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Educational Imbalance, Socio-Economic Inequality, Political Freedom, and Economic Development

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This paper describes tests of several hypotheses put forward in the literature on the significance of education as a determinant of economic development. It is shown that the generally positive impact of education on economic development is severely impaired by "educational imbalance" in the case of tertiary education, whereas economic inequality and repression of political rights primarily seem to reduce the social returns of the lower educational levels.

I. Introduction

The idea to consider education as an investment in future skills rather than merely a consumption good has been elaborated by "human capital theory". Moreover, since the seminal article of Lucas (1988), education has been one of the main candidates to generate endogenous growth in long-term growth modeling. The underlying economic intuition is quite simple and can be stated thus: Economies with a better educated labor force can make better use of the material factors of production as well as of the relevant technical knowledge.

Critics of this approach (cf. among others Klees (1991)), however, claim that its theoretical foundations are unsound. Specifically, the basic assumption of human capital theory that education raises productivity is just taken as given; if it is discussed at all, the proof is claimed to be in the domain of sciences others than economics. Hence, for lack of deeper insights, economists usually model human capital accumulation as a linear function of time devoted to education, a specification which may be misleading, since there could be various effects of education at different ages, different levels of education and other "structural breaks" (Helberger (1988)). Thus, the crucial questions are *how* education changes individuals and *what effects* it has on the aggregate level.

An answer from *social psychology* is that education promotes individual "modernity". The chain of causation is stated as education → individual modernity → income. Specifically, Inkeles and Smith (1974) demonstrate that "years of schooling" is the best predictor for individual modernity on their "OM"(Overall Modernity)-personality scale, provided schooling has been regular and continuous for at least some three to four years (Coulclough (1982)). Their conclusion is that the school is the major modernizing

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institution and that the education-modernity link depends most of all on the *socializing* function of regular school attendance at primary educational levels.

Others deny that "human capital" is a useful concept at all. First of all, the *signaling/screening*-hypotheses refer to the selective function of educational systems and claim that differences of individual income may have little or nothing to do with productivity differentials caused by education. Instead, economic positions (and incomes) are allocated according to the applicant's formal level of education (Bhagwati and Srinivasan (1977), Spence (1973)). According to this view, formal education promotes "credentialism" and does not add anything to macroeconomic efficiency (though it perfectly explains private rates of return to education).

While pure educational credentialism is unlikely to be very common, it might prevail in certain labor markets, especially where diplomas of distinguished colleges or universities serve as entry tickets into the local elite. The more the signaling function of diplomas reveals some characteristics relevant to economic productivity, however, the more it is likely to increase economic efficiency. It is thus reasonable to assign some relevance to the competing hypotheses, though for different explanatory ranges (Rubinson and Browne (1994, p.594)). While human capital theory and modernization hypotheses rely on increased productivity by socialization or acquisition of skills which are provided by the primary and perhaps the secondary levels of the educational system, educational credentialism might be the rule for the tertiary level.

In this context, a lively controversy is concerned with the educational policy of LDC's. Specifically, critics argue that too many poor countries spend too much on tertiary education (e.g., Blaug (1979), Justman and Teubal (1991)). In this view, "educational imbalance", i.e., fostering higher education while neglecting basic educational levels, often create nothing but highly specialized "academic proletarians" without hope of ever using their skills; or strong incentives for the highly skilled to migrate abroad, resulting in the so-called "brain drain" (Blomqvist (1986)).

In addition, this controversy has to do with economic and political power. Specifically, according to Mokyr (1990), economic history shows that an educated elite which is generally keeping away from economic, technical, and other practical matters, has been a major obstacle to technological progress and economic growth; and when nowadays some of the poorest countries afford a sophisticated system of higher education which has little or nothing to do with the real problems of backward countries (Pritchett (1995)), while illiteracy and poverty continue to be the fate of the majority of the population, it may indeed not be a far-fetched assumption that these educational systems serve mainly to perpetuate social and economic inequality and thereby the privileges of the ruling elite.

In less extreme cases, however, the potential dynamics of economic development may suggest other conclusions. The rise to economic and political power of a well-educated, highly motivated and innovative new elite plays a decisive role in various theories of economic development (e.g., Bartel and Lichtenberg (1987), Easterlin (1991), Eisenstadt (1973), Machlup (1970), Schultz (1988)), and it is considered a precondition for the Rostowian "take off into sustained growth" (Rostow (1960)). Moreover, education figures

prominently among other possible determinants of a country's capacity to absorb technology from abroad (Dowrick and Gemmell (1991)), and in this context it is plausible to assume that the *higher* levels of education are more important than more basic ones.

To summarize, the present theoretical knowledge about the role of education in economic development is highly fragmented and inconclusive.

II. Education and Economic Growth: Empirical Evidence

For empirical investigations, the standard procedure in the "new growth" literature is to refer to an "augmented" aggregate production function

$$Y = AK^{\alpha}L^{\beta}H^{\gamma}T^{\phi}, \tag{1}$$

where Y is GDP, A a constant, K physical capital, L labor, H human capital, and T a proxy for the state of technical knowledge. Assuming constant returns to scale in K, L and H ($\alpha+\beta+\gamma=1$),[1] i.e., the production inputs traded on factor markets, dividing by L, and taking logarithms and time derivatives yields

$$g_{(Y/L)} = g_A + \alpha g_{(K/L)} + \gamma g_{(H/L)} + \phi g_T, \tag{2}$$

where g_X stands for the continuous growth rate of a variable X. As much of the recent discussion is concerned with "catching up", in addition to the right-hand variables derived above, there usually is a "convergence" variable like the log of per capita income at the beginning of the time period studied (Y/L), as well as a vector Z of proxy-variables for possible determinants of a country's capacity to absorb technology from abroad. Sometimes, following Barro (1991), a number of socio-political and institutional variables are added.[2] The typical estimation equation thus generally comes close to

$$g_{(Y/L)} = a_0 + a_1 g_{(K/L)} + a_2 g_{(H/L)} + a_3 g_T + a_4 \ln(Y/L) + \Sigma a_j Z_j. \tag{3}$$

From the studies conducted so far, several general conclusions emerge (cf. Levine and Zervos (1993), Sala-I-Martin (1994)). First, physical capital accumulation is by far the most important determinant of economic growth. Second, controlling for physical capital accumulation and educational variables, countries with initially lower per capita incomes are indeed catching-up (*conditional* convergence). Third - and of most importance for the present paper -, controlling for physical capital accumulation and initial per

1. It was checked that for our data, the null hypothesis of constant returns to scale to *K*, *L* and *H* may be maintained at all conventional significance levels.
2. Adding level-variables as regressors for the growth rate of per-worker income rates somewhat alienates the estimation equation from the production function framework, the parameters, therefore, should not be interpreted as exact production elasticities. In addition, while the growth rates are stationary, the level-variables *Y/L* and *H/L* are not, which may cause further biases (Pritchett (1995)). As in most of the "new growth" empirics, attention, therefore, will be given primarily to the estimated signs rather than to minor differences in parameter magnitudes.

capita income, countries with higher scores for educational variables tend to grow faster.

However, there are serious difficulties to come to a coherent interpretation of the various and in many instances contradictory regression coefficients of the wide range of educational variables used by different researchers; and especially the empirical evidence on the benefits of tertiary education is far from clear: Some studies suggest that poor countries may expect high returns to investments in the tertiary level of education, while others indicate no social benefits, or even adverse effects.

To a certain degree, this may probably be explained by the use of indicators that are notoriously unreliable (e.g., enrollment rates and literacy rates). Worse, perhaps, is that frequently researchers choose indicators of dubious validity (e.g., enrollment rates for educational *stocks*, educational attainment of *urban* workers in largely *rural* societies, or years of schooling in the labor force *excluding all persons under 25*, i.e., its possibly *most dynamic part*). Moreover, the model of educational effects is generally *linear*, assuming homogeneous human capital. Consequently, possibilities of structural breaks, critical values, diminishing or increasing returns to education, and contingencies of certain types of education on other variables cannot be dealt with.

An exception from this simplistic model is the well-known contribution of Bowman and Anderson (1976), who show that literacy rates must exceed some 40 per cent before they show any correlation with economic growth. Others have demonstrated that the same applies to "years of schooling" which likewise show no correlation - simple or partial - unless they exceed three to four years (Azhar (1988), Graff (1995), Lau *et al*. (1993)). A few other studies test for structural breaks (Benavot (1989) Timmermann/Graff (1995), Wolff and Gittleman (1993)). These studies consistently confirm that primary education contributes more to economic growth in LDC's than in DC's, thereby giving some evidence for the modernization-hypothesis. The results for tertiary education, however, are again contradictory: While Benavot (1989) finds a significantly *negative* influence of tertiary enrollment on the growth rate of per capita income, Wolff and Gittleman (1993) get a significantly *positive* regression coefficient, although *only for the DC's*. Timmermann and Graff (1995) compute a principal component variable for higher educational levels which yields a *positive* coefficient for *all income levels*, and in Graff (1995) "years of schooling" of persons with tertiary education is significantly *positive* only *in the LDC's.*

Hence, there is not only a *theoretical*, but also an *empirical* "higher education puzzle", and much research remains to be done. In what follows, we shall try to give some tentative answers.

III. A New Empirical Analysis

Our empirical analysis draws on the "new growth literature" cross-country regression method outlined above.[3] The sample consists of all 74 countries (comprising LDC's

3. In the last time, this procedure has been criticized as naively empiricist (cf. Harberger (1998, p.21)). Specifically, the ever-present endogenity bias prohibits to interpret the estimated parameters as anything

as well as DC's), for which the required variables were available, and covers the period from 1960-92.

The left-hand variable $(g_{(Y/L)})$ is the 1960-92 growth rate of per capita income in "international $". While the focus is on human capital resulting from education H/L, the set of variables which in other studies has consistently be shown to contribute to economic growth: the growth of capital intensity $g_{(Y/L)}$, the "convergence" variable $\ln(Y/L)$, and - now widely accepted (cf. Otani and Villanueva (1990)) - a proxy for openness to trade Z, is taken into account. In addition, we compute a rarely used variable, a proxy for technical progress g_T.

H/L, $g_{(Y/L)}$, $\ln(Y/L)$, Z and g_T are then simultaneously included on the right-hand side, thereby reducing the ever-present omitted variable bias. Consequently, the basic estimation equation is:

$$g_{(Y/L)} = a_0 + a_1 \ln(H/L) + a_2 g_{(K/L)} + a_3 g_T + a_4 \ln(Y/L) + a_5 Z. \qquad (4)$$

The sampling procedure, the operationalization and computation of the variables are described in the appendix. Two remarks, however, are in order:

First, economists have only recently become aware of the serious problems underlying international statistics on educational data supplied by organizations as UNESCO, UNDP and the World Bank (Behrman and Rosenzweig (1994)). While these data are readily available for use in cross-country/time-series analysis, little attention has usually been given to the scarcity of the underlying observations (most of the printed data are actually no more than extra- or interpolations, or even worse: mere "guesstimates"). Moreover, the informational content of widely used data such as adult literacy rates or the mean years of schooling of the population over 25 is doubtful for the econometrics of economic growth, since it may be a poor proxy for educational attainment of the economically active population. In addition, the latest available data-bases on educational attainment (Barro and Lee (1996), Nehru *et al*. (1995)) unfortunately suffer from the fact that schooling is grouped by the traditional levels (primary, secondary and tertiary, which vary considerably across countries), rather than by grades, thereby ignoring some important information on the *structure* of the educational stock. The present paper tries to avoid some of the usual problems by using *all available information* on educational attainment from population census publications. Census data on *educational attainment* have several advantages: They are neither biased by the prestige of literacy, nor are they representing flows, as are enrollment rates. To capture most of the economically important education-related skills, contrary to the praxis of using data for the population over 25, this study refers to the *labor force*. Available census data allow the computation or estimation of the *mean years of schooling in the labor force* for the 74 countries of our sample in 1975 (*MYS*), and a further desegregation into three subgroups of educational attainment

close to "growth elasticities" from which researchers may draw conclusions for future growth behavior. Accordingly, the following estimates should not be taken to be more than heuristic explorations into some "stylized facts" of modern economic growth and development.

corresponding to the first six grades, the seventh to eleventh grades, and the higher levels of education (*LOW*, *MED*, and *HIG*).[4]

Second, the inclusion of "technical progress" is motivated by our special interest in "higher education" which is likely to be correlated and/or to interact with "technical progress" (Grossman and Helpman (1994, p.29)). However, no single variable from published statistics is likely to give an unbiased estimate of technical progress. The procedure followed here is to consider a wide array of information from international statistics on R&D, patenting activity, scientific publications, and direct acquisition of technical knowledge from abroad, and then to take the first *principle component* of these variables as a proxy for g_T.

IV. Results

The first step of analysis is to conduct four OLS-regressions of $g_{(Y/L)}$ on the set of its potential determinants considered in this study according to the basic equation derived above, where H/L is represented by *MYS*, *LOW*, *MED* and *HIG* respectively. The results are given in Table 1.

Table 1 Basic Regressions

Estimation	1	2	3	4
Intercept · 10^{-2}	4.79*** (3.39)	4.19*** (2.72)	4.51*** (3.14)	5.67*** (3.60)
ln *MYS* · 10^{-3}	7.23*** (2.97)			
ln *LOW* · 10^{-3}		1.23 (.71)		
ln *MED* · 10^{-3}			3.26** (2.34)	
ln *HIG* · 10^{-3}				3.80*** (2.50)
$g_{(K/L)}$	.52*** (13.51)	.53*** (12.42)	.55*** (14.18)	.50*** (12.20)
g_T · 10^{-3}	3.87*** (2.38)	5.26*** (3.02)	4.13*** (2.50)	3.74* (2.30)
ln (Y/L) · 10^{-3}	-7.01*** (-3.57)	-4.88** (-2.46)	-5.59*** (-2.99)	-6.49*** (-3.29)
Z (Openness) · 10^{-4}	8.08** (3.24)	8.91*** (3.38)	7.50*** (2.89)	9.61*** (3.77)
R^2	.84	.83	.84	.84

t-statistics in brackets, n = 74, one-tailed significance: *** p≤.01, ** p≤.05 * p≤.1.

4. It would have been desirable to include *growth rates* for the schooling variables as well; due to the scarcity of census data, however, this would restrict the sample to less than 30 countries, which is insufficient for statistical inference. Thus, $g_{(H/L)}$ was dropped as a right-hand variable.

As shown in Table 1, the estimated coefficients - with the notable exception of *LOW* - are significantly different from zero with their expected signs. Compared to other estimations in the "new growth" literature, the model fares very well (all R^2s exceed .8) and confirms the importance of physical capital accumulation and openness for economic growth as well as strengthening the evidence for "conditional convergence", though according to the present estimates, convergence is proceeding very - and for the LDC's: painfully - slow.[5]

The coefficients for educational human capital reveal the following pattern: *MYS*, *MED* and *HIG* contribute significantly to economic growth, whereas the coefficient of *LOW* is not significantly different from zero. The human capital accumulated during the years of schooling of members of the labor force with no more than 6 years of schooling, so might be followed, does not add to labor productivity.

Before accepting such far-reaching conclusions, however, the next step is to control for possible *structural breaks*. To this end, the sample is split into two sub-samples by educational attainment: 37 countries with less and 37 countries with more than the median value of *MYS*. Then a regression with the general human capital variable *MYS* for *H/L* is run across the two sub-samples to test for the stability all regression coefficients, including the intercept, but excluding *H/L*. The usual F-Test with five and 63 degrees of freedom results in an empirical F-statistic of 1.10, whereas the critical value ($p \leq .1$) is 1.94, so for the five freed parameters taken together - and holding *H/L* constant - there is no sign of a structural break between the two subgroups with different educational attainment. The same test is then conducted with *LOW*, *MED* and *HIG* for *H/L*, likewise giving insignificant F-statistics (.63, .50 and .65, respectively). Therefore, in the regressions that follow, the slopes for the control variables and the intercept are always computed for the whole sample, while the coefficients of the different variables for *H/L* are allowed to vary across the subgroups. Table 2 gives the resulting human capital coefficients for the two subgroups and the corresponding F-statistics for the significance of structural breaks concerning the educational regressors.

Table 2 Regressions for Subgroups by Educational Attainment (*MYS*)

	low *MYS* (n=37)	high *MYS* (n=37)	F-Test for structural break
ln *MYS* · 10^{-3}	7.91^{***}	7.14^{***}	.25
ln *LOW* · 10^{-3}	0.32	1.72	.26
ln *MED* · 10^{-3}	3.77^{**}	2.32	.38
ln *HIG* · 10^{-3}	6.75^{***}	9.42	5.72^{**}

One-tailed significance for coefficients, two-tailed significance for structural breaks (df = 1, 67), *** $p \leq .01$, ** $p \leq .05$, * $p \leq .1$.

5. Following Mankiw *et al.* (1992), the "convergence rates" that can be computed from the coefficients for ln *(Y/L)* are .0063, .0045, .0055, and .0065. Taken at face value, these convergence rates imply that for a typical country, it would take 111, 153, 135 or 118 years (depending on the specification of the educational human capital variable) to halve the difference between its actual and "secular" growth rates. Therefore, convergence, be it "unconditional" or "conditional", is of course nothing for the LDC's to count upon for a fast remedy against their present poverty and misery.

Table 2 shows that though the estimated coefficients for *MYS*, *MED* and *LOW* vary across the two subgroups, the differences are far from significant.

Moreover, as in Table 1 for all 74 countries taken together, the coefficients for *LOW* are in no case significantly correlated with growth - not even, as might be expected, in the educationally more backward subgroup of countries. A possible interpretation could refer to the "law of diminishing returns". There might already be so much of human capital at lower levels - even in LDC's - that the *marginal* contribution escapes conventional significance levels. Another possible explanation is statistical: If educational attainment is about to surpass the level measured by *LOW* in all countries, i.e., also in LDC's, there is little or no variance across countries. Consequently, all countries might benefit greatly from members of the labor force with primary education (compared to none), but exactly the fact that all (or most) countries have surpassed this level of educational attainment implies that it cannot make any difference in a cross-country comparison. Be this as it may, there are good reasons not to underrate the importance of primary education, and not too much weight should be given to its statistical insignificance in the present context.

Finally, *HIG* deserves special attention. As Table 2 shows, the coefficient for *HIG* is significantly *higher* for the subgroup of countries with less educational attainment; moreover, it is significantly positive only in this group of countries; for the more educated countries alone, it is not even significant at very moderate levels ($p \leq .1$). This finding is again compatible with human capital theory. Specifically, since higher education yields higher coefficients in the group that comprises the countries with lower educational attainment, a plain explanation is that the more advanced countries have begun to run into "diminishing returns". Therefore, inferring from the present sample and model, the thesis that poor countries spend too much on tertiary education seems to be misguiding. From our results, one might rather conclude that the richer, rather than the poorer countries, have reason to doubt the macroeconomic usefulness of their educational policy.

These conclusions, however, would stand in striking contrast not only to the results of other empirical analyses that imply *little*, *none*, or even *negative* effects of higher education on economic growth of LDC's, but also with what is known of its sometimes extremely dubious integration into practical economic uses in LDC's due to rent seeking and other - at least from a macroeconomic perspective undesirable - activities.

To reconcile these contradictions, we suggest to take a closer look at the arguments put forward by the critics of higher education in LDC's. Specifically, there is no doubt that higher education *may* be useful to economic development; what critics actually claim, however, is that in many LDC's it does not serve any of its economically useful functions; instead it has rather the characteristics of a "consumption good" for the upper classes, which need not necessarily be regarded as "waste", but for which, of course, there is no social necessity for subsidy either. Worse, education might indeed generate skills which, in some societal settings are mainly devoted to unproductive or even harmful activities like rent seeking or crime (Pritchett (1995)). At the same time educational credentialism may prevail, turning higher education into a pure screening device, serving to legitimate socio-economic inequality and deprivation of political participation (Rubinson

and Browne (1994, p.594)).

Higher education proper would then be neither an impediment nor an inducement to economic development. However, "educational imbalance" might indicate that scarce resources are used in the interest of the members of the elite instead of being channeled into uses with high social rates of return.[6] In this view, "educational imbalance" not only implies macroeconomic "opportunity costs", but indicates the existence of an influential elite and of high inequality and, thereby, a high potential for social conflict which in turn, may indeed be harmful to economic growth.

For a test of this hypothesis, a country's "educational imbalance" (*EI*) is approximated by an index that captures the relation of resources channeled into tertiary education as compared to primary education in 1975.[7] Specifically, the 74 countries are split into two new sub-samples by *EI*, 37 low scorers and 37 high scorers.

In addition, two other, and possibly related, variables are considered: Gastil's "political rights and civil liberties" index, which is likely to capture deprivation of political participation, and as a measure of inequality the Gini coefficient (for which data are available for 69 countries of our sample).

Accordingly, there are three variables by which to split our sample into 37 educationally more vs. 37 less balanced, 37 politically more vs. 37 less repressive and 35 more vs. 34 less egalitarian countries. Then the basic regression is repeated with an additional degree of freedom for *H/L*, for which the coefficient is allowed to vary between the subgroups. The results are given in Table 3.[8]

Table 3 Regressions for Subgroups by Educational Imbalance, Inequality, and Political Participation

	low educational imbalance IE (n = 37)	high educational imbalance IE (n = 37)	F-Test for structural break
ln *MYS* · 10^{-3}	7.41***	6.94***	.10
ln *LOW* · 10^{-3}	1.50	.99	.04
ln *MED* · 10^{-3}	3.69***	1.45	.82
ln *HIG* · 10^{-3}	5.19***	0.01	3.70**
	low repression (n = 37)	high repression (n = 37)	F-Test for structural break
ln *MYS* · 10^{-3}	8.92***	6.72***	2.30*
ln *LOW* · 10^{-3}	2.96**	-2.07	3.44**
ln *MED* · 10^{-3}	3.61*	3.14**	0.04
ln *HIG* · 10^{-3}	3.37**	4.19**	.17

6. Pritchett (1995) gives some evidence for the suspicion that the public sector in LDC's acts as an "employer of last resort" for the well-educated labor force which may indeed result in serious misallocations of scarce resources.
7. For details see appendix.
8. Note that, according to the imbalance/distortion-hypothesis outlined above, the significance tests for structural breaks are one-tailed.

Table 3 (Continued)

	low inequality (n = 35)	high inequality (n = 34)	F-Test for structural break
ln *MYS* · 10^{-3}	6.86***	4.84**	2.57*
ln *LOW* · 10^{-3}	0.18	0.96	0.09
ln *MED* · 10^{-3}	3.43**	1.09	1.34
ln *HIG* · 10^{-3}	2.91**	3.50**	.12

One-tailed significance for coefficients; one-tailed and structural breaks (df = 1, 67), *** $p \leq .01$, ** $p \leq .05$, * $p \leq .1$.

Table 3 shows no significant differences for *MYS*, *LOW* and *MED* between countries that score low or high on *EI*. *HIG*, however, has a significantly higher coefficient in the low-*EI* sub-sample. Moreover, as predicted by the "educational imbalance" version of the signaling/screening-hypotheses, *higher education* yields a coefficient close to zero in the high-*EI* sub-sample.

The results are, however, different for the sample split by the civil liberties/political repression variable. The F-statistics show that there is no difference between the coefficients for the higher educational levels, whereas there are significant structural breaks for *MYS* and *LOW*. Hence, a lack of political rights seems to exert the expected negative influence on educational efficiency on the basic educational levels rather than on higher education. According to these results, the lower levels of education seem to be especially growth promoting in countries with low repression.

The results for the sample split by the Gini coefficient are fairly similar to the civil liberties/political repression sub-sampling procedure. Here, a significant structural break is detected for *MYS*, indicating that education taken as a whole yields generally higher social returns in more egalitarian countries, though this regularity is weak and not significant.

These first - and admittedly still tentative - tests give some support to the educational imbalance/distortion-hypotheses: According to the present sample and model, a less repressive and more egalitarian system generally seems to provide a better environment for a positive contribution of education to economic growth and development. Moreover, the contribution of higher education to economic growth is indeed negligible in countries that are characterized by strong "educational imbalance", whereas in countries with a more balanced educational policy, it is clearly positive.

V. Conclusion

The results of the present study offer some new insights into the role of education at different levels of development which - if robust - could be a useful contribution to the debate about the wisdom of giving high priority to tertiary education in LDC's.

Specifically, some critics of tertiary education in LDC's, although having good reasons for their complaints about "educational wastage" and "diploma disease" in poor countries, miss the decisive point which - according to our results - lies in the fact

that it is not poverty or backwardness which makes tertiary education a waste of scarce resources; quite on the contrary: it is shown that the marginal contribution of tertiary education to productivity growth declines with the accumulation of educational stocks.

A slight re-formulation of the critics' argument, however, is bringing it in line with the facts: tertiary education is indeed not a growth inducing factor - or even harmful to growth - in countries which are characterized by strong "educational imbalance". However, in countries which follow a "balanced" educational policy with a base of widespread primary education, secondary and - perhaps most of all - tertiary education may be a decisive growth factor. Consequently, countries which invest heavily in higher education while neglecting more basic educational levels may gain little or no social returns.

Moreover, socio-economic inequality (as measured by the Gini coefficient) and deprivation of political participation (as measured by Gastil's political rights and civil liberties index) do not seem to exert the same detrimental influence on the social benefits of higher education as educational imbalance proper, though educational efforts generally - and possibly especially efforts aimed at the elementary level - seem to be more promising as a growth promoting device in less repressive and more egalitarian countries.

Appendix

country-sample, variables, data and sources

The country sample consists of 74 countries (excluding countries with a population of less than one million and oil-export based economies), for which the required educational, technological and economic variables were available (Table 4). The analyzed period ranges from 1960-92. If not stated otherwise, the primary data are from the "Penn World Tables, Mark 5.6." (revised version, University of Toronto, December 1997).

Table 4 Country-Sample and Variable Values for Educational Attainment, Technical Progress and Imbalance Proxies, Sorted by Per Capita Income 1975

	MYS	*LOW*	*MED*	*HIG*	g_T	*EI*	*GI*	*Gini*
Malawi	3.13	1.09	2.00	.02	-.93	.009	6.5	52
Niger	.83	.72	.13	.06	-1.11	.005	6.0	36
Togo	1.90	.82	.86	.21	-.82	.012	5.9	…
Rwanda	1.87	1.74	.28	.05	-.87	.005	5.6	29
Central Afr.	2.19	1.01	.82	.07	-.75	.005	6.3	55
India	2.18	1.12	.69	.37	-.89	.106	3.0	31
Kenya	2.99	.59	2.31	.10	-.82	.008	4.6	54
Cameroon	2.11	1.49	.59	.09	-.80	.015	5.4	49
Haiti	1.52	.54	.83	.10	-.62	.011	3.0	…
Bangladesh	2.37	.72	1.39	.22	-1.31	.036	4.2	35
Pakistan	1.89	.69	.88	.30	-1.07	.046	5.0	32
Indonesia	4.27	2.60	1.30	.36	-1.11	.028	5.3	34
Ghana	3.48	.36	2.87	.16	-.88	.015	5.0	35
Senegal	2.56	1.87	.56	.12	-.49	.050	4.1	54
Zambia	4.90	1.39	3.35	.13	-.46	.022	5.1	47
Nigeria	.84	.59	.11	.00	-1.24	.015	3.9	39
Egypt	2.95	1.26	1.06	.61	-.58	.180	4.6	37
Sri Lanka	6.52	1.59	4.62	.21	-.79	.017	3.3	41
Honduras	3.60	2.25	.98	.36	-.39	.053	5.7	55
Botswana	2.70	.74	1.81	.14	-.34	.010	3.1	54
Philippines	6.20	2.15	2.10	1.92	-.69	.184	4.5	48
Paraguay	4.92	2.61	1.76	.52	-.64	.067	5.4	42
Congo	4.48	1.10	2.91	.33	-.53	.027	6.2	…
Thailand	4.45	2.39	1.59	.45	-1.16	.042	4.0	45
Ivory Coast	2.87	1.28	1.65	.00	-.77	.020	5.2	39
Tunisia	3.52	1.42	1.05	.96	-.38	.043	5.1	43
Dominican Rep.	4.26	1.58	1.76	.54	-.51	.100	2.6	47
El Salvador	4.36	1.43	2.54	.36	-.33	.105	3.7	48
Jordan	5.72	1.68	2.68	1.31	-.33	.162	5.7	39
Algeria	3.16	1.36	1.52	.27	-.83	.034	6.0	39
Guatemala	3.12	1.92	.84	.34	-.49	.068	4.1	56

Table 4 (Continued)

	MYS	*LOW*	*MED*	*HIG*	g_T	*EI*	*GI*	*Gini*
Korea, Rep.	5.91	2.13	2.82	.92	-.20	.103	5.0	34
Colombia	4.92	2.08	2.14	.68	-.73	.077	2.8	52
Nicaragua	3.33	1.64	1.07	.21	-.35	.101	4.7	...
Ecuador	5.51	2.89	1.77	.84	-.70	.269	3.3	52
Malaysia	6.11	2.81	2.86	.39	-.58	.034	4.0	50
Turkey	3.37	1.76	.93	.65	-.74	.093	3.9	50
Jamaica	6.13	4.83	1.85	.00	-.34	.070	2.7	42
Panama	5.83	2.08	2.62	1.08	-.19	.173	4.7	52
Peru	5.79	2.20	2.33	1.21	-.63	.146	3.9	49
Costa Rica	4.50	2.29	1.10	.60	-.19	.177	1.0	46
Syria	4.31	1.94	1.59	.32	-.66	.126	6.6	...
Brazil	4.52	1.40	2.43	.65	-.25	.122	3.5	57
Portugal	4.19	2.71	.89	.58	-.07	.108	2.5	37
Mexico	4.93	2.26	1.61	1.02	-.16	.105	3.7	54
Greece	6.04	2.73	1.98	1.30	.27	.183	2.0	35
Singapore	4.84	1.97	2.20	.62	-.15	.090	5.0	40
Ireland	5.95	1.97	2.83	1.10	.71	.189	1.2	36
Argentina	7.03	2.27	3.58	1.14	.25	.272	3.7	42
Iran	2.17	.85	.97	.36	-.63	.053	6.9	43
Hong Kong	7.99	2.04	4.88	1.04	-.16	.101	2.0	42
Spain	5.58	3.14	1.32	1.10	.46	.204	3.1	26
Israel	9.43	.52	5.44	3.42	1.98	.254	2.4	33
Venezuela	5.44	2.40	2.30	.75	-.10	.181	2.0	44
Trinidad & Tobago	7.02	1.02	5.62	.37	.04	.051	2.0	46
Japan	8.65	3.32	3.32	1.97	2.15	.248	1.0	35
Italy	7.20	2.11	4.27	.72	1.07	.256	1.6	35
Austria	8.15	1.47	5.78	.81	1.17	.187	1.0	29
Finland	7.63	2.78	3.57	1.24	1.34	.272	2.0	30
U.K.	10.90	.29	5.14	4.24	1.74	.188	1.0	26
Belgium	8.13	2.79	3.74	1.53	1.48	.227	1.0	27
Norway	9.12	.77	6.44	1.82	1.37	.221	1.0	34
Netherlands	9.55	1.19	6.18	2.06	1.91	.258	1.0	29
Germany, West	9.58	1.39	6.36	1.68	1.93	.246	1.6	31
New Zealand	10.62	1.24	6.03	3.25	1.01	.259	1.0	34
France	5.57	2.79	1.76	.98	1.66	.245	1.8	42
Denmark	7.67	2.78	3.49	1.26	1.15	.294	1.0	32
Australia	10.35	.89	5.77	3.57	1.42	.240	1.0	24
Sweden	8.25	1.61	4.56	2.07	1.86	.288	1.0	32
Canada	10.42	1.59	5.21	3.58	1.27	.397	1.0	31
Switzerland	9.54	1.87	5.84	1.79	2.23	.165	1.0	34
USA	11.27	.94	5.90	4.38	2.24	.579	1.0	35

The per capita growth rate $g_{(Y/L)}$ from 1962-92 is taken as β_1 from $\ln(Y/L)_t = \beta_0 + \beta_1 t$.

The "convergence variable" is given by the predicted value for $\ln(Y/L)_{1960}$ as outlined above.

The average growth rate of physical capital 1960-92 $g_{(K/L)}$ is computed from estimates of aggregate capital stocks that have been obtained by the *perpetual inventory* method as specified for LDC's by Harberger (1978) and refined by Nehru and Dhareshwar (1993), using a depreciation rate of 10 per cent. Growth rates are computed in the same way as for $g_{(Y/L)}$.

Educational human capital (H/L) is from census data and from related sources (as documented in Psacharopoulos and Arriagada (1992)), where *MYS* is *mean years of schooling in the labor force* around 1975, and *LOW*, *MED*, and *HIG* result from a desegregation of *MYS* into three subgroups of educational attainment corresponding to adults that have completed the first six grades, the seventh to eleventh grades, and levels of education higher than eleventh grade. The present study draws on Psacharopoulos' and Arriagada's (1992) data as well as their method, which has been used to extend their original educational database relying on various editions of the *UN Demographic Yearbook*.

Technical progress g_T is computed as the first principal component explaining 85 per cent of the overall variance of six technology related indicators. Indicators are R&D (expenditure and professionals engaged), patenting activity (one domestic and two international), scientific publications, and acquisition of technical knowledge from abroad (royalties and expenditure for foreign licences). Data are from various volumes of the UNESCO Statistical Yearbook (manpower and expenditure for R&D), the IMF Balance of Payments Statistics (royalties and licence fees), the journal Scientometrics (scientometric data). Patent data are from unpublished sources and were generously put at our disposal by the World Intellectual Property Organization in Geneva, and the ifo-Institute in Munich. All indicators are period averages.

A country's openness to trade (Z) is proxied by the residual $\hat{u}$ from the regression $((M+X)/Y) = \beta_1 + \beta_2 \ln Y + \hat{u}$, where Y is GDP, M is imports and X is exports, and all data are taken as 5-year averages from 1973-77 (for 1975). This procedure is motivated by the dependence of the volume of international trade on the size of a country's home market. (The estimated parameter for β_2 equals -.83 with a highly significant t of -3.40, i.e. the variables are indeed behaving as expected.)

Educational imbalance (*EI*) is proxied by 1 - *((PRIPM - TER) / PRIM)*, where *PRIM* and *TER* are primary and tertiary enrollment rates for 1975, and data are from *UNESCO Statistical Yearbook*. Since - due to "repeaters" - reported primary enrollment rates *exceed* 1 for 33 countries in our sample, thereby not unambiguously expressing primary schooling for a higher share of a cohort, 1 is taken as the upper bound.

Economic inequality (Gini) is measured by the Gini coefficients as given in Deiniger and Squire (1996). Mean values for 1960-92 are computed using data labeled "accept"

(highly reliable), referring to lower quality data only for countries that would otherwise have to be dropped from the sample.

Political rights and civil liberties (GI) are measured by Gastil's well-known and widely used index (mean values for 1960-89). Data are from King and Levine (1994).

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