a \right] \tag{6}$$

can be said to be "credit constrained" in the sense that obtaining education level m is optimal, however, due to limited initial assets and/or the size of δ, they are unwilling (or unable) to borrow in order to invest in education level m. If we allow for heterogeneity in abilities, so that the net values of each education level (i.e. S_m, and thus s_m as well) are taken to be random draws, then we can make the following statement about the impact of credit constraints on the observed distribution of education. In the absence of credit constraints, the share of the population with education level m is given by

$$p_m^{nocc} = \Pr\left[\left(s_m > 0\right) \cap \left(s_{m+1} < 0\right)\right]$$

while in the presence of credit constraints, the same share is given by

$$\begin{aligned} p_m^{cc} &= \Pr\left[\left(s_m > 0\right) \cap \left(a > a_m^*\right) \cap \left\{\left(s_{m+1} < 0\right) \cup \left(a < a_{m+1}^*\right)\right\}\right] \\ &= p_m^{nocc}\left[1 - F\left(a_m^*\right)\right] + \Pr\left(s_m > 0\right)\left[F\left(a_{m+1}^*\right) - F\left(a_m^*\right)\right] \end{aligned} \tag{7}$$

From equation (7) it is clear that credit constraints can have the effect of raising or lowering the equilibrium share with education level *m*. Consider for instance, the case with three education levels: primary, secondary and higher education. Suppose that individuals are of two types, high or low, where high types occur with frequency λ, and find all education profitable. Low types, by contrast, find education profitable only through the secondary level. Let the asset distribution be characterized by denoting as *A* the poorest share of the population who can afford only primary education, *B* the share who can afford up to secondary, and *C = 1 – A – B* the share that can afford any level. The table below summarizes the relative difference in the distributions between the non-credit constrained and credit constrained environments.

	Education Level	With no credit constraints	With credit constraints
share of the population	primary secondary higher	0 $1-\lambda$ λ	A $(1-\lambda)(1-A)+\lambda B$ $\lambda(1-A-B)$
cumulative distribution function	primary secondary higher	0 $1-\lambda$ 1	A $(1-\lambda)+\lambda(A+B)$ 1
average number of years	primary secondary higher	h_p h_s λh_h	h_p $(1-A)h_s$ $\lambda(1-A-B)n_h$

In the presence of credit constraints, the share of the population with primary education, the lowest level, always increases and the share with higher education always falls. The share with secondary education falls if $\lambda < (A/(A + B))$, which – for a given distribution of abilities – is more likely to occur when there is less inequality (as the area B relative to A and C in general decreases with the variance of a)). As shown in rows below, however, the ambiguity does not affect the cumulative distribution and the average years of schooling at each level, which will rise and fall, respectively, under credit constraints. For this reason, the cumulative distribution of education rather than the share of each schooling level, will be used in empirical specifications of the labor market.

F. The determination of educational costs

The schedule of educational costs $e(h)$ is a primary determinant of the educational distribution in the model above, yet little has been said yet about what these costs might be. In many economies, governments provide primary, secondary, and sometimes even higher education at no nominal cost to the pupil. The cost of tuition alone is too narrow a definition of educational costs to be applicable, however. The availability and proximity of schools, and the resulting travel costs, are also an important cost in individual's investment decisions, as is the opportunity cost of the time spent. In other words, it is not the nominal but the shadow cost of education that is of interest.

The shadow cost of education is determined by the supply and demand for schooling. Total demand for schooling will be given by the demand per individual,

specified in equation, multiplied by the number of potential pupils, which is proportional to the fertility rate times the existing population. The supply of schooling is determined by the supply of schooling institutions – governed primarily by government spending – as well as the supply of teachers willing to teach, which is likely to be increasing in the existing stock of human capital (which will affect the supply of teachers). Despite the lack of information on direct educational costs in most countries, we will therefore assume therefore that $\ln\left[e\left(h_m\right)\right]$ is linear in the log of educational spending per pupil at level *m*, the student/teacher ratio at level *m*, and the number of children born that survive past age 5, per 1,000 people.

The log of educational expenditures was constructed by taking data from the World Bank on the log of educational expenditures per student as a share of per-capita GDP and multiplying by the PPP adjusted per-capita GDP from the Penn World Tables. The student/teacher ratio was constructed from data on teachers and students from the World Bank. Net fertility was calculated as the birthrate * (1-*D*/1,000) where *D* is the mortality rate of children under 5, per 1,000. All data was taken from the year of the observations on educational distribution and returns, or the closest year to it with available data. The fact that educational costs are also likely to be rising in the return to education through teacher salaries (and/or equivalently, falling in the supply of educated labor) generates potential complexities discussed later.

V. The Specification of Supply and Demand

The model presented above suggests the use of $E_m \equiv -\Phi^{-1}(P_m)$ as a measure of educational attainment. This measure alleviates problems of interdependence when estimating the determinants of individual educational shares, p_m, interdependence caused by the constraint that the shares sum to one. Using P_m to measure attainment requires some care in interpretation, of course, since a *decrease* in the c.d.f. implies a general *rise* in the level of attainment, which is the reason for pre-multiplying by negative one in constructing E_m.

Although the interpretation of E_m is not immediately intuitive, one can think of this variable as being related to average years of schooling level $m+1$. To understand the relationship between the two, note the following: the average years of primary schooling is simply the total number of possible years of primary schooling times the share of the population recorded as achieving primary, secondary, or higher education. Similarly, the average years of secondary schooling is proportional to the share with secondary or higher education. In other words, for every education level m,

$$\bar{h}_m \propto (1 - P_{m-1})$$

Since the inverse of the normal distribution function is monotone, this, in turn, is correlated with $1-\Phi^{-1}(P_{m-1})$, which is equivalent to $1+E_{m-1}$. Although the coefficient estimates are slightly more difficult to interpret, for the purposes of intuition, E_m can be thought of as being similar to average years of schooling of level m+1. In particular, since demand curves for education of level m are likely decreasing in the average years of schooling at level m, which is not true of p_m, the variable E_m is an appropriate measure of distributional quantity for use in the specification of both supply and demand of education.

This argument naturally raises the question why average years of primary, secondary and higher education should not be used in the regression specification in place of the less familiar E_m. There are two reasons. The first is that changes in costs, credit constraints, and returns are proportional to E_m, while the relationship with $\bar{h}_m \propto 1-\Phi\left(\frac{\ln\left(a_m^*\right)-\mu}{\sigma}\right)$ is highly non-linear. Secondly, because different countries have different schooling systems, average years of schooling data vary with both the educational distribution and the length of the schooling cycle.

A. The Supply Equation

Our model predicts the following relationship between educational attainment, measured by E_m, and its determinants:

$$E_m = \frac{-\ln\left(a_m^*\right)+\mu}{\sigma} \approx \sigma^{-1}\left[\mu - \ln\left(e\left(h_m\right)\right) + s_m / \delta e\left(h_m\right)\right].$$

The Psacharopoulos [1994] estimates of educational returns can be thought of as approximating the term $s_m / e\left(h_m\right)$, which represents the marginal absolute return to education level *m* as a share of costs. Educational attainment E_m is expected to rise at each level with increases in educational returns. Reductions in credit constraints should strengthen this association and increases in inequality should both lower overall inequality, and increase the value of credit markets. The general specification for supply is therefore given by[12]

$$\begin{aligned} E_m = {} & \alpha_{0m} + \alpha_{1m}\text{return}_m + a_{2m}\text{credit} + a_{3m}\text{inequality} + a_{4m}\text{credit*inequality} \\ & + a_{5m}\text{lny} + \alpha_{6m}\text{life} + a_{7m}\text{inflation} + a_{8m}\text{prop} + \alpha_{9m}\text{lspend} \\ & + \alpha_{10m}\text{ratio}_m + \alpha_{11m}\text{netfert} + \varepsilon_{sm} \end{aligned} \tag{8}$$

for m = 0, 1, 2, representing primary, secondary and higher education, respectively. The variables and their definitions are given in the table below.

The distributional variables E_m are measured over the support of the standard normal distribution (roughly -3 to 3) and summarize the c.d.f. of the educational distribution reported by Barro and Lee [2000] in the year most closely corresponding with the data on educational returns. Details on the source and measurement of the data on educational returns are described in Psacharopoulos [1994]. Data on other variables are from the World Bank's World Development Indicators, and are from the year of the educational returns survey, or the closest available.

variable	definition
return$_m$	rate of return to education level m
credit	stock of private credit / GDP
inequality	σ^{-1}, calculated from Gini coefficient
lny	ln(GDP/capita), a proxy for μ
life	life expectancy
inflation	inflation rate, a proxy for the real interest rate
prop	index of property rights
lspend$_m$	log(government expenditure / GDP) at level m
ratio$_m$	student / teacher ratio, at level m
netfert	net fertility rate (number born & surviving past age 5 / 1,000)

In general it is presumed that E_m will be falling (and the average years of schooling increasing) in the return to education. The fact that the supply of and return to education also affect educational costs raises additional considerations, however. In the presence of credit constraints, the role of educational costs rise relative to incentives. In the extreme case, small changes in the return to education may do little to change people's incentives but may do much to raise the cost of supplying education. As a result, it is possible for the net impact on α_{1m}, the coefficient on the return to education, to be

positive. It should still be the case, however, that the coefficient on the interaction α_{3m}, is positive.

B. The Demand Equation

Determination of the rates of return to each level of education requires the specification of the demand for education in firm hiring decisions. In general, the distribution of education in firm labor demand will depend on the distribution of economic activity between agriculture (requiring fairly low levels of skill), industry (requiring more educated labor), and services. Technology, as proxied by the level of per-capita income, may also generate a skill bias. International trade and foreign direct investment are also likely to affect the skill-bias of labor demand, although trade theory suggests the effect is likely to be different between low and high income countries. The specification of educational returns is therefore

$$\text{return}_m = \beta_{0m} + \beta_{1m}E_m + \beta_{2m}\text{industry} + \beta_{3m}\text{agemploy} + \beta_{4m}\text{lny} + \\ + \beta_{5m}\text{trade\_low} + \beta_{6m}\text{trade\_high} + \beta_{7m}\text{FDI\_low} + \beta_{8m}\text{FDI\_high} \tag{9}$$

where the variables are defined as follows

variable	definition
E_m	supply index of education of level m
industry	industrial value added/ GDP
agemploy	the agricultural share of employment
lny	natural log of GDP/capita
trade_low	(exports+imports)/GDP * dummy if low income
trade_high	(exports+imports)/GDP * (1- dummy if low income)
FDI_low	FDI/GDP * dummy if low income
FDI_high	FDI/GDP * (1 - dummy if low income)

In addition to these variables, two controls for educational returns were included. The first, "soc[m]" (where m is “pri”, “sec,”or “high”) is a dummy variable equal to one when the data on educational returns are based on the social rather than private rate of

return. The second, "out," is a dummy variable for observations with primary returns in excess of 50%, which, as potential outliers, are given a separate intercept.

In theory, the system of six equations specifying quantities and returns of education at the primary, secondary, and higher levels of education can be estimated simultaneously using three stage least-squares. With a maximum of 73 country observations, however, and missing data in most of those, the ability to estimate the full model is constrained by the number of exogenous control variables included. As a result, two complementary approaches are taken. First, estimates from the entire six equation system are generated using a subset of the exogenous variables suggested by theory. Second, simple two-equation systems of supply and demand are estimated separately for each level of education. By avoiding the constraint that data on all six endogenous variables be available, the number of observations available for estimation is increased and, as a result, additional control variables can be included to avoid potential specification bias at each level.

C. Estimation of the Full System

The results of the first approach are summarized in the table in Table III. The results show that primary attainment improves in response to increases in the return to primary education, although at higher levels of education, educational returns appear to be negatively associated with attainment. Although curious, this result that the "supply curve slopes downward" is consistent with the argument that increased educational returns at higher educational levels implies higher educational costs, since teachers are drawn from the pool of educated workers. If household investment choices are relatively

inelastic with respect to educational returns, but are constrained by costs, this implies that the net impact of higher educational returns could be to reduce educational investment. That this occurs at the secondary and higher education levels but not primary is consistent with this explanation.

Although the impact of educational returns on investment decisions is consistent with the credit constraints argument, additional support for the hypothesis appears weak. The stock of private credit has a small and statistically insignificant effect upon attainment of primary and secondary education, and has a negative and statistically significant impact on years of higher education.[13] This suggests either that inequality of opportunity is not an explanation for variance in educational attainment, or that the use of the private credit stock as a proxy for credit market imperfections. Given the results, it is possible that the primary impact of strengthening credit markets is to create saving opportunities that are viewed by households as a substitute for higher education. The level of inequality also appears to have little impact on the educational distribution.

What seems to have the most significant impact on the supply of education is life expectancy, which has a strong impact on educational attainment. When life expectancy is excluded, the coefficients and standard errors on private credit and inequality provide more support for the credit constraints argument. However, both theory and the strong empirical evidence suggest that life expectancy is an important and appropriate control.

To identify the determinants of educational returns a number of demand curve shifters were included. Log per-capita income was included as a measure of technological development. Although it might reasonably be expected to be associated with increasing skill bias in labor demand, a 50% increase in per-capita income is

associated with a rise in the primary premium of 1.5 percentage points, approximately no effect on the secondary premium, and a 2 percentage point fall in the premium to higher education. This is after controlling for the impact of increased educational supply, which (as expected) reduces the equilibrium return paid to educated labor at the secondary and higher levels. At the primary level, educational attainment appears to increase the rate of return, although the coefficient is not significant.

As expected, the share of employment in agriculture is associated with higher primary returns, and industry's share of GDP is associated with increased secondary and tertiary returns. Trade, as a percent of GDP, seems to be particularly strongly associated with educational returns. In developing countries, trade is associated with higher educational returns across the board, while in developed countries the results give support for the conventional wisdom that trade lowers wages of the less skilled and raises wages or the more highly skilled.

D. Educational Attainment and Returns by Level

By estimating supply and demand at each educational level individually, more observations can be employed, allowing more complete specifications of the supply and demand equations. As a result, a number of additional potential determinants of educational investment and returns can be included as controls. In addition, government spending on education at different levels, which is likely to vary in each country for reasons due in part to the relative supply and demand for education, can be included as an endogenous variable.

Tables IV, V, and VI report estimates at primary, secondary, and higher levels of education, respectively, on the determinants of supply, demand, and educational spending. Including additional controls and observations does not appear to have much impact on our original conclusions. Evidence for the credit constraints hypothesis remains limited: credit, inequality, and interactions between the two do not have a statistically significant impact on educational investment decisions. The impact of credit in reducing the negative effect of inequality on attainment of secondary and higher education does conform to expectations, however.

Interestingly, when the level of property rights (indexed from 0 to 1) is included, it is strongly associated with greater educational investment at the primary and secondary levels. Inflation, a proxy for the cost to holding physical assets (R in the model), has a positive impact as would be expected. The small coefficient reflects incidents of hyperinflation: controlling for these countries using a dummy causes larger and more significant coefficients on both inflation and the hyperinflation dummy. Educational spending per student also does not appear to have a significant impact on educational investment decisions. (Using educational spending as a share of GDP was not significant either). This is true when expenditures are treated as both exogenous and endogenous. Life expectancy again emerges as the most significant determinant of educational investment choices, but the net fertility rate, which was expected to be associated with reduced educational attainment particularly at higher levels of education, enters with a positive coefficient at the primary level. It is relatively insignificant at the secondary and higher levels. The availability of agricultural employment appears to have a negative impact on primary and secondary attainment, as does the living in a predominantly

Muslim population. The availability of teachers relative to pupils has a negative impact on primary investments, but no impact at the secondary level.

E. Dynamics of Educational Attainment

Explaining static, cross-country patterns of educational attainment say little about how the distribution of education is evolving over time within countries. Three questions are of particular interest to those looking to assess inequality of opportunity:

1) Do countries with higher returns have faster growth in education?

2) Is higher government spending correlated with faster growth in education?

3) How do the level of private credit and inequality correlate with changes in education?

Table VII presents results of cross-country regressions of the percent change in average years of schooling from 1960-1995 designed to address these questions. The estimates suggest the presence of long-run convergence properties across educational distributions. Convergence appears particularly rapid in secondary and higher education, schooling levels that only a small fraction of the world enjoyed in 1960. Increases in the average number of years of primary and secondary schooling appear reasonably elastic with respect to the rate of return. Interestingly, the rate of return to higher education does not appear to have much impact on growth in attainment, nor do most other variables. Credit constraints and inequality appear to play the most significant role in secondary schooling.

VI. Conclusion

Income inequality results from a combination of factors, of which the distribution of education is among the most clearly important from a normative perspective. In particular, it frequently has been suggested that the inalienable nature of human capital generates credit market imperfections that hamper efficient investment in education. From a moral standpoint, if educational attainment is linked to inherited wealth, than an inequality of opportunity exists that is more problematic than income inequality statistics alone may suggest. Credit constraints may be particularly likely to arise in developing countries with weak financial systems. For governments, this raises several issues with regard to educational policy: is the most effective approach to improving the educational distribution increasing public expenditures on educational system, developing credit markets to allow individuals more freedom to follow their own incentives, or something else entirely?

In theory, if credit constraints exist, several things should be true. First, educational attainment should increase with greater financial development, and should decrease with the inequality of wealth in society. Additionally, the impact of incentives should increase with financial development and the impact of inequality should decrease. This paper has shown that neither the stock of private credit, nor income and asset inequality appear to have a clear and consistent impact in explaining the distribution of education across countries. Over time, however, countries with less (income/asset) inequality appear to have more rapidly decreasing educational inequality. The initial stock of credit and the level of equality appear to have the most statistically significant effect in the growth of secondary education.

A possible explanation for the mixed evidence on the relationship between the availability of private credit and educational attainment fact may be that greater availability of credit may reduce constraints but also generate new saving opportunities that act as substitutes for higher education. The fact that inflation and educational returns appear to be fairly significant in explaining investment patterns across countries suggests that educational choices do respond to incentives as much as costs and constraints.

The impact of educational returns as an incentive for educational investment appears to be greatest at the primary and secondary levels. Educational expenditures do not appear to be particularly effective in increasing educational investment. Perhaps the most interesting finding from a policy standpoint is the strong positive association of educational choices with life expectancy. Low levels of attainment do seem to be driven more by supply-side than demand-side factors, but it appears that it is poor incentives created by low life expectancy rather than actual constraints posed by poorly developed credit markets that are most significant. This suggests that governments in developing countries interested in increasing educational attainment might consider diverting resources from educational spending and financial market development and shifting them towards combating public health risks associated with premature mortality.

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Endnotes:

[1] Some, like Martin Feldstein [1999], have argued that normative statements about inequality entail inter-personal utility comparisons, making it inappropriate for the attention of economists. A different view is taken by Amartya Sen [1997], who suggests that inter-personal utility comparisons are not only possible, they occur regularly in daily life.

[2] This is true, obviously, even allowing for heterogeneity in individual's benefit from education, due to differences in ability, preferences, etc.

[3] It is worth noting that several issues regarding the Psacharapoulos rate of return estimates complicate making this comparison. First, the estimates represent Mincerian returns to years of education rather than a clear opportunity cost. Second, even if rates of return are measured perfectly, the estimates likely suffer from selection bias. If we assume, for example, an 8% rate of return on capital, then only agents who foresee a rate of return on capital greater than 8% should choose to invest. The estimated average returns will therefore be in excess of 8% by construction. Finally, comparison of rates of return assumes education is purely an investment vehicle with no consumption value. Despite these caveats, the magnitude of the returns in most countries helps to support the argument.

[4] The Gini coefficients for years of schooling calculated for this paper are taken from Hopkins [2002]. This approach to measuring educational inequality has been used by other authors, however, notably Thomas, Wang and Fan [2000] of the World Bank (TWF). There are a few differences between the educational Gini coefficients used in this paper and those constructed by TWF: the Gini coefficients calculated by TWF cover fewer countries and years, use a different formula for generating the Gini coefficients, and use a different source for data on length of schooling cycles. Nevertheless, the results are very similar: the correlation between the two sets of Gini coefficients is 0.98.

[5] It should be noted that the welfare implications of these trends cannot be assessed directly. Since the share with no education has fallen, the composition of the group defined as "those with some education" has also changed over time. For example, giving one year of schooling to all those with no schooling is consistent with both a fall in $G(h)$ and a rise in $G(h|h>0)$.

[6] As Levine, Loyaza and Beck [2000]argue, "while private credit does not directly measure the amelioration of information and transaction costs, we interpret higher levels of private credit as indicating higher levels of financial services and therefore greater financial intermediary development."

[7] Although this model can be extended to study long-run dynamics, the focus of the present paper is limited to the first period investment decision.

[8] The general functional specification $e(h)$ allows interpretations that include both financial costs (such as tuition, travel, and other pure resource costs) and the opportunity cost of the time spent in terms of lost wages; for instance, if $e(h) = hw(0)$.

[9] For example, Galor and Zeira [1993] show that enforcement costs can lead to a linear relationship $i = br$ ($b > 1$), between the interest rate paid on private household debt (i) and interest received from capital lending (r). Applied to the model in this paper this would mean $\delta=(b\text{-}1)r$. The extreme case considered by Loury [1981], in which borrowing against future human capital is not possible at all, can be characterized as $\delta=\infty$.

[10] The equilibrium dynamics of this decision problem with a single education level are discussed in Galor and Zeira [1993], who show that under several parametric assumptions regarding the rates of return to education and capital the inter-generational dynamic path for wealth displays multiple long-run steady states depending on the initial level of wealth. Interested readers are encouraged to look for further details of the model available in that paper that are omitted here for expediency.

[11] Given the log-normal distribution, $\mu \approx \ln(\text{gdp/capita})$ and $\sigma \approx \sqrt{2}\Phi^{-1}\left(\frac{1+Gini}{2}\right)$. See Aitchison and Brown [1963].

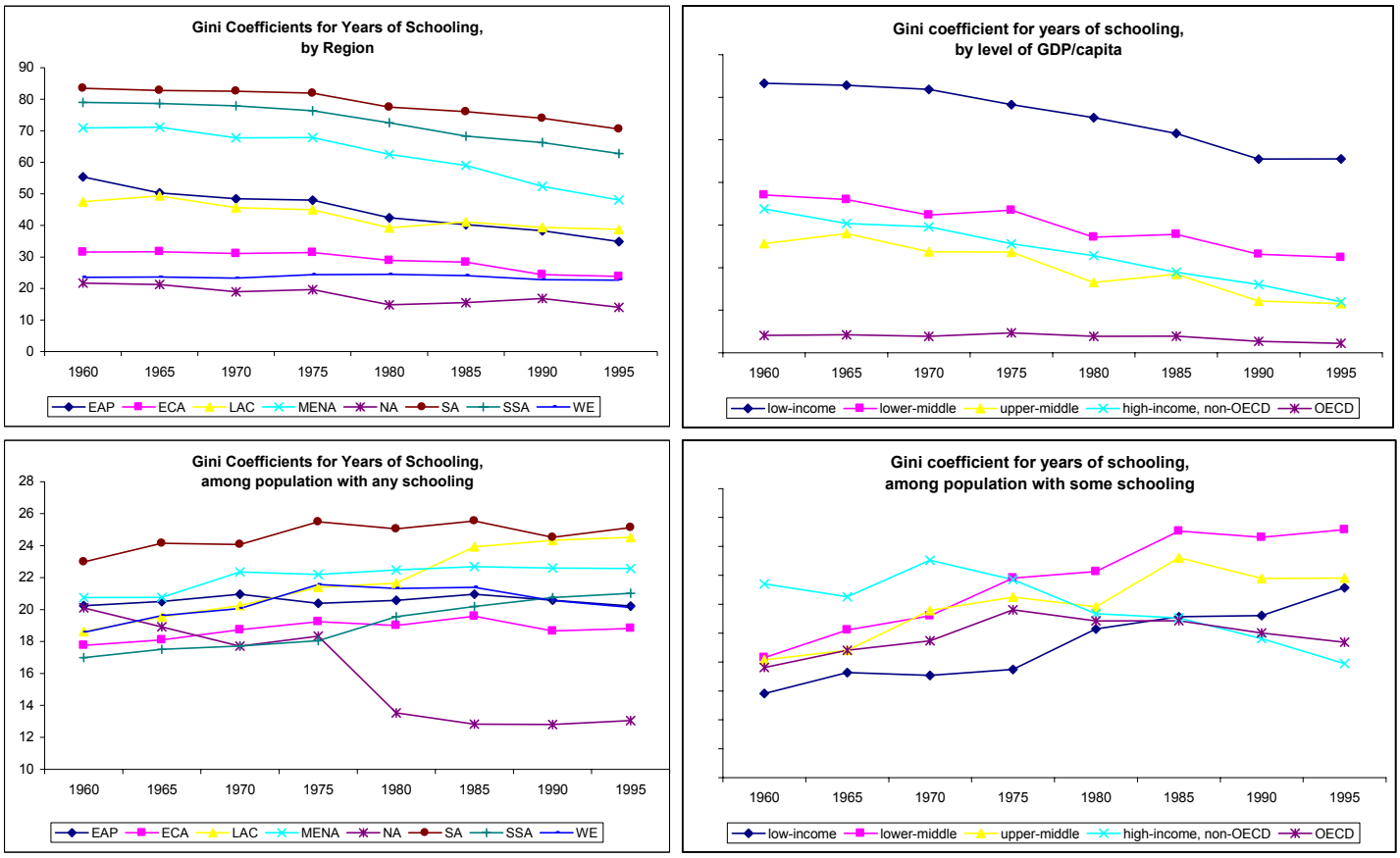
[12] Equation (6) also reveals that, in addition to affecting the overall distribution p_m, credit constraints δ also modify the impact of the educational incentives given by s_{m+1}. As $\delta \to 0$, transaction costs disappear, and the share of the population with education level m depends entirely on the probability that $S_m > 0$, which depends on the distribution of abilities, as well as the level of the real interest rate, the average Mincerian return to education level, and the cost of education $e(h_m)$. As $\delta \to \infty$, however, the impact of the "incentives" embodied in S_m on educational choices will decrease. This will have two effects: first, the general level of educational attainment will fall, and second, the impact of changes in the Mincerian returns on the education supply response will decrease. If we proxy s_m, the marginal incentives for education by Psacharopoulos' [1994] estimates of the returns to education, and assume that $1/\delta$ is proportional to the stock of private credit in the economy, then we will be interested in particular on the role of the interaction between them. As capital markets develop, the role of incentives should increase.

[13] Following standard conventions, the term "significant" is used here to imply p-values below 5%. Given the scarcity of observations, of course, some flexibility in interpretation of what can be considered "significant evidence" is warranted to maintain the power of the hypothesis tests.

Table I

	country	year	average years of schooling			average rate of return (%)		
			primary	secondary	tertiary	primary	secondary	tertiary
1	Argentina	1990	5.8	1.6	0.4	10.1	14.2	14.9
2	Australia	1975	6.3	2.9	0.7		8.1	21.1
3	Austria	1980	3.7	4.6	0.1		11.3	4.2
4	Belgium	1960	6.0	1.3	0.1		21.2	8.7
5	Bahamas	1970					26.1	
6	Bolivia	1990	3.2	1.2	0.3	9.8	8.1	16.4
7	Brazil	1990	2.7	0.9	0.2	36.6	5.1	28.2
8	Botswana	1985	2.6	0.3	0.0	99	76	38
9	Canada	1985	5.6	3.9	1.0		20.7	8.3
10	Chile	1990	4.8	1.9	0.4	9.7	12.9	20.7
11	Cote d'Ivoire	1985				25.7	30.7	25.1
12	Colombia	1990	2.8	1.3	0.2	27.7	14.7	21.7
13	Costa Rica	1990	3.9	1.2	0.5	12.2	17.6	12.9
14	Cyprus	1980	4.6	1.7	0.3	15.4	7	5.6
15	Germany	1980	3.6	4.6	0.2		6.5	10.5
16	Denmark	1965	5.4	2.9	0.5			10
17	Dominican Republic	1990	3.1	0.9	0.3	85.1	15.1	19.4
18	Ecuador	1985	3.7	1.4	0.5	17.1	17.2	12.7
19	Spain	1970	4.0	0.5	0.1	31.6	10.2	15.5
20	Ethiopia	1970				35	22.8	27.4
21	France	1975	4.2	1.8	0.2		14.8	20
22	United Kingdom	1980	5.8	2.0	0.4		11	23
23	Ghana	1965	0.7	0.1	0.0	24.5	17	37
24	Guatemala	1990	2.0	0.5	0.1	33.8	17.9	22.2
25	Hong Kong, China	1975	3.7	1.8	0.1		18.5	25.2
26	Honduras	1990	2.9	0.7	0.2	20.8	23.3	25.9
27	Indonesia	1990	2.3	0.9	0.1		15.7 *	13.1 *
28	India	1980	1.9	0.7	0.1	33.4	19.8	13.2
29	Iran, Islamic Rep	1975	1.0	0.5	0.0	19.7 *	21.2	18.5
30	Israel	1960	5.5	1.2	0.3	27	6.9	8
31	Italy	1970	4.0	1.1	0.1		17.3	18.3
32	Jamaica	1990	2.9	1.5	0.1	20.4	15.7	
33	Japan	1975	5.1	2.0	0.2	13.4	10.4	8.8
34	Kenya	1980	2.0	0.4	0.0		16	
35	Korea, Rep	1985	4.8	2.8	0.4		10.1	17.9
36	Sri Lanka	1980	3.4	1.7	0.0		12.6	16.1
37	Lesotho	1980	3.4	0.2	0.0	15	26.7	36.5
38	Morocco	1970				55 *	14.7 *	21.1 *
39	Mexico	1985	3.2	1.0	0.2	21	15.1	21.7
40	Malawi	1980	2.3	0.1	0.0	19.2 *	16.8	46.6
41	Malaysia	1980	3.3	1.1	0.1		32.6	34.5
42	Netherlands	1965	4.8	0.7	0.1		8.5	10.4
43	Norway	1965	4.9	1.2	0.1		7.4	7.7
44	Nepal	1980	0.4	0.2	0.0		15	21.7
45	New Zealand	1965	7.2	2.1	0.1		20	14.7
46	Pakistan	1975	0.9	0.6	0.1	20	11	27
47	Panama	1990	4.6	2.1	0.6	5.7	21	21
48	Peru	1990	3.8	1.6	0.5	13.2	6.6	40
49	Philippines	1990	4.9	1.6	0.6	18	10.5	11.6
50	Papua New Guinea	1985	1.1	0.2	0.0	37	41.6	23
51	Puerto Rico	1960				68.2	52.1	29
52	Paraguay	1990	4.2	1.3	0.3	23.7	14.6	13.7
53	Sudan	1975	0.4	0.1	0.0		13	15
54	Senegal	1985	1.6	0.3	0.1	33.7	21.3	
55	Singapore	1965	2.3	1.0	0.0	11.1 *	20	25.4
56	Sierra Leone	1970	0.4	0.1	0.0	24.5 *	26.7 *	17.6 *
57	El Salvador	1990	2.6	0.7	0.2	18.9	14.5	9.5
58	Sweden	1965	5.0	2.5	0.2		15.2 *	10.3
59	Thailand	1970	3.2	0.2	0.0	56	14.5	14
60	Tunisia	1980	1.3	0.5	0.1		13	27
61	Turkey	1970	1.8	0.4	0.1		24	26
62	Taiwan, China	1970	3.1	1.1	0.2	50	12.7	15.8
63	Tanzania	1980					9.7 *	
64	Uganda	1965	1.0	0.0	0.0	70.5 *	34.3 *	20.1 *
65	Uruguay	1990	4.4	1.9	0.4	27.8	10.3	12.8
66	United States	1985	5.8	4.8	1.1		14.7 *	20.1 *
67	Venezuela	1990	3.4	1.0	0.4	36.3	14.6	11
68	Yemen, Rep	1985				10	41	56
69	Yugoslavia, FR (Serbia/	1985	5.6	1.1	0.3	14.6	3.1	5.3
70	South Africa	1980	3.8	1.0	0.1	26.6 *	22.4 *	19.9 *

Figure I



Trends in Educational Inequality, 1960-1995, by Geographic Region and Income Level.

Table II

Dependent variable: Gini coefficient for years of schooling								
covariate	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
ln GDP/cap	-16.86	*-0.50*	-1.66	-10.89	*-1.13*	-10.81	-1.65	*-0.55*
std err:	0.80	*0.33*	0.46	1.27	*0.63*	1.41	0.66	*0.86*
priv. Credit	*-2.74*	-3.55	-2.56	*-3.08*	-3.94	-4.55	-4.05	-5.36
std err:	2.50	0.71	0.94	*2.08*	0.99	2.24	1.03	1.15
gov't ed. exp.	-1.66	*0.01*	0.32	*-0.53*	*0.13*	*-0.12*	*0.17*	*-0.03*
std err:	0.31	*0.09*	0.12	*0.52*	*0.20*	*0.54*	*0.21*	*0.31*
% no education		0.71	0.69		0.65		0.64	0.60
std err:		0.01	0.01		0.02		0.02	0.02
land gini			*0.02*	*0.00*	*0.02*	*-0.01*	*0.02*	n/a
std err:			*0.01*	*0.10*	*0.03*	*0.10*	*0.03*	
saving						*0.08*	*0.03*	*0.01*
std err:						*0.07*	*0.03*	*0.03*
[constant term]	192.41	33.56	41.09	139.01	38.77	136.79	42.29	37.25
std err:	5.99	2.86	4.09	12.67	5.81	13.37	5.92	7.16
# obs	430	430	296	296	296	265	265	265
R^2 (adjusted)	0.68	0.97	0.96	0.63	0.96	0.66	0.96	0.96
type	pooled	pooled	pooled	Rdm Eff.	Rdm Eff.	Rdm Eff.	Rdm Eff.	Fixed Eff.
numbers in italics represent variables *not* significant at the 5% level								

Figure II

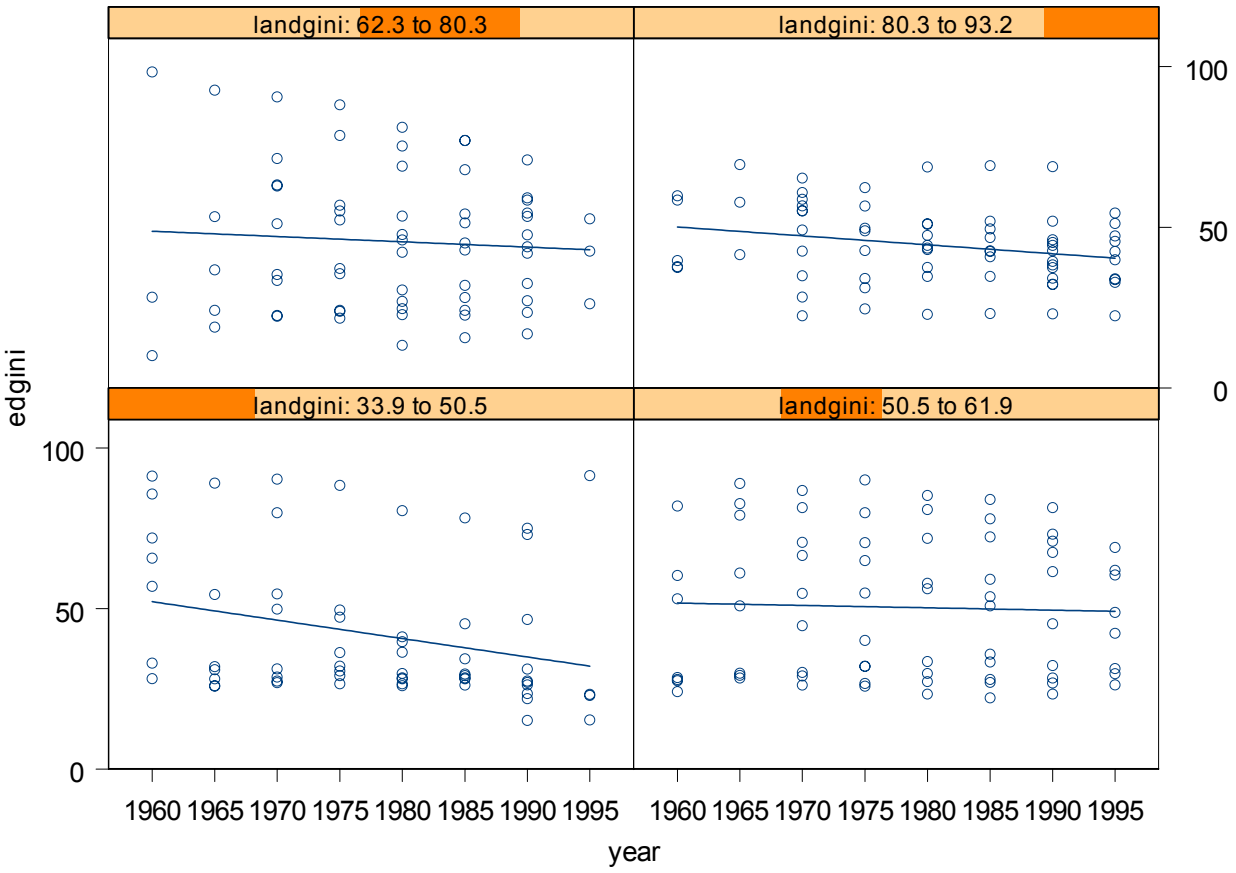

landgini: 62.3 to 80.3
landgini: 80.3 to 93.2
landgini: 33.9 to 50.5
landgini: 50.5 to 61.9
edgini
0
50
100
1960 1965 1970 1975 1980 1985 1990 1995
year

Table III

Results of Three-Stage Least Squares: FULL SYTEM (31 countries in sample)

	Dependent Variables						Summary Statistics			
Covariates	E0	E2	E3	primary return	secondary return	tertiary return	mean	std. dev.	min.	max.
E0 (primary)				2.13			0.49	0.85	-1.45	2.41
t-stat				*0.26*						
E1 (secondary)					-12.34		-0.90	0.54	-2.03	0.10
t-stat					*-2.30*					
E2 (higher)						-3.11	-1.75	0.60	-2.88	0.89
t-stat						*-0.69*				
primary return	0.01						27.16	20.54	5.70	99.00
t-stat	*1.04*									
secondary return		-0.02					19.83	14.03	5.10	76.00
t-stat		*-3.07*								
tertiary return			-0.04				19.95	10.23	5.10	46.60
t-stat			*-2.09*							
log (stock of private credit)	0.10	0.06	-0.19				3.14	0.64	1.70	4.88
t-stat	*0.65*	*0.80*	*-1.52*							
equality (inverse sigma)	0.03	0.03	-0.04				1.09	0.23	0.79	1.59
t-stat	*0.08*	*0.14*	*-0.09*							
life expectancy	0.07	0.03	0.04				62.55	9.82	34.36	75.38
t-stat	*6.49*	*5.51*	*4.32*							
ln(GDP/capita)				2.92	-0.27	-4.13	7.78	0.66	6.32	9.03
t-stat				*0.37*	*-0.07*	*-1.03*				
agric. employment (share)				0.18			40.39	23.01	5.07	87.26
t-stat				*0.58*						
industrial value added (share)					0.08	0.22	32.53	10.04	16.21	54.32
t-stat					*0.38*	*1.13*				
trade (for developing countries)				0.14	0.14	0.10	49.87	32.35	0.00	142.23
t-stat				*1.07*	*2.28*	*1.88*				
trade (for developed countries)				-0.06	0.00	0.06	13.43	52.31	0.00	269.04
t-stat				*-0.73*	*0.08*	*1.61*				

Table IV

Determinants of Educational Attainment, Primary

	Supply (E)		Demand (return)		Spending equation	
	coeff	*t*-stat	coeff	*t*-stat	coeff	*t*-stat
E (distribution)			-11.56	-3.30		
return	0.002	0.41				
lpspend	0.176	0.99				
credit	0.008	0.54				
ineq	0.004	0.25				
credit*ineq	-0.0001	-0.20				
lny	-0.308	-1.18				
life	0.078	3.91				
netfert	0.035	1.68				
prop	1.615	3.87				
priratio	-0.011	-1.29				
inflation	0.000	1.25				
muslim80	-0.003	-0.89				
agemploy	-0.007	-0.84				
lny			10.07	2.31		
trade_low			0.05	0.73		
trade_high			-0.06	-0.64		
gdi			0.21	0.62		
socpri			-0.10	-0.01		
out			47.81	7.68		
gc					0.095	5.18
dma					0.018	0.99
lny					0.923	6.83
ineq					-0.005	-0.46
constant	-5.460	-1.93	-54.83	-1.65	1.72865	1.39
R2	0.84		0.74		0.72	

Table V

Determinants of Educational Attainment, Secondary

	Supply (E)		Demand (return)		Spending equation	
	coeff	*t*-stat	coeff	*t*-stat	coeff	*t*-stat
E (distribution)			-10.1842	-1.92		
return	0.030	1.24				
lsspend	-0.161	-0.73				
credit	-0.003	-0.16				
ineq	-0.025	-0.9				
credit*ineq	0.0002	0.26				
lny	-0.080	-0.18				
life	0.023	0.97				
netfert	0.002	0.07				
prop	0.350	0.77				
secratio	0.000	0				
inflation	0.0002	1.11				
muslim80	-0.0001	-0.02				
agemploy	-0.014	-1.36				
lny			3.31934	0.85		
trade_low			0.11043	1.49		
trade_high			0.01603	0.17		
gdi			-0.15341	-0.43		
socsec			(constant)			
out			-6.52592	-0.99		
gc					0.09216	4.68
dma					0.01456	0.69
lny					0.82159	5.11
ineq					0.00982	0.76
constant	0.910	0.26	-18.6476	-0.55	2.55401	1.59
R^2	0.54		0.10		0.71	

Table VI

Determinants of Educational Attainment, Higher

	Supply (E)		Demand (return)		Spending equation	
	coeff	*t*-stat	coeff	*t*-stat	coeff	*t*-stat
E (distribution)			-4.28162	-1.18		
return	-0.033	-1.33				
lhspend	0.098	0.53				
credit	-0.011	-0.74				
ineq	-0.004	-0.26				
credit*ineq	0.0002	0.51				
lny	0.063	0.31				
life	0.034	2.25				
netfert						
prop						
inflation	0.0005	0.82				
muslim80						
agemploy						
lny			1.14	0.45		
trade_low			0.09	2.36		
trade_high			0.01	0.47		
gdi			2.44	0.45		
sochigh			-0.18	-0.73		
out			3.95	0.87		
gc					0.10	2.71
dma					-0.03	-0.93
lny					0.12	0.43
ineq					-0.03	-1.21
constant	-4.72	-2.76	1.56	0.07	10.89	4.05
R^2	0.27		0.20		0.23	

Table VII

Changes in Educational Attainment, 1960 -1995

	percent change in average years of		
	primary	secondary	higher
initial value (1960)	-0.135	-0.799	-3.841
	-1.09	*-6.77*	*-6.02*
rate of return	0.011	0.013	-0.004
	1.64	*1.87*	*-0.39*
private credit	-0.004	0.004	-0.002
	-0.52	*1.26*	*-0.63*
inequality	0.008	-0.023	-0.005
	0.55	*-2.60*	*-0.55*
ln(spending/student)	-0.336	0.059	0.020
	-1.65	*0.66*	*0.41*
observations	37	48	50
R^2 (adjusted)	0.28	0.55	0.47