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Where Has All the Education Gone?

How to explain the surprising finding that more education did not lead to faster economic growth?

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Summary findings

Cross-national data on economic growth rates show that increases in educational capital resulting from improvements in the educational attainment of the labor force have had no positive impact on the growth rate of output per worker.

In fact, contends Pritchett, the estimated impact of growth of human capital on conventional nonregression growth accounting measures of total factor productivity is large, strongly significant, and *negative.*

Needless to say, this at least appears to contradict the current conventional wisdom in development circles about education's importance for growth.

After establishing that this negative result about the education-growth linkage is robust, credible, and consistent with previous literature, Pritchett explores three possible explanations that reconcile the abundant evidence about wage gains from schooling for individuals with the lack of schooling impact on aggregate growth:

- That schooling creates no human capital. Schooling may not actually raise cognitive skills or productivity but schooling may nevertheless raise the private wage because to employers it signals a positive characteristic like ambition or innate ability.
- That the marginal returns to education are falling rapidly where demand for educated labor is stagnant. Expanding the supply of educated labor where there is stagnant demand for it causes the rate of return to education to fall rapidly, particularly where the sluggish demand is due to limited adoption of innovations.
- That the institutional environments in many countries have been sufficiently perverse that the human capital accumulated has been applied to activities that served to *reduce* economic growth. In other words, possibly education does raise productivity, and there is demand for this more productive educated labor, but demand for educated labor comes from individually remunerative but socially wasteful or counterproductive activities — a bloated bureaucracy, for example, or overmanned state enterprises in countries where the government is the employer of last resort — so that while individuals' wages go up with education, output stagnates, or even falls.

This paper — a product of the Poverty and Human Resources Division, Policy Research Department — is part of a larger effort in the department to investigate the determinants of economic growth. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Sheila Fallon, room N8-030, telephone 202-473-8009, fax 202-522-1153, Internet address sfallon@worldbank.org. March 1996. (48 pages)

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Where has all the education gone?

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The World Bank

Where has all the education gone?[1]

The claim that expanding education is good for economic growth seems intuitively obvious, receives apparent empirical support from both individual and aggregate data, and has become a fundamental tenet of development strategy. However, like many beliefs the empirical basis for this claim is substantially weaker than is often supposed. Two recently created data sets on the education attainment of the labor force show that the growth of educational capital per worker has had no (or even perhaps a mildly negative) impact on the rate of growth of output per worker. Put another way, the growth of education has a strong negative association with conventionally constructed growth-accounting measures of TFP.

The first section demonstrates the strength of this surprising and striking finding in several ways. First, the result is robust to choice of sample and estimation technique. Second, while acknowledging the potential weaknesses of the data, I show the results are not caused by pure measurement error of educational attainment. Third, in order to build credibility for the fact that schooling has not always paid off in economic growth, I show the intuition behind this result with regional and country examples. Finally, many believe the previous cross country growth regressions have established the importance of human capital accumulation. However, I show that previous empirical work which relies on enrollment rates as a proxy for human capital growth, while not invalid statistically, is irrelevant to the discussion of human capital because in the available data both primary or secondary enrollment rates are *negatively* correlated with the rate of human capital growth.

[1] Without implicating any I would like to thank many. I am very grateful for discussions with and comments from Harold Alderman, Jere Behrman, Deon Filmer, Mark Gersowitz, Paul Glewwe, Peter Lanjouw, David Lindauer, Mead Over, Harry Patrinos, Martin Ravallion, Dani Rodrik, and Michael Walton and the participants at the Johns Hopkins development seminar.

How does one interpret the lack of an association between growth and expanded education? There is abundant and overwhelming evidence at the individual level from simple cross-tabulations as well as Mincerian type regressions that more educated individuals tend to have higher wages and incomes. It would seem to naturally follow this micro evidence that if more individuals were educated, average income should rise. In fact it does not. I discuss three possibilities for reconciling the macro and with the micro evidence. First, schooling may not actually raise cognitive skills or productivity but schooling may nevertheless raise the private wage because it serves as a signal to employers of some positive characteristic like ambition or innate ability. Second, expanding the supply of educated labor in the presence of stagnant demand for educated labor causes the rate of return of education to fall rapidly. The third possibility is that education does raise productivity, and that there is demand for this more productive educated labor, but that demand for educated labor comes from individually remunerative but socially wasteful or counter-productive activities so that while individual wages go up with education, aggregate output stagnates or even falls.

I) More education does not lead to more rapid growth

A) Measuring education and physical capital

There are two sets of recently created cross national, time series data about the years of schooling of the labor force which use different methods to estimate educational attainment. Barro and Lee (1993) (B-L) estimate the educational attainment of the population aged 25 and above using census data where available. They create a full panel of five yearly observations over the period 1960-85 for a large number of countries by filling in the missing data using enrollment rates. Nehru, Swanson and Dubey (1994) (N-S-D) take a different approach, using a perpetual inventory method to cumulate enrollment rates into annual estimates of the stock of schooling of the labor force aged population, creating annual observations for 1960-1987.

From these measures of the years of schooling, I create a measure of educational capital. By analogy with the specification used in Mincer, I assume that the natural log of the wage in any period is a linear function of the years of schooling:

$$\ln(w_N) = \ln(w_0) + r*N$$

where w_N is the wage with N years of schooling, N is the number of years of schooling and r is the wage increment to a year's schooling[2]. The value of the stock of educational capital at any given time t can then be defined as the discounted value of the wage premia due to education:

$$HK(t) = \sum^{T} \delta^{t}*(w_N - w_0)$$

where w_0 is the wage of labor with no education[3]. This is just the value now of a given stock of schooling. After substituting in the formula for the educational wage premia into this definition and taking natural logs, the rate of growth of educational capital is approximately[4]:

$$\Delta hk(t) = \Delta\ln(\exp^{rN(t)} - 1)$$

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[2] This is not the "rate of return" to schooling, which only happens to equal the wage increment under very special conditions. For growth accounting of the current stock the wage increment, not the rate of return is relevant.

[3] Mulligan and Sala-i-Martin (1995) pursue this approach directly by calculating the human capital for the U.S. state by state by comparing the aggregate labor income versus the income of workers with no schooling.

[4] There are two reasons this is only approximate. The discount factor is assumed constant and hence is factored out of the time rate of change. However, it does depend on the average age of the labor force (since the discount is only until time T (retirement)) which certainly varies systematically across countries, but I am assuming that changes in this quantity over time are small. The other, potentially more serious problem is that I dropped out the growth rate of the ln (w_0) term because I didn't know what to do with it. This seems wrong.

where lower case for HK is logs and the Δ is the time rate of change[5]. In order to empirically implement this I have to choose a value for r. I assume it is 10 percent. This is based on a large number of empirical estimates from micro data. Since we use the same wage increment for every country, the growth rate of educational capital is very robust to variations in the value of r. I also assume r is constant across the years of schooling, an assumption which is more problematical, but not grossly inconsistent with the data[6].

While both of the sets of educational attainment data have been roundly criticized on a number of grounds (Behrman and Rosenzweig, 1993,1994) I will plow ahead for several reasons. First, using real, but flawed, estimates of the growth of educational capital stock for estimation of equations in which the growth of that stock is the conceptually appropriate variable must be better than the widely used alternative of using flow investment rates (enrollment rates) and simply pretending they are estimates of the growth of the stock. Second, the degree of pure measurement error is easy to overstate relative to the signal in the data and in any case pure measurement error can (and will) be handled econometrically. Third, even if years of schooling do not proxy well human capital accumulation, they do proxy the policy alternative often considered, which is not to improve human capital (since that is not under policy control), but to increase years of schooling.

That said, one should not be too facile about the association between the years of schooling (and derived educational capital) measures, which is all we really have to hand, and "human capital" which is a much broader concept. An individual's marketable human capital can be defined to be the annualized

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[5] Most previous studies use either the growth rate of the log of years of schooling or the growth rate of the level of years of schooling as proxies for growth of human capital. While the present specification is arguably ad hoc (for instance, this is not aggregated up from individual levels), it is not clear what fundamental specification of the earnings function would generate either of the other two specifications.

[6] This does not contradict the widely asserted to be a fact that the rate of return to investment in primary education is higher than that of other levels of schooling to growth accounting. For growth accounting what is needed is the wage increment, which is the amount by which wages are higher ex-post, not the return anticipated ex-ante. This is important because much of the reason why calculations (such as those reported by Psacharopolous (1993)) show primary education having a higher return is not because the increment to wages from a year of primary school is higher, but because the opportunity cost of a year of primary schooling is much lower given the assumption that the foregone wage attributed to a primary aged unschooled child is very low (Bennell, 1994).

value of the difference between the individual's wage and the wage for the rawest of raw labor. There are a number of elements of human capital in addition to the kinds of general education captured by formal schooling enrollment statistics. There are the additions to productivity from better health and physical strength (Fogel 1994). There are formal and informal occupational (but not firm) specific training programs (such as apprenticeships. There are firm specific training programs for employees[7]. In addition there are wage increments to seniority, perhaps from on the job learning not specifically associated with training. Finally there are rents to special acquired skills that can be called human capital[8]. Moreover, since wage regressions in the US (and elsewhere) with every conceivable individual specific observable characteristic (age, education, sex, race, location of residence) typically only explain only about 40 percent or less of wage differences, if "human capital" is invoked to explain wage difference there are clearly large amounts of human capital left unmeasured. Henceforth, to call spades, I shall refer to only educational capital, not human capital.

In addition to the measures of educational capital I use two measures of physical capital. These are both created by a perpetual inventory method from investment rates and an initial assumption about the capital stock (based on a guess of the initial capital-output ratio). The major difference is that the capital stock series created by King and Levine (1994) (K-L) uses the Penn World Tables, Mark 5 (Summers and Heston, 1991) investment data while Nehru and Dhareshewar (1993) (N-D) use World Bank investment data. The two capital stock series are highly correlated and give very similar results. In most of the subsequent regressions, I use K-L physical capital data in regressions with B-L human capital and N-D physical capital data with N-S-D human capital data, but this pairing of the different physical and

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[7] Total training expenditures by firms in the US is estimated to be around 40 billion, roughly a tenth of total (1992) expenditures of educational institutions of $390,000.

[8] Steve Young, the quarterback of the San Francisco 49ers, for instance, could be said to have extraordinarily large human capital, although it has very little to do with his formal schooling. After all, I attended the same educational institution at the same time and, I would guess, had better academic performance, and yet my human capital is a (vanishingly) small fraction of his.

educational capital stock series is just for convenience and nothing critical hangs on this association.

The dependent variable of interest will be the growth of GDP per worker. GDP per worker (as opposed to GDP per work-aged population or total population) is the appropriate variable for growth accounting[9]. Although the estimates of labor force participation are, like all aggregate data, subject to criticism, they are better than using population or workforce aged population figures for labor which implicitly assumes what is known to be false--that labor force participation is equal across countries. Growth rates of GDP are calculated from PWT5 data unless otherwise specified (but World Bank growth rates give nearly identical results).

B) <u>Growth accounting regressions with human capital</u>

Mankiw, Romer and Weil (1992) suggest that the Solow aggregate production function framework extended to include human capital is a useful way to approach long run growth:

1) $Y_t = A(t) * K_t^{\alpha_k} * H_t^{\alpha_h} * L_t^{\alpha_l}$

Assuming constant returns to scale and normalizing by the labor force suggests estimating (where lower case represents per worker quantities):

2) $y = a(t) * k^{\alpha_k} * h^{\alpha_h}$.

Now if this specification is valid, this equation could be estimated either in levels or in rates of growth. Since estimation in levels raises numerous problems (to which I return below), I will estimate the following

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[9] This output variable does raise one problem. My estimates of human capital are based on estimates of the educational capital of the labor force aged population, while my output is output per estimated labor force (although not corrected for unemployment) so that systematic differences in the evolution of the labor force versus the labor force aged population (say through differential female labor force participation) could affect the results.

cross-country equation in per annum growth rates over the entire period:[10]

3) $\hat{y} = \hat{a} + \alpha_k * \hat{k}_i + \alpha_h * \hat{h}_i + \epsilon_i$

The results using the two schooling series for the entire sample of countries are reported in table 1[11]. The partial scatter plots are displayed in figures 1a and 1b[12]. The physical capital results look entirely reasonable with a large and very significant effect. The estimates, although somewhat high, correspond reasonably well to prior, national accounts based, estimates of the capital share[13].

Very much on the other hand, the estimates of the impact of growth in educational capital on growth of per worker GDP are consistently small and negative. Using the N-S-D measures the negative estimate is even (barely) significant. Before making too much of this strange result, let's put it through some econometric paces.

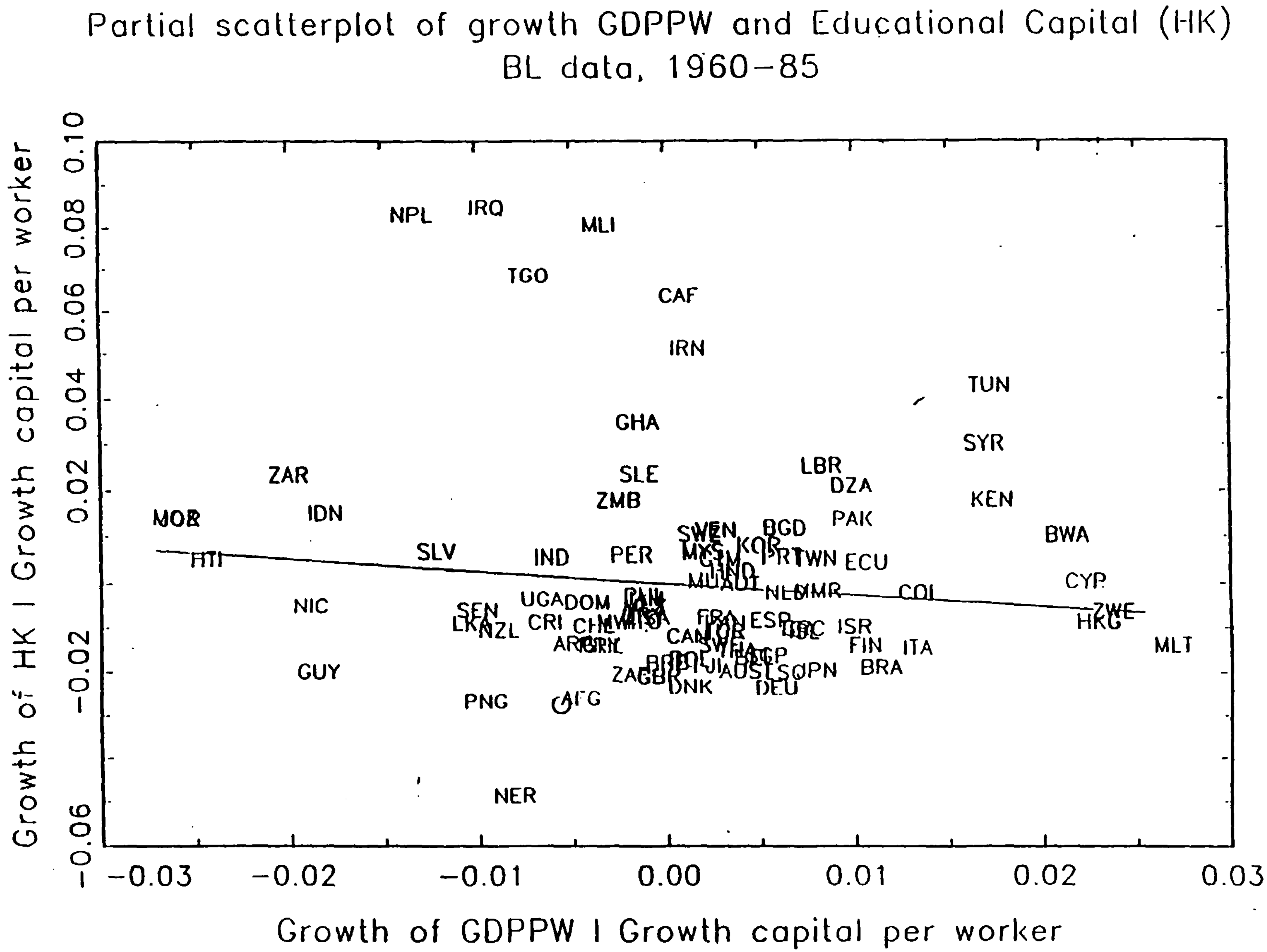
[10] Growth for each of the variables is calculated as the logarithmic least squares growth rates over the entire period for which the data is available. This makes the estimates of growth rates much less sensitive to the particular endpoints than simply calculating the beginning period to end period changes. However, this means the time period over which I calculate the growth rate does not always correspond exactly to the time period for the education data, but since both are per annum growth rates this difference does not matter much.

[11] Four countries are dropped from all regressions because of obvious data problems. Kuwait, because PWT5 GDP data is bizarre, Gabon, because labor force data (larger than population) is clearly wrong, Ireland because the N-S-D data report an average of 16 years of schooling (immigration wreaks havoc with their numbers), and Norway because B-L reports an impossible increase of 5 years in schooling over a period of 5 years.

[12] The partial scatter plot is the scatter plot of the dependent (GDP per worker growth rate) and independent (growth rates of the years of education) after projecting out the growth rate of capital per worker (and a constant). The slope of the line in the partial scatter plot is the multivariate regression coefficient.

[13] The higher coefficient on capital in regressions then the share in national accounts may be due to general spillovers or externalities to certain types of investment such as machinery (DeLong and Summers 1991).

Figure 1a



Partial scatterplot of growth GDPPW and Educational Capital (HK)
BL data, 1960–85
Growth of HK | Growth capital per worker
Growth of GDPPW | Growth capital per worker
-0.06
-0.02
0.02
0.04
0.06
0.08
0.10
-0.03
-0.02
-0.01
0.00
0.01
0.02
0.03
NPL
IRQ
MLI
TGO
CAF
IRN
TUN
GHA
SYR
LBR
ZAR
SLE
DZA
KEN
ZMB
IDN
PAK
BGD
BWA
HTI
SLV
IND
PER
TWN
ECU
CYP
COL
NIC
SEN
CRI
ISR
HKG
MLT
FIN
ITA
GUY
BRA
PNG
DNK
NER

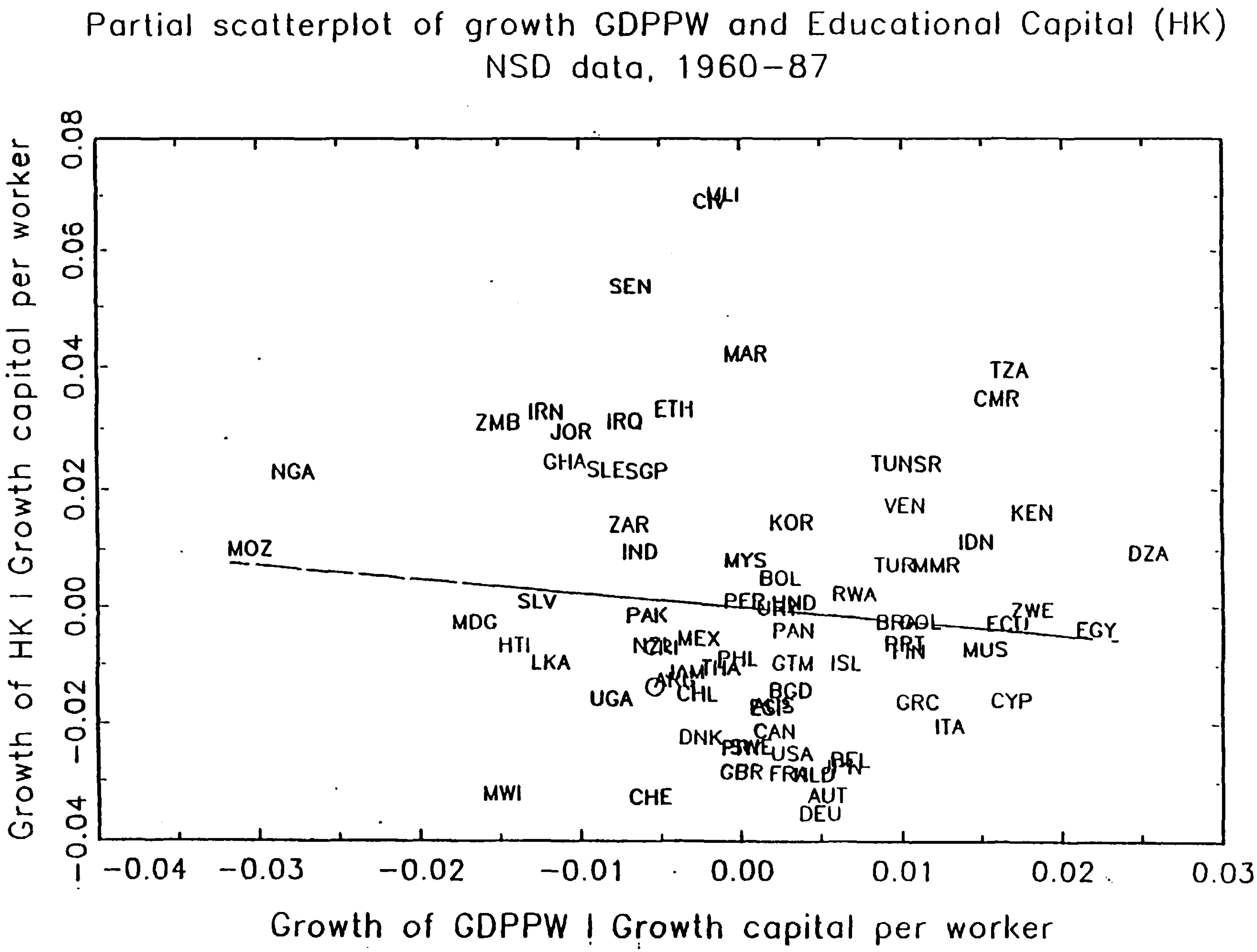
Table 1: Basic OLS growth accounting regression, dependent variable per annum growth of GDP per worker.				
	Barro-Lee education data[1)]		Nehru-Swanson-Dubey education data[2)]	
	Basic	with initial GDPPW	Basic	with initial GDPPW
Physical capital per worker	.524 (12.8)	.526 (12.8)	.501 (9.54)	.501 (9.49)
Educational capital per worker	-.049 (1.07)	-.038 (.795)	-.104 (2.07)	-.117 (2.04)
Ln (Initial GDPPW)		.0009 (.625)		-.0008 (.491)
Number of countries	91	91	79	79
R-Squared	0.653	0.655	0.557	0.561
Notes: Absolute values of t-statistics in parenthesis constants are included but not reported. 1) Uses King-Levine data on physical capital stocks. 2) Uses Nehru-Dhareshewar data on physical capital stocks.				

Two columns in table 1 add the initial level of GDP per worker to the basic regressions, for two reasons. First, on a theoretical level, much attention has been given to conditional convergence which implies TFP growth should be higher the lower the initial level of income (Barro and Sala-i-Martin, 1995)[14]. On a more pragmatic level, perhaps poorer countries have more rapid percentage growth of human capital or the measurement error is associated with level of development, either of which could bias the results. However, adding the initial level of GDP per worker has no impact on the negative estimates of the effect of education.

The results for both physical and human capital are robust to the sample used. The negative coefficient on schooling growth persists if: a) only developing countries are used, b) the observations from Sub-Saharan Africa are excluded or c) regional dummies are included. Moreover, as a test for the robustness of the results to outliers, individual observations identified as influential were deleted

[14] Although conditional convergence is of theoretical interest, it is obvious that absolute divergence in per capita incomes is obviously the prime empirical phenomena of the modern era (Pritchett 1995).

Figure 1b


Partial scatterplot of growth GDPPW and Educational Capital (HK)
NSD data, 1960-87
Growth of HK | Growth capital per worker
Growth of GDPPW | Growth capital per worker

sequentially, up to 10 percent of the sample size[15]. The human capital coefficient remained negative for all of these trial sub-samples.

The results are also robust to variations in data or estimation technique. Estimates using World Bank constant price GDP growth rates instead of the PWT5 GDP data are roughly the same. Using growth of GDP per person or per work-aged labor force produces an even larger negative estimate for education. Using either of the two physical capital stock series in conjunction with either human capital series gives similar results. Relaxing the assumption of constant returns to scale does not alter the negative estimate on human capital[16]. Using weighted least squares using either (log of) population, GDP per capita, or total GDP as the weights also gives nearly identical results.

As surprising as these results are, they are actually quite close to what other researchers have found when they have examined the education/growth relationship using data on changes in the stock of education. Benhabib and Spiegel (1994) and Spiegel (1994) use a standard growth accounting framework (extended to include initial per capita income) and find the growth of years of schooling enters negatively (although it is statistically insignificant)[17]. Spiegel (1994) shows the finding of a negative effect of educational growth is robust to the choice of sample and to the inclusion of a wide variety of ancillary variables (i.e. dummies for SSA and Latin America, size of the middle class, political instability, share of

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[15] Observations are identified as influential based on the difference in the estimates with and without the observation included, that is;

$$Influence_i = \sum_k |\beta_k - \beta_k^{(i)}|$$

where (I) indicates the estimates with the i^{th} observation dropped.

[16] Others have tried relaxing the Cobb-Douglas assumptions about substitution between the various factors but without much success (Judson, 1993).

[17] The Benhabib and Spiegel (1994) and Spiegel (1994) papers use a completely different set of estimates of human capital created by Kyriacou (1991), adding credence that the present results are not an artifact of the particular estimates of schooling.

machinery investment, inward orientation). Lau, Jamison and Louat (1991) estimated different effects of education by level (primary versus secondary) and five regions and found that primary education had an estimated negative effect in Africa and Middle East and North Africa, insignificant effects in South Asia and Latin America and only positive and significant in East Asia. Jovanovic, Lach and Lavy (1992) use annual data on a different set of capital stocks and the N-S-D education data and find similarly negative coefficients for their non-OECD sample[18]. Using even cruder proxies than educational capital, such as changes in adult literacy, gives similar results as Behrman (1987) and Dasgupta and Weale (1992) find that changes in adult literacy are not significantly correlated with changes in output.

Finding that a variable is not statistically significant in a regression is typically not very interesting, for three reasons. First, since pure measurement error attenuates estimated coefficients (that is, creates a bias towards zero) using a sufficiently badly measured proxy for the true variable of interest will always suffice to produce an estimated coefficient that is insignificantly different from zero no matter how large the true impact of the correctly measured variable. Second, we frequently do not have a good prior reason for knowing what the coefficient "ought" to be so it is difficult to know how far any given point estimate is from the "expected" value. Finally, the failure to reject may simply be low statistical power, so while a zero effect cannot be rejected, it is possible a wide range of other plausible values are also not rejected. The next subsections address these problems in turn.

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[18] One estimate using stocks that do not find a negative coefficient are those reported in the East Asia Miracle study (World Bank, 1993a), which uses annual data in a CRS constrained production function and find a coefficient of .154. First, the use of annual data in this regression will add enormous noise and potential bias given that by far the major determinants of annual GDP growth rates are cyclical, not long run growth, effects while education growth is very smooth (Easterly, et al, 1993). Second, the t-statistic on human capital using 2,093 observations is just 1.5, which again suggests tremendous noise. Third, their estimate of the physical capital stock estimate, .178, is just not on, as it is completely implausible and at odds with nearly all other empirical results and with very solid non-regression evidence.

C) Measurement error

The zero result may just reflect pure measurement error of educational capital. By "pure" measurement error I intend to distinguish two types of measurement problems. The first, which I call "pure" measurement error, is that the estimates of years of schooling of the labor force are bad estimates of the years of schooling of the labor force. The other possibility is that the data are perfectly acceptable measures for the years of schooling of the labor force, but years of schooling of the labor force is a very bad proxy for educational capital, perhaps because poor quality schooling does not raise cognitive skills. I address this second type of measurement error below.

There are three defenses to the accusation that the finding of a negative coefficient on educational attainment is simply the result of pure measurement error. The first is simply that the results are robust across various, independently constructed measures. I present results above using two different measures and Spiegel (1994) reports similar negative estimates using a third. One check on the magnitude of measurement error is the correlation amongst various measures. The correlation in levels between the B-L and N-S-D years of schooling estimates in 1985 is .91[19]. More importantly, the correlation of the growth rates of the two educational attainment series is .67 (table 7). If the measurement errors of the two methods were uncorrelated (which they won't be because they both use enrollment rate data) this would suggest that the magnitude of measurement error bias would reduce the education coefficient by about an equivalent amount (e.g about .7).[20]

[19] Of course the correlation in levels is a rather weak criteria for judging cross national data quality as most of the variation is between rich countries with a high level and poor countries with a low level. As an illustration I asked my colleague in the office next door, Peter Lanjouw, a poverty specialist with no emphasis on the economics of education and who had not seen the data, to guess the years of schooling in 1985 for each country based only on the minimum, maximum and mean of the data. His guessing took about 15 minutes. The correlation between the levels of years of schooling N-S-D data and Pete's guesses is .88 while the correlation of the B-L data and Pete's guess/data is .86.

[20] The simple calculations is the "true" variable is x^* and the observations are $x^* + v_{1(2)}$, where $v_{1(2)}$ are the measurement error in the first(second) observation. The expression for OLS bias is:

A second simple defense is that pure measurement error cannot make a positive coefficient negative. So while pure measurement error could account for a small, or statistically insignificant estimate, it cannot account for a negative estimate.

The third defense is the econometric solution for pure measurement error, instrumental variables (IV) estimates. In this case I have one legitimate instrument because of the repeated measurements on the growth of the educational capital stock. I can use the N-S-D schooling estimates as an instrument in the regression which uses the B-L data and vice versa[21]. Table 2 presents the IV estimates. The coefficient on schooling becomes slightly more negative when instrumented. The IV estimates using the two measures in identical samples are very similar, -.12 (B-L) and -.13 (N-S-D), and both are borderline statistically significant. Of course, the IV estimates will only be consistent if the measurement errors are uncorrelated, but even if the correlation were substantial the IV estimates should move substantially towards the true value.[22]

$$OLS\ bias = \frac{\sigma^2_{x^*}}{\sigma^2_{x^*} + \sigma^2_v}$$

While the correlation (rho) of two measures is;

$$\rho = \frac{\sigma^2_{x^*}}{\sqrt{\sigma^2_{x^*} + \sigma^2_{v_1}}\sqrt{\sigma^2_{x^*} + \sigma^2_{v_2}}}$$

[21] Instrumental variables always seem a little like magic, but this case, in which two potentially bad measures are used to correct for each other the magic seems particularly egregious. The intuition is that since measurement error creates a bias in OLS because the effect of the real variable and the effect of the measurement error are constrained to be the same (because they cannot be identified). Using another measurement, even one that is itself measured with error, allows identification of the variable because of the information from the differing covariance of the new measure with the components of the original measurement between the "truth" and the measurement error.

[22] For instance, assume enough pure measurement error in both variables to drive the coefficient from a presumed "true" value of .3 to .10, and assumed that the correlation of the measurement errors (in growth rates, not levels) is .5. Then the IV estimate should be about 40 percent than larger OLS.

Table 2: Growth accounting regressions, Instrumental variables estimates.

	Barro-Lee data			Nehru-Swanson-Dubey data		
	OLS	IV (w/Nehru)	IV (w/ other country	OLS	IV (w/Barro)	IV (w/other country)
Growth of capital per worker	.458 (10.19)	.460 (10.18)	.527 (12.42)	.455 (10.08)	.455 (10.01)	.501 (9.35)
Growth educational capital	-.091 (1.61)	-.120 (1.42)	-.088 (.593)	-.076 (1.41)	-.13 (1.59)	-.104 (2.30)
Number of countries	70	70	77	70	70	79
R-Squared	.611	--	--	.607	--	--

Notes: Absolute values of t-statistics in parenthesis.

Another possible instrument is to use the growth rate of educational capital in a similar country as an instrument. To implement this I simply matched each country with another country that I felt (without actually examining the data) was similar, usually using the geographically closest neighbor. One can expect the correlation of the educational capital growth rates in similar countries to be positively correlated (and the actual correlation is .316 for the B-L data and .619 for the N-S-D data) while the pure measurement error of country reported enrollment rates is plausibly uncorrelated across countries. The results from this instrument are in columns 3 and 6 of table 2. Again, the coefficients estimated with IV are the same or larger more negative than OLS estimates.

Taken together, the correlations of the two measures of educational capital growth and the IV regressions suggest that there is in fact substantial pure measurement error. The signal to signal plus noise ratio is as low as 70 percent[23]. Correcting this measurement error however makes the estimates larger in absolute value which is more negative, which only deepens the puzzle.

A final point about measurement error in growth regressions. It is very easy (and fun) to complain about the quality of aggregate data. One can easily show a myriad of ways in which what is measured deviates from what one would like to measure. But it is just as easy (and again, fun) to tell stories about why physical capital stocks are badly mis-measured and *a priori* there are few reasons to believe that measurement error is not as bad for physical as for human capital. Yet the growth accounting regressions are not just random noise. The estimated physical capital coefficient is strong, statistically significant, and not appreciably downward biased at all (actually, relative to our non-regression guess it is a little high). Therefore, if a critic is to dismiss these regressions entirely because of the estimates of the impact of educational capital are downward biased because of measurement error, he/she should have an explanation as to why the problem is not just a little, but wildly, orders of magnitude, worse for educational than for physical capital.

D) How much should years of schooling matter?

The benefit of taking the extended Solow approach is that under the assumptions of this model we actually have non-regression based estimates of how much the expansion of physical and educational capital ought to matter. Using non-regression based estimates of the contributions of various types of capital to growth allows a growth accounting decomposition (Denison, 1967). After accounting for the growth due to factor accumulation effects we can define TFP as the residual.

Since the weights in the aggregate Cobb-Douglas production function represent the shares of income, the coefficient on educational capital in a growth regression ought to be equal to the share of

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[23] If the ratio of $\frac{B_{OLS}}{\beta_{IV}}$ is used as an estimate of the magnitude of measurement error is .09/.13=.69, roughly the same as the correlation between the B-L and N-S-D measures.

educational capital in GDP. Guessing a plausible value for this number is more complicated than finding the capital share, since it is not published in the national accounts, but we can nevertheless make plausible guesses. The physical capital share is typically around .4 for developed countries and somewhat higher in LDCs, a figure which is roughly consistent with a variety of evidence; the estimates from national accounts[24], the estimates from regression parameters and from rough calculations that depend on rates of return and capital output ratios[25]. If the share of physical capital is .4 the total wage share must be .6. If the total wage share is .6, how much of that total wage share is due to educational capital?

One way of making this calculation for the share of wages due to human capital is simply to use the ratio of the minimum wage to the average wage. Mankiw, Romer, Weil (1992) use the historical ratio of average to minimum wages in the US to estimate that half of wages are due to human capital[26]. A similar calculation based on the distribution of wages in Latin America estimates the human capital share between 50 and 60 percent[27]

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[24] From the OECD national accounts the average share of capital across the 12 countries is 40.3. The difficulty with estimating capital share in non-OECD countries is that "proprietor's income" is typically all attributed to capital, which means in poor countries that all of self-employment (including subsistence agriculture) ends up in capital share, which is therefore much higher than believable. Reasonable assumptions about the allocation of proprietor's income between labor, land and capital can make the existing national accounts shares consistent with a 40 percent capital share (Pritchett, 1995).

[25] For instance if the capital-output ratio (K/Y) is 2.5 and the rate of return to capital is 16 percent then the share of capital rK/Y is 40 percent.

[26] This is the calculation that MRW use, that the ratio of the average wage in the US to the minimum wage has hovered around 2. Since the wage share w*L can be decomposed into a share due to raw labor w_0 and a share due to human capital, wL - W_0 L/wL or 1 - w_0/w is the share due to human capital.

[27] Using data on the distribution of worker's earnings (World Bank, 1993) we take the ratio of the average wage of wages up to the 90th percentile (to exclude the effect of the very long tails of the earnings distribution) to the wage of those workers in either the 20th or 30th percentile (to proxy for the wage of a person with no human capital). The estimates of human capital share of the wage bill are 62 and 47 percent respectively. If the top tenth percentile is included (so I take the ratio of average wages to 20th or 30th percentile) the estimates of human capital share are even higher, 74 and 63 percent respectively. While these are considerably higher than other estimates, these are estimates of all human capital, not just educational capital.

The other way to make this calculation is to assume a wage increment to education (taking the micro evidence discussed below at face value) and calculate the fraction of the labor force in each educational attainment category to derive the educational capital share. Table 3 shows the results of two calculations. The top half shows the fraction of the labor force in various educational attaintment categories in various regions. If one assumes a wage premia for each of these categories then one can calculate the share of the wage bill due to educational attainment.

$$\textit{Educational capital share} = \frac{\sum_{i=0}^{K} (w_i - w_0) * \alpha_i}{wL}$$

where i represents each educational class and α_i are the shares of the labor force in each educational attainment category. Row A of table 3 shows the share of the wage bill that is educational capital in various regions if it is assumed that the wage increment to a year of schooling is 10 percent at all levels of education[28]. Under that assumption the educational share of the wage bill varies across regions from 26.3 percent (in SSA) to 62.1 percent in OECD and is 36.4 percent for the developing countries as an aggregate. Row B shows the share of the wage bill due to educational attainment if it is assumed that primary has a higher impact than secondary and secondary than tertiary. Under this assumption, the share is 49 percent for all developing countries and varies from 38 percent (in SSA) to 73 percent (in the OECD).

[28] In the Psacharopoulos (1993) report the developing country average was 11.7 percent.

Table 3: Share of human capital in wage bill							
	Wage premia by educational attainment under assumption:		Share of work force by educational attainment, 1985				
	A	B	Developing Countries	Sub-Saharan Africa	Latin American and Caribbean	South Asia	OECD
No Schooling	1.00	1.00	49.7%	48.1%	22.4%	69.0%	3.3%
Some Primary	1.40	1.56	21.3%	33.2%	43.4%	8.9%	19.4%
Primary Complete	1.97	2.44	10.1%	8.5%	13.2%	4.8%	18.3%
Some Secondary	2.77	3.42	8.7%	7.7%	8.4%	8.8%	20.7%
Secondary	3.90	4.81	5.9%	1.6%	5.5%	5.3%	20.1%
Some Tertiary	5.47	6.06	1.4%	0.2%	2.5%	0.9%	7.7%
Tertiary	7.69	7.63	3.0%	0.8%	4.6%	2.3%	10.5%
Average years of schooling							
			3.56	2.67	4.47	2.81	8.88
Calculated share of return to human capital in total wage bill under assumptions:							
A) Assuming that the Mincerian return is 10%			36%	26%	43%	30%	62%
B) Assuming the Mincerian return is; primary 16%, secondary 12% and tertiary 8 %.			49%	38%	56%	42%	73%
Sources: Data on educational attainment by region from Barro and Lee (1993).							

These are obviously very rough calculations and do not create tight bounds but do suggest the outer limits for reasonable estimates[29]. Both methods suggest that the human capital share of the wage bill should be between .35 and .7 and hence, hence if the wage bill is .6 the share of human capital in GDP should be between .21 and .42. One way to interpret these shares is that the share of educational capital, and hence the coefficient in the above growth accounting regression really ought to be around .3.

Another way to use non-regression growth accounting is to use the shares of human and physical capital from national accounts rather than estimated from regressions. I define the growth rate of TFP to be:

[29] One noticeable feature is that the human capital share does appear to be higher in the wealthier countries which is inconsistent with the imposition on the regressions. Three points. First, this increase in the human capital/ output ratio is also found by Judson (1993). Second, in this case the result is an artifact of assuming equal wage increments across countries. Third, the constancy of factor shares is a condition that has been imposed in nearly all Solow type regressions.

$$\hat{TFP} \equiv \hat{y} - \alpha_k * \hat{k} - \alpha_h * \hat{h}$$

where $\hat{y}$ is growth of output per worker and the shares of physical and human capital are imputed from non-regression data[30].

Table 4 shows the results of regressing TFP growth on the growth of physical and human capital. If the assumed shares are .4 (physical) and .3 (educational) then the growth of educational capital shows a large and very significant negative effect on TFP growth[31]. Even if I assume that the physical capital share is on the high side at .5 and that the share of human capital in the wage bill is on the low side, at a third, so that the educational capital share imposed is about as low as can be reasonable (.166), it is still the case that educational capital accumulation is strongly negatively related to TFP growth (column 2 of table 4).

Table 4: TFP growth and physical and human capital.

	Assumed α_K and α_H (shares of physical and human capital)	
	α_K=.4, α_H =.3	α_K=.5, α_H=.167
Growth of physical capital	.126 (3.08)	.026 (.651)
Growth of Schooling capital	-.338 (6.91)	-.205 (4.19)
ln(Initial GDP per worker)	.0009 (.625)	.0009 (.625
R Squared	.419	.205
N	91	91

Notes: absolute value of t-statistics in parenthesis. Physical capital is King-Levine and educational capital is Barro-Lee.

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[30] By saying I define it in this was I am admitting to ignoring several whole large and important literatures on what productivity really is, how aggregate TFP can be rigorously derived from micro production functions, and how it can be consistently estimated. I am simply, for purposes of discussion, associating the concept TFP with the extended Solow growth accounting residuals by fiat.

[31] Although the result is only presented for one physical (King-Levine) and schooling (Barro) growth measure the result is robust to alternatives.

I am aware that the above TFP result is an arithmetic trick. I could have simply done the t-test using the regression results in table 1 that the human capital coefficient is equal to the assumed values of α_H[32]. But the TFP arithmetic is an effective way of making the point that failing to reject the hypothesis that educational capital increases growth is interesting because it addresses two of the issues raised above, prior beliefs on the coefficient and low power.

First, we know from non-regression based estimates what the educational capital coefficient ought to be, and it is not zero. If we make seemingly reasonable assumptions about schooling returns based on available microeconomic evidence we know that educational capital accounts for a large share of output. Hence its growth accounting share ought to be far from zero. But it is not[33].

Second, the TFP formulation makes it clear that the failure to reject a zero impact of educational growth is not due to low statistical power. Many times a failure to reject that a coefficient is zero simply reflects very imprecise estimates. But not here. The results in table 1 are a high powered failure to reject. While the data fail to reject that the educational capital coefficient is zero, the data provide enough precision to reject the hypothesis the educational capital estimate is not in a large range of values. This rejection range includes all of the values that non-regression estimates suggest. Matter of fact, the estimates and their standard errors reject pretty much all plausible values for the human capital share (as the N-S-D data reject zero from below and the B-L data can reject any share above .06).

E) Can this really be right?

Since I am arguing for what many find an implausible proposition, that increased education did not pay off in economic growth, I want to go beyond what regression coefficients say and show its intuitive

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[32] A t-test from the specification in table 1 (B-L data) that includes initial income that the estimated human capital share is equal to .167 gives a value of 4.16, a convincing rejection.

[33] Weale (1994) makes similar calculations about the likely externality impact of education on TFP using the coefficients from enrollment rates. As shown below regressions using enrollment rates are invalid, but even using those estimates Weale found that the evidence was only consistent with micro returns to education in the 5 to 8 percent range, which is significantly lower than found for most LDCs.

plausibility. The basic credibility of these results are enhanced by the stylized facts of four regions: Sub-Saharan Africa, East Europe, the "good" guys, and the LDCs as a whole. I give these examples not because the statistical results are driven by these countries (as the I showed above, the result is robust to the choice of sample) but because these examples enhance the credibility of the regressions.

The educational attainment of Africa's labor force actually grew at a faster percentage rate than any other region, including East Asia. This is partly because of the initial low base, but even its absolute growth in years of schooling is nearly as high as other regions. Yet the statistics on performance in SSA are well known (Easterly and Levine, 1995). Growth of GDP per worker in Sub-Saharan Africa was half that of Latin America and only a quarter that of the more rapidly growing regions. Again, this is not to say the empirical result is driven by SSA, as excluding it from the sample does not change the results. Rather SSA, contrary perhaps to intuition, did in fact accumulate a great deal of educational capital over the last three decades. But that this increased education appears not to have paid off in aggregate growth.

Table 5: Regional comparisons of education and growth

Region:	Educational growth				Growth of output per worker
	Barro-Lee, 1960-1985		N-S-D, 1960-1987		
	Educational capital growth	Absolute increase in years of schooling	Educational capital growth	Absolute increase in years of schooling	
Sub-Saharan Africa	4.16	1.11	4.56	1.97	.753
South Asia	3.73	1.44	2.54	1.66	1.05
Latin America	2.46	1.77	2.74	2.44	1.58
East Asia and Pacific	2.81	2.57	4.00	2.83	3.66
North Africa, Mediterranean	3.98	2.38	4.74	3.19	3.99
OECD	1.78	2.22	.603	.973	2.45

The second intuition building example is the comparison of the Eastern European countries (EE) with their West and South European counterparts. Even prior to the beginning of the recent structural reforms the EE had very high levels of education and yet massively lower levels of output (the large falls in per capita income at roughly given levels of education since the reforms of course only reenforce this point)[34]. Average years of schooling were almost as high in the three EE countries for which we have comparable data and yet output per worker was only a third as high. Educational attainment was much higher in EE than in the Southern European countries, yet again GDP per worker was only about half.

Table 6: Comparisons of years of schooling and GDP per worker, some Eastern European countries versus averages for Western and Southern Europe

	Years of Schooling, 1985	Real PPP GDP per Worker, 1985
Poland	8.4	7,388
Hungary	10.7	10,565
Yugoslavia	7.2	9,892
Western Europe	9.3	28,471
Southern Europe	6.7	18,772

The third example is that of the countries and regions that are often cited educational over-performers, such as Sri Lanka, Costa Rica, Jamaica, and Kerala state in India. For instance, years of schooling in Sri Lanka, at 5.37 B-L (or 6.07 N-S-D) are more than a full year of schooling higher than would have been predicted on the basis of per capita output. The positive spin to put on these countries performance is that they have had persistently high educational levels for their level of income. Yet the flip side is that these countries have had persistently very low levels of output for their level of education,

[34] These high levels of education appear to reflect real levels of achievement in EE countries. In an internationally comparable test of reading ability of 14 year old Hungarian, Slovens and E. German students all scored above Denmark or W. Germany (Elley 1994). In internationally comparable science exams Hungary had the highest score (Posthlewaite and Wiley 1992).

as Sri Lanka's educational stock was higher than expected in 1965, but its per capita growth rate was well below average, at only 1 percent. The existence of good educational performers relative to income implies that human capital investment does not invariably lead to high levels of output[35]. The Philippines was among the top five educational over performers in both 1965 and 1985 (by both education measures) and yet has hardly been a star growth performer.

Finally, for the LDCs as a whole the basic story line about education just does not scan. Two basic facts are well known. Enrollment rates in LDCs have increased dramatically in the last 30 years. The average gross primary and secondary enrollment rates in LDCs have increased from 66 and 14 percent respectively in 1960 to essentially 100 percent primary and over 40 percent for secondary. Therefore, the experiment of massive expansion of education enrollments has been tried. However, the second well known fact is that, on average, growth rates of LDCs have been stagnant, or even falling, over time and are lower than those of the developed countries. The average growth rate of output per worker in LDCs was 3 percent in the 1960s, 2.5 percent in the 1970s and -.48 percent in the 1980s[36]. Just when one would have expected the massive investments in education of the 1960s and 1970s to pay off, growth collapsed. Similarly the growth of GDP per worker was 2.4 percent in developed countries and lower (1.9 percent) in LDCs while the growth of education was at least as large or larger in LDCs because of the rapid expansion of schooling. There are of course explanations of the poor growth performance of the 1980s or of slower growth in LDCS that have nothing to do with education, but nevertheless the basic facts about the recent historical record on education and growth do not make the growth pay-off to education obvious.

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[35] This is not of course to detract from the very real social achievements that apparently stemmed from the expansion of education in these countries and regions.

[36] These are unweighted country averages. Results which weight by population give very different results because of the outstanding performance of China.

E) What the previous growth regressions really show

There are two empirical findings from the growth literature that appear to contradict the present results: growth regressions using enrollment rates and growth regressions in which the growth of output is specified as a function of the level of schooling.

1) Growth and enrollment rates

A huge literature exists showing that enrollment rates are robustly correlated with growth rates (Barro, 1991, Levine and Renelt, 1992). The justification for putting enrollment rates into growth regression has typically been a more or less explicit argument that the enrollment rates are a proxy for the flow of investment in human capital which is a proxy for the change of the stock of human capital of the labor force (Mankiw, Romer, Weil, 1992)[37]. However, the enrollment rate is a valid proxy for the rate of accumulation of schooling across countries only if each country is roughly at their steady state rates of the stock and the enrollment rates are constant over time across countries[38]. This assumption is obviously false as it ignores what is one of the most well known and striking features about development, the massive expansion of schooling (Schultz, 1988). This false assumption works to make initial enrollment rates a worse than terrible proxy for the rate of growth of human capital, as the correlation between either of the estimates of the actual growth of the stock since 1960 and the primary or secondary enrollment rates in 1960 is strong and negative (table 7). A terrible proxy would be at least uncorrelated.

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[37] I argue that MRW were roughly right about what the human capital share "ought" to be, about .33 (in their paper they suggest a share of .33 for each of physical capital, human capital, and labor). However, I disagree sharply that the aggregate data can be used to support an estimate of .33.

[38] This warning about levels of investment and changes in stocks holds true for physical capital as well. The correlation between the investment share and the growth of capital stocks is very near zero (Pritchett, 1995).

Table 7: Correlation of enrollment rates in 1960 and growth of human capital since 1960.

	Growth of human capital		Enrollment Rates		Initial output per worker
	B-L	N-S-D	Primary	Secondary	
B-L	1	.67	**-.485**	**-.414**	-.332
N-S-D		1	**-.704**	**-.558**	-.502
Primary			1	**.697**	.582
Secondary				1	.742
Initial output per worker					1

Notes: All correlations are statistically significant at the 5 percent level at the available sample size.

A simple illustration of why this negative correlation exists can be seen in comparing data for Korea and Great Britain. Korea's secondary enrollment rate in 1960 was 27 percent while Great Britain's was 66 percent. But the level of schooling of Great Britain's labor force in 1960 was 7.7 years while the level of Korea's was 3.2 years. Subsequently Great Britain's enrollment rate increased to 83 percent by 1975 and then remained relatively constant, while Korea's enrollment rate also increased from 27, to 87 percent by 1983. Given these differences in initial stocks and the large changes in enrollment rates, Korea's years of schooling expanded from 3.2 to 7.8 by 1985 while Great Britain's expanded massively only from 7.7 to 8.6.

If the education of the existing stock of workers is higher, then a higher enrollment rate will be necessary just so that the cohort entering the labor force is as educated as that leaving, while when schooling is expanding rapidly a given enrollment rate at a point in time will imply a much larger increase in the stock as more educated cohorts replace older, less educated cohorts in the labor force[39].

[39] Note that this is not about the fact that the growth rate of the stock is in percentage terms and the initial base is very low. This low correlation feature of the data is because the levels of enrollments change significantly over the period, meaning that stocks however measured will behave differently than flows of enrollment. Even using the absolute growth in years of schooling the correlation between enrollment rates and growth is low (although not negative) and the absolute growth of years of schooling does not come significantly into a growth regression.

What does this negative correlation imply for growth regressions? Table 8 shows the results of adding initial levels of primary and secondary enrollment to a regression that already includes the growth of human capital. The estimate of the effect of human capital growth is still negative while the enrollment rates come in positive and (typically) significant.

No one is denying that there is a positive partial correlation between enrollment rates and economic growth. But that partial correlation is completely irrelevant for assessing the impact of human capital change. Both the negative correlation of enrollments and changes in educational capital stocks and the observation that even controlling for educational capital change enrollment rates are significant in a growth regression suggest that there must be another interpretation for the partial correlation of enrollment rates and growth other than that it proxies educational capital growth [40]. This does leave somewhat of a puzzle as to why the enrollment rates do tend to come in significantly in a growth regression, but I suspect this simply reflects the exclusion of some other important variable that affects growth, like government capacity (which would affect the supply of decent education) or income distribution (which would affect demand for schooling) (Rodrik, 1994).

[40] I just do not see how one can defend using the crude proxy of enrollment rates, which is known theoretically to be systematically incorrect, once stocks, estimates for which enrollment rates are supposedly a proxy, are available. Since the two measures are negatively correlated, if the changes in stock measures and enrollment rate estimates differ, it must be so much the worse for enrollment rates interpreted as educational capital proxies, even if the enrollment rates provide more "plausible" estimates in growth regressions.

Table 8: Regressions of GDP per worker growth including growth of human capital and enrollment rates at the same time.

Growth Physical capital	.501 (9.49)	.458 (8.57)	.485 (9.07)	.452 (8.35)
Growth of human capital	-.117 (2.04)	-.025 (.369)	-.08 (1.31)	-.01 (.139)
Ln(initial GDP per worker)	-.0008 (.491)	-.006 (2.75)	-.004 (1.53)	-.0076 (2.89)
Primary enrollment, 1960		.022 (2.92)		.021 (2.65)
Secondary enrollment, 1960			.016 (1.64)	.010 (1.11)
N	79	77	77	76
R-Squared	.558	.626	.573	.632

Notes: Absolute values of t-statistics in parenthesis. Physical and human capital data are from N-D and N-S-D.

2) Growth and the level of schooling

That the level of education is significant in a growth regression is an interesting finding, but one that is more puzzling than is generally acknowledged. If one were going to use the level of human capital an augmented neoclassical production function would suggest regressing the level of output on the level of physical and human capital. The level-on-level regressions results in table 9 show, analogous to the growth-on-growth regressions above, that physical capital is very strong (definitely too strong in this case) and always significant. In contrast the human capital estimate is much smaller and is only statistically significant in 1985 using B-L data. There are many well known reasons why these coefficients (for both types of capital) will be biased upwards in levels on levels regressions. If the educational capital results are biased upward by as much as the physical capital results appear to be (relative to growth-growth regressions or national accounts estimates) that is, by between .1 and .2, then the negative levels from the growth-growth regressions are consistent with the small positive and nearly always insignificant, effects in the level-level regressions reported here[41].

Table 9: Regressions of level of GDP per worker on level of physical and human capital per worker, various years.

	B-L education data			N-S-D education data		
Year:	1965	1975	1985	1965	1975	1985
Physical capital	.601 (15.7)	.598 (14.6)	.612 (14.88)	.619 (16.55)	.626 (15.68)	.625 (15.28)
Educational capital	.085 (1.68)	.089 (1.49)	.136 (1.97)	.032 (.658)	.064 (.966)	.114 (1.36)
N	89	96	96	79	79	79
R-Squared	.867	.888	.909	.885	.900	.917

Notes: Absolute values of t-statistics in parenthesis. PWT5 data for GDP per worker and King-Levine physical capital data used for all regressions.

A result from the "new" growth regressions, which do not rely on neoclassical production functions is that the level of education matters for subsequent growth or that there is a threshold effect which depends on the level of education (Joyanovich, Lach and Lavy, 1992, Benhabib and Spiegel, 1994, Azariadis and Drazen, 1990). A level on growth effect is typically rationalized in terms of spillover effects that make the creation (or utilization) of human capital better or easier if there is more of it. With the present data, if the initial level of education is added to the specification the mildly negative impact of the education accumulation persists.

While an empirical finding in cross-national data that the level of education affects growth rates has some interest, it probably raises more puzzles than answers. First, one would think that the spillover effects of knowledge would be *in addition to*, rather than *instead of* the usual productivity effects. That is,

[41] If one includes the growth of the level of the years of schooling (as opposed to the growth of the log of schooling or of educational capital as I define it) then the coefficients are not negative but are small and insignificant, as in the level on level regressions. It is not clear what to make of this finding as the only rationale ever presented for a production function specification of the type necessary to include the growth of the level of schooling in a growth regression is the circular one that is the production function assumption that is necessary to justify that specification.

if there are spillovers then shouldn't the effect of education be evident both in changes (to represent the standard private productivity augmenting effect) and levels (to represent the externality)? Second, if the entire return to education at the aggregate level is primarily spillover type effects, why the wage premia observed at the individual level? Third, the threshold type findings at the aggregate level seem inconsistent with the assertion from micro estimation that wage increments for individuals are falling (or at least not rising) as a function of the level of schooling (a point acknowledged by Azariadis and Drazen, 1990). Fourth, the time series properties of regressing growth rates on the level of education are wrong because the stock of education has an obvious upward trend while GDP growth rates do not. Growth rates are stationary (or at least driftless) while the stock of education is non-stationary[42]. This is a criticism that applies to all endogenous growth models that make growth rates a function of any variable (such as the magnitude of R&D or the stock of knowledge) that are non-stationary (Jones, 1995).

II) Why does schooling not matter?

So far I have I have shown that a simple, but standard and widely accepted, growth accounting framework provides no support for the idea that the investments made in schooling accelerated the rate of economic growth. I have shown that this result is not the result of simple measurement error of years of schooling and is robust to a variety of choices of specification and sample. I have also shown that widely accepted evidence about the importance of education in macroeconomic growth is far more problematic and ambiguous than is often acknowledged as, it typically relies on a clearly erroneous use of enrollment rates. The data are definitely telling us something about education and growth, but what?

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[42] In the current econometrics jargon education is an I(0) series while the stock of education is clearly I(1), where I(n) is the notation for a series that needs to be differenced in times to achieve stationarity. It generally does not make sense to regress an I(0) series on an I(1) series as it cannot be the case that there is a linear relationship between a trending and non-trending series (unless one includes several I(1) series on the rhs that are cointegrated , so that some combination of the I(1) series might be I(0)). Thus it may be the case that a higher level implies a transitorily high rate of growth but no effect on long-run levels. Pappell and Ben David (1995) find, using Madison's historical data that growth rates are stationary after allowing for one structural break.

I will explore three possible explanations, a) that schooling creates no human capital, b) that the supply of human capital has outstripped demand, and c) that human capital has been devoted to socially unproductive activities.

A) Does schooling create skills?

Before examining the micro evidence for the growth benefits of education, I would like to point out that, strictly speaking as a point of logic, the micro evidence is no evidence at all.

If the question is "will increasing a given individual's education by one year raise or lower total aggregate economic welfare?" the individual level data are not just weak, but logically inadequate. Individual data can show that individuals with higher education have higher wages. However to infer from this increase in wages to an increase in aggregate output requires the claim that private (or market) and social marginal products are equal (or at least not too unequal). But this claim about private and social returns, which is necessary to make micro data useful for macro questions is precisely what individual data can never show (besides being almost certainly false)[43]. There are plausible models, discussed below, in which education has all the usual effects at the micro level, but no, if not perverse, effects in the aggregate. So, while micro evidence is strong for individual level questions and aggregate data is weak, if we want to ask about aggregate social welfare (and I think we do) we are stuck with the weak aggregate evidence, but whose *interpretation* should be consistent with the micro facts.

[43] It is hard to think of many major developing country where one could assert even a rough correspondence between prevailing prices and true social returns to activities over the period in question, in which most developing countries were riddled with distortions. Just thinking of the largest developing countries, is this correspondence of actual prices and social returns true of India? of Egypt? of Turkey? of Brazil? of Nigeria? of China? of Pakistan?

1) What the Mincerian regressions show

If individual level (log of) wages or earnings are regressed on years of schooling (or educational attainment) under certain restrictive assumptions it is the case that, following Mincer (1974) the coefficient can be interpreted as a rate of return to schooling. Regressions estimating the Mincerian rate of return have been carried out in a large number of countries and the results are generally quite stable within countries and are reasonably consistent across countries[44]. Table 10 shows typical results, which show regional average private returns to schooling of various levels. That individuals with higher levels of education earn higher wages is one of the best established facts in economics.

Table 10: Regional averages of the Mincerian rate of return.

Region	Average years of schooling in the sample used	Coefficient
Sub-Saharan Africa	5.9	13.4
Asia	8.4	9.6
Europe, Middle East, North Africa	8.5	8.2
Latin America	7.9	12.4
OECD	10.9	6.8

Source: Psacharopoulos, 1993.
Note: The Mincerian rate of return is the simple coefficient on years of schooling in a semi-log regression on earnings or wages.

This large accumulated body of microeconomic evidence is what makes the macroeconomic evidence above even more interesting. This evidence rules out one obvious response to the finding that, on average, increases in schooling did not increase output per worker. That is, the education provided was of such low quality that it is not surprising that it had no effect on output. This explanation seems to be ruled

[44] Montenegro (1995) for instance runs the Mincer regression (which includes a quadratic in experience) on Chilean data for every year from 1960 to 1993 and finds the coefficient varies from .095 to .167. Funkhouser (1994) runs Mincer regressions for five Latin American countries over several years and finds similar stability. The results are similarly stable in year by year Mincer regressions in the US, where the dramatic role given to the increase in schooling returns in widening income inequality is because it has apparently increased (at the median) from .0635 to .0962 (Bushinsky, 1994).

out by the fact that those with more education earn more. If schooling were really of very poor quality then why would private employers pay more for more educated workers?

2) Is schooling just a signal?

The most plausible explanation of the micro data consistent with education having no impact on productivity and yet having a large impact on individual wages is a signaling model. Spence (1974) has a model in which education has no impact on skills or productivity, but if workers with high initial (or innate) ability have an easier time investing in school than workers with low initial ability, employers will nevertheless pay more for high schooling workers.

The empirical difficulty with answering this objection is having measures of innate ability, and cognitive skills and schooling and wages to control for the self selection of the more able into greater years of schooling. However, whenever the requisite data have been available there has generally been little support for the signaling model. In the U.S. a variety of samples have been exploited to identify the pure education effect and at least some conclude that there is no evidence that the estimated rates of return to schooling are biased by signaling.[45] One detailed study of workers in Kenya and Tanzania using data on ability, schooling, skills and wages shows that, by and large, the effect of schooling on wages is not because of signaling, but rather because schooling raises skills and skills raise wages (Knight and Sabot, 1991). Glewwe (1991) with data on skills, ability, and wages also finds no evidence of screening using data from Ghana. Alderman, Behrman, Ross and Sabot (1996) find in a sample from rural Pakistan that cognitive achievement, and not schooling attainment apart from achievement, raises wages.

A second argument against the importance of screening in explaining private wage effects is the

[45] Ashenfelter and Krueger (1994) use data from a sample of twins raised apart to control for innate ability, while Angrist and Krueger (1991) use variations in the amount of compulsory schooling required. On the other hand Behrman, Rosenzweig, and Taubman (1994) testing different samples of twins found their ability controlled estimates to be significantly lower than the conventional estimates.

amply demonstrated impact of maternal education on non-wage outcomes like child mortality and fertility where there is no signaling involved (Hobcraft, 1993). It is hard to explain the effect of maternal education on child mortality if schooling has no impact on knowledge or cognitive skills (Glewwe, 1995). Even in areas where *a priori* one might expect the quality of schooling to be very low the health benefits of education are present. In data from sixteen SSA countries women with primary education have 24 percent lower child mortality than women with no education and among women with a secondary education mortality is 50 percent lower[46].

The most plausible way to interpret the wage-schooling regressions is that schooling expands cognitive skills and that these increased cognitive skills account for higher wages.

3) Is a negative macro finding just failure to control for quality?

Even though on average the effect of schooling on wages is the result of increased cognitive skills, it is still the case that quality of schooling, in the limited sense of the increase in cognitive skills created by an additional year of schooling, must vary enormously across countries. Perhaps the problem is not pure measurement error in measuring years of schooling (which, given the arguments above, it is not) but that years of schooling do not measure accumulation of productive human capital.

First, the general expectation is that the exclusion of quality of education measures will bias the estimate of the returns to the quantity of schooling *upwards*, due to what Schultz (1988) refers to as the "general underlying positive covariance between quantity and quality of schooling." Behrman and Birdsall (1983), in perhaps the most famous paper emphasizing the impact of failure to measure quality on estimates of the returns to schooling, show that without controls for quality the wage impact of years of schooling is seriously overestimated by a multiple of 2.

I can simulate the impact of ignoring quality on my estimates if I assume that the "true" education

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[46] These figures are complied from recent Demographic and Health Surveys (DHS) which record child morality (${}_0q_5$) by level of maternal education.

coefficient is .3 and an increase in the wage increment return from 5 percent to 15 percent would induce an increase in growth of years of schooling by one standard deviation. In this case in my estimates are 25 percent too high due to lack of quality adjustment. . Conversely, in order for lack of quality adjustments to explain the zero result if the "truth" were .3 there would have to be a sharply negative relationship between quality and the expansion of quantity. A strong negative correlation is hard to reconcile with models of the private demand for schooling[47].

Second, quality of schooling across countries is impossible to measure, as there is no particular reason to believe that physical indicators (such as teacher per pupil) or resources expended per student will adequately proxy quality, and many reasons to believe it will not. In particular, since schooling is typically publicly provided there is no reason to believe that dollars spent will be closely associated with output (that is, one cannot apply the usual theory about the relationships between inputs and outputs derived from production theory of profit maximizers). There is a huge literature on the impact of various physical and financial measures of resources expended per student on achievement, with generally ambiguous results (Hanushek 1986, 1995).

Third, Judson (1993) creates a new human capital variable in which human capital is valued at its cost of creation across countries and finds marginally "better" results for the growth of the human capital share in that her estimate of the human capital contribution is not negative. However, her measure of human capital which attributes greater value to human capital depending on the cost per pupil of a years of schooling ignores the serious questions raised above about the measurement of quality. Moreover, attributing an enormously higher value of a year of schooling to education in developed countries simply because more is spent on it seems seriously inconsistent with both the valuation of education using micro returns on education, that do not show significant rises in the wage premia in countries in which more is

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[47] There is no correlation, positive or negative, between the rates of growth of schooling and one possible measure of the quality of schooling, the wage increment to schooling from the wage regressions reported by Psacharopolous (1993).

spent per pupil, and with the international comparisons of educational achievement. For instance, the reading scores of nine year olds in Greece were slightly better than those in West Germany, even though expenditures per primary pupil were only roughly a sixth as high. Scores were higher in Indonesia than in Venezuela, in spite of per pupil primary expenditures at least twice as high in the latter (Elley, 1992).

B) Is demand for educated labor falling fast?

A second explanation is that the marginal returns to adding on additional year of schooling economy-wide can be dramatically different from the average returns estimated from a Mincer regression if the demand for educated labor does not expand. There are two versions to this demand for educated labor story: sectoral shifts and exogenous technological change.

1) Schooling by sector

The returns to schooling appear to differ sharply by economic activity. Nearly all of the Mincer regressions ever reported are based on wage data, principally because incomes of the self-employed, including and especially farmers, are so difficult to estimate. While the average wage increment to schooling for wage earners is typically over 10 percent per year of schooling, the increase of farmers' incomes is very much smaller. Jamison and Lau (1982), in an extensive review of the literature, find that the output of farmers (holding inputs constant) is higher by only 2 percent for each additional year schooling.

These sectoral differences in returns are important because in many poor countries wage employment is a very small fraction of total employment. An examination of table 10 above for instance, shows that the average schooling in the samples used for the Mincer regressions in SSA was 5.9, far above the economy-wide average, reflecting the selection of educated workers into the wage labor force. Table 11 illustrates this point with data from Africa, where the expansion of education has often exceeded the expansion of wage employment many many fold. It is easy to believe that this dramatic expansion has significantly eroded the wage premia.

However, there is little direct aggregate evidence that sectoral shifts account for cross country differences in returns to education or that the estimates of wage increments to schooling have fallen dramatically as education has expanded. Birdsall, Ross and Sabot (1995) find in cross national data that the estimated returns to schooling are higher the higher the growth in manufactured exports. They argue this reflects differences in the expansion of demand for educated labor. Of the few countries for which long time series on rates of returns do exist, some do show a modest, but not a dramatic, decline in estimated returns while others show a modest increase, but it must be admitted that the countries with the available data may be atypical.

Table 11: Growth of enrollments and of wage employment in selected Sub-Saharan African countries, from date of study estimating Mincerian return study to 1990 (or most recent).

Country	Change in enrollments ('000)	Change in wage employment ('000)	Ratio, expansion of enrollment to wage employment	Wage employment as percent of total labor force.
Botswana	157	122	1.3	50.4
Burkina Faso	351	35.4	9.9	3.8
Cote d'Ivoire	323	-7.7	-	9.0
Ghana	1312	80.0	16.4	3.8
Kenya	1709	436	3.9	14.1
Lesotho	142	14.9	9.5	5.4
Malawi	546	143	3.8	13.7
Senegal	180	45.4	4	5.5
Sierra Leone	257	8.9	28.9	4.9
Tanzania	-49	9	-	5.6
Uganda	2254	13.2	17.1	4.7
Zambia	446	-4.3	--	13.1
Zimbabwe	135	111.1	1.2	36.6

Source: Bennell, 1994, table 5.

2) Education and disequilibria: Exogenous technical progress

A second version of the fact that returns to education may vary across countries is the view that the major reason that education increases productivity is that it increases a workers ability to learn new skills and respond to changes (Schultz, 1975, Nelson and Phelps, 1977). Schultz (1975) argues that in a technologically stagnant agricultural environment the production gains from education would be zero, as even the least educated could reach the efficient allocation of factors and only when new technologies and inputs are available does education pay off.

Rosenzweig and Foster (1995) add to the literature which supports this conjecture. Using panel data on agricultural production they find that the returns to schooling to farmers were very low where technological progress was low, but that technological progress increased the return to schooling. The return to primary schooling versus no schooling, (measured as the additional net farm profit) in the average district studied was 11 percent (446 rupees on average profits), a low figure quite similar to the very low values per year of schooling for agriculture mentioned above. However, the authors emphasize the interaction of returns to schooling with exogenous increases in district wide farm profits. In an area with farm profits one standard deviation higher than the average district the predicted return to primary schooling was 32 percent. The down side of this calculation, however, is that the estimated returns to schooling were negative in all those districts in which growth of profits was 2/3 of a standard deviation less than the mean profits[48]. In one interpretation, schooling only paid off handsomely in those areas in which the Green Revolution brought technological advances that could be taken advantage of by the more educated farmers while in technologically stable areas education was not important for output.

This explanation might suggest that the reason education appears not to have paid off in Africa, for instance, is that there has been little exogenous change in the technical production functions appropriate to

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[48] Another way to summarize their results is that since the education return is only barely significant for the average district (t of 2.03) in districts where exogenous progress is only slightly below the mean the return is indistinguishable from zero.

African agriculture for more educated farmers to adopt, as the Green Revolution innovations were not adaptable to African conditions. Other countries may have limited the flow of exogenous technical change by barriers to foreign firms and goods.

C) Are cognitive skills socially productive?

A final possibility I will explore for the apparent negative effect of education on aggregate growth is that social and private rates of return to education diverge. One possibility is that the improved cognitive skills created by education are devoted to rent seeking and directly unproductive (DUP) activities. These activities can be privately remunerative but actually reduce overall growth.

North (1990) uses an interesting and powerful metaphor that suggests the problem;

> To be a successful pirate one needs to know a great deal about naval warfare, the trade routes of commercial shipping; the armament, rigging, and crew size of potential victims; and the market for booty.
>
> To be a successful chemical manufacturer in early twentieth century United States required knowledge of chemistry, potential uses of chemicals in different intermediate and final products, markets, and problems of large scale organization.
>
> If the basic institutional framework makes income redistribution (piracy) the preferred economic opportunity , we can expect a very different development of knowledge and skills than a productivity-increasing (a twentieth century chemical manufacturer) economic opportunity would entail. The incentives that are built into the institutional framework play the decisive role in shaping the kinds of skills and knowledge that pays off.

Murphy, Schliefer and Vishny (1991) present a simple model of the allocation of talent in an economy in which, if returns to ability are the greatest in rent seeking, then entrepreneurial talent flows into this activity. This inhibits economic growth by drawing the most talented people away from productive sectors[49]. They find that in a growth regression the fraction of higher level (tertiary) students in engineering increases and fraction of higher level students in law decreases economic growth[50].

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[49] Anecdotal evidence of this type of effect abounds. There is the possibly apocryphal, but nevertheless instructive, story of one West African nation with an employment guarantee for university graduates. In a year in which the exchange rate was heavily overvalued (and hence there was a large premia on evading import controls) 60 percent of university graduates in all fields designated the Customs as their preferred government branch for employment.

[50] One way to distinguish the usual models of education from the signaling and distortion hypotheses about micro and macro returns is that the usual model is the "engineering" metaphor in which education is subsequently used in innovation, the signaling model can be thought of as the "Harvard MBA" metaphor of education in which nothing is really learned

Another shred of empirical evidence for a conclusion that misallocation of skills might account for negative growth comes from Judson (1993) who shows the returns to education differentiated by type (primary, secondary, and tertiary) and by initial level of income. She finds that for the poorest two quartiles of countries primary education had a positive effect while secondary and tertiary education had no significant impact at all, with some point estimates negative.

When educated labor is devoted to low or unproductive activities, what may appear to be low returns to schooling may in fact be a low quality environment for applying cognitive skills. Orazem and Vodopivec (1995) find that the returns to schooling in Slovenia for all levels of schooling increased substantially from 1987 to 1991. The wage premium to a university education increased by 32 percent, from .715 to .943. It appears in the Slovene economy that the skills acquired under a communist system (in which increased education did not appear to pay off in the aggregate (table 6)) are paying off in the transition.

Gelb, Knight and Sabot (1991) show that in many developing countries the public sector has often accounted for a large share of the expansion of wage employment (see table 12). They build a dynamic general equilibrium model in which government responds to political pressures from potential unemployment of educated job seekers and becomes an employer of last resort of educated labor force entrants. They show that when employment pressures are strong and the government is responsive to those pressures is strong the employment of "surplus" educated labor in the public sector can reduce growth of output per worker by as much as 2 percentage points a year (from a base case growth of 2.5 percent). Even in the case of weak pressures and weak government response, the endogenous response of government employment reduces growth by .7 percentage points from the base case.

This type of government explicit or implicit guarantee of employment for the educated is common and can lead to large distortions. In Egypt the government guaranteed every secondary school and higher graduate a job and acted as employer of last resort forcing both government ministries and parastatals to

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but wages are higher because a highly ambitious group is pre-selected for employers, versus the "Harvard Law" metaphor in which wages are higher because stuff is really learned, but of dubious social product.

employ a fixed quota each year. The result is legendarily overmanned enterprises and bureaucracies in which the government or public enterprises as of 1988 employed 70 percent of all university graduates and 63 percent of those with education at the intermediate level and above[51]. This obviously induced large economy-wide distortions in the supply and demand for educated labor (Assaad, 1994).

[51] This preponderance of educated labor in the public sector is probably not atypical, although most labor force surveys only calculate employment by economic sector, not employer. Gersovitz and Paxton (1995) calculate that in Cote d' Ivoire in 1986-88, 50 percent of all workers between 25 and 55 with any post primary schooling or above worked in the public sector.

Table 12: Fraction of wage employment growth accounted for by public sector growth in selected developing countries.					
Country:	Period:	Average growth (% per annum)			Percentage share of public sector in increase of total wage employment
		Public	Private	Total	
Brazil	1973-83	1.4	0.0	0.3	92
Costa Rica	1973-83	7.6	2.8	3.5	34
Egypt	1966-76	2.5	-0.5	2.2	103
Ghana	1960-78	3.4	-5.9	-0.6	-
India	1960-80	4.2	2.1	3.2	71
Kenya	1963-81	6.4	2.0	3.7	67
Panama	1963-82	7.5	1.8	2.7	45
Peru	1970-84	6.1	-0.6	1.1	140
Sri Lanka	1971-83	8.0	0.9	3.9	87
Tanzania	1962-76	6.1	-3.8	1.6	190
Thailand	1963-83	6.3	5.5	5.7	33
Venezuela	1967-82	5.1	3.4	3.7	27
Zambia	1966-80	7.2	-6.2	0.9	418
Unweighted mean		5.5	0.3	2.4	
Source: Derived from Gelb, Knight, and Sabot, 1991, table 1.					

The persistence of negative institutional incentives is often built into the system because by and large the most educated control the access to power[52]. Selection into the elite national civil service in China well into the twentieth century was based on an exam that rewarded detailed knowledge of

[52] Another fun quote from North (1991):

> But so too, can unproductive paths persist. The increasing returns characteristic of an initial set of institutions that provide disincentives to productive activity will create organizations that interest groups with a stake in the existing constraints. They will shape the polity in their interests. Such institutions provide incentives that may encourage military domination of the policy and economy, religious fanaticism or plain, simple redistributive organization, but they provide few rewards from increases in the stock and dissemination of economically useful knowledge. (p 99)

Confucian material that many potential Chinese reformers argued had little or no relevance to creating a modern nation state. However, almost every official with any power in China had to have spent a large portion of his adult life studying for the exam, making it unlikely these same officials would find the material irrelevant.

Similar claims can be made about the persistence of damaging policies. The growth inhibiting policies typical of many developing countries, such as a large urban bias, explicit and implicit taxation of agriculture, industrial protection, and a tendency to allocate educational expenditures regressively can perhaps be understood as direct products of the demands of a relatively small educated elite. More education might lead to a reenforcement of these policies as the newly educated protect their gains rather than risk reform[53].

I want to emphasize I am not equating government, or the magnitude or growth of government employment, with the magnitude of rent seeking, nor am a I saying that the expansion of education in government is necessarily unproductive. On the contrary, the most recently successful of developing countries have had strong and active governments and highly educated civil servants (World Bank, 1994). Wade (1990) asserts that college graduates were as likely to enter government service in Korea and Taiwan as in African economies. The question is not whether the educated labor flows into the government so much as what the educated labor does once it is in the government[54].

Conclusion

Recently created data on the growth of years of schooling provide no support at all for the proposition that more rapid rates of growth of education capital produce greater output growth. In fact,

[53] This is perhaps the answer to my earlier posed puzzle as to why physical capital works exactly like it should while education capital does not. To paraphrase the NRA, "physical capital doesn't lobby people, people lobby people."

[54] Wade (1994) demonstrates the importance of institutional environment for government performance with an intriguing comparison of government irrigation in India and Korea.

the estimated impact of educational capital accumulation on a widely accepted, growth accounting, definition of TFP growth is large, negative, and statistically significant. I explore three possible explanations for this puzzling result[55].

* Perhaps schooling has, on average in the sample, created no skills. This is contradicted by three facts that the micro literature has overwhelmingly established: a) that educated workers have higher wages and that the magnitudes of higher wages are hard to reconcile with screening alone, b) that schooling, even relatively poor schooling, does raise cognitive skills that are rewarded by the market, c) the non-market benefits of schooling indicate changes in cognitive skills.

* Perhaps the rate of expansion of schooling has greatly increased the supply of educated labor relative to demand so that the rate of return has fallen over time. There is likely something to this argument, but the falls in micro returns over time recorded in the data are not large enough to explain the very small (or negative) coefficients observed.

* Perhaps schooling has created cognitive skills but the typical institutional environment was sufficiently bad that these skills were devoted to privately remunerative but socially wasteful, or even counter-productive, activities.

I hasten to add that none of this has the implication that governments should invest less in schooling, for several reasons.

First, the evidence is clear that education (especially if it done well) does raise cognitive skills. The implication of a poor aggregate payoff from increased cognitive skills in a perverse policy environment is not, "don't educate if the incentive environment for cognitive skills is perverse," but rather "reform the incentive environment now so investments in cognitive skills will pay off." The study cited above shows that workers in Eastern Europe (Slovenia) are able to use their previously acquired skills in the new policy environment and the return to education is increasing (Orazem and Vodopivec, 1995).

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[55] Most economists would accept that there exist, in theory, institutional and incentive environments in which investment in schooling can actually worsen welfare. After all, the theory of the second best suggests that in a distorted environment pretty much anything can happen. What is surprising then is not that it is possible for education not to pay off, but that the conditions in developing countries over the past three decades were, on average, actually such that education did not in practice appear to pay off.

Showing that education is not a sufficient condition for growth does not mean it may not be a necessary condition or lessen its importance, but rather raises the importance of identifying and undertaking those complementary reforms in the non-education sector that will lead education to pay off. In some sense this paper only highlights what is acknowledged in the World Bank's policy paper on education, that the payoff to education is conditional not absolute[56].

Second, as indicated above, evidence suggests schooling has a large number of direct beneficial effects beyond raising economic output. In particular a large amount of evidence suggests that infant mortality falls significantly with the education of mothers.

Third, education had a large non-economic component and is often privately valued for its own sake. Fifty percent of (non-education) university students in Saudi Arabia in 1988 were studying "Humanities, Religion, and Theology" (UNESCO, 1990). That this field of study may not raise economic output per worker is both obvious and obviously of no concern to those so engaged (but may well have implications for government subsidies)[57].

Fourth, many, if not most, societies believe that at least basic education is a merit good so that its provision is not, and need not be, justified on economic grounds at all.

Fifth, perhaps very little in this paper is of direct relevance to government decisions about educational investment. But, in my defense, it has more relevance than most of the previous literature which relied on micro data. Most of this literature justified *government* investment in education using data which showed the *private* rate of return to education was higher than the *social* rate of return, which is, of course, the definition of activities that should have larger taxes (or have their fees raised, since the difference in this case is due to a subsidy to education investment), not have its subsidy increased. Of course, those authors that present these social and private returns do not really mean what they say and in

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[56] In the first paragraph of the Executive Summary: "Education at all levels increases growth, but education alone will not generate growth. Growth requires not only investment in human capital but also in physical capital; *both types of investment contribute most to growth in open, competitive economies that are in macroeconomic balance*." (My italics) World Bank, 1994b.

[57] One estimate of the returns to higher education by field in the United States suggested that advance training in theology had a negative private rate of return of 17 percent (I can't now remember the reference, but it did keep me out of divinity school).

particular they are usually pretty clear that they do not mean "social" when they say "social."[58] Presumably an economists' rationale for the government provision or subsidization of education is either based on their being some positive externality to education, in which case the social return calculated without this externality wrong. Or is based on there being some impediment to private investment in education (like imperfect capital markets), in which case the private rate of return calculated without factoring in this impediment is similarly wrong.

As a final comment, one might ask why, even if it is true, one would want to point out education has not paid off, especially since it is unclear how this would affect investment policies. My answer is that the problem of poverty in developing countries is so pressing and constitutes a human tragedy of such immense proportions it creates a natural and even desirable tendency to want to do "something." This desire to do "something" in the face of so many problems and constraints in developing countries often lends itself to a search for a magic bullet, that one activity which can be isolated from all the other problems and promoted irrespective of the institutional, political or policy climate. But I think the experience with education shows there are no magic bullets. Both history and recent experience have shown that development is intrinsically a difficult business and all facets of development, economic, social, political, are interrelated in complex ways. That acknowledgment makes life tricky, as progress must be made on many fronts simultaneously. Even as desirable a goal as expanding education may be, it simply cannot go it alone.

[58] There is an additional problem that the rate of return to an activity by the government is not the return to the activity when the government does it. The return to the government action is the difference between the outcome when the government does what it does and what would have happened in the absence of government action. In nearly all cases, including of course the provision of education, one cannot assume that in the absence of government action nothing would have been done.

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