Where has all the education gone?

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Revised, December 21, 1999

Abstract:

Cross national data show no association between increases in educational capital due to rising educational attainment of the labor force and the rate of growth of output per worker. This implies the association of growth of educational capital and conventional measures of TFP is large, strongly statistically significant, and *negative*. While these are the regression results "on average" (from imposing a constant coefficient) it should be obvious the impact of education has not been the same in every country. There are three explanations for why the impact of education has varied and has so often fallen short of what was hoped. First, perhaps educational has been so low that "years of schooling" have created no human capital. Second, perhaps the marginal returns to education fell rapidly as supply expanded while demand for educated labor was stagnant. Third, perhaps the institutional environment has been sufficiently perverse that the educational capital accumulation *lowered* economic growth. Some mix of the three explanations plays a role in most developing countries.

Where has all the education gone?[1]

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 pay off.

Douglas North (1990)

That individuals with more education earn more is probably the second (after Engel's law) best established fact in economics. From this it would seem to follow naturally that if more individuals were educated, average income should rise. And if there are positive externalities to education, average income should rise by even more than the sum of the individual effects. The belief that expanding education promotes economic growth has been a fundamental tenet of development strategy for at least forty years.[2] In part because of these beliefs in the benefits of education, the post WW II period has seen a rapid and historically unprecedented expansion in education. Just since 1960 average developing country (gross) primary enrollments have risen

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

[2] The idea that either the "new" growth theory or the "neo-classical revival" have "discovered" the importance of human capital is belied by even a casual reading of Kuznets (1960), Lewis (1956), Schultz (1963) or Dennison (1967). Gunnar Myrdal's *Asian Drama*, written in the late 1950s treats the importance of human capital in development as the already settled conventional wisdom.

from 66 to 100 percent and secondary enrollments from 14 to 40 percent.

So, the experiment of massive expansions in education has been tried. How did it turn out? The answer is not obvious. While enrollments and attainment have expanded, GDP per capita growth in the typical developing country has fallen: from 3 percent in the 1960s, to 2.5 percent in the 1970s to *negative* .48 percent in the 1980s, and the slow growth continued into the 1990s. While the rapidly growing East Asian countries did have rapid growth of educational capital—2.8 percent per annum over 1960-1985 by the measure presented in this paper—so too did the slow growing regions—4.2 percent in Sub-Saharan Africa, 3.98 percent in the Middle East and North Africa, 3.7 percent in South Asia. While there are examples of high education countries that did well, there are many examples of high education countries—Philippines, Sri Lanka, Hungary—that have stagnated and have much lower output than their less educated neighbors. Moving beyond anecdotes, this paper uses two recently created data sets on the education attainment of the labor force to show that the growth of educational capital per worker has no association with the growth of output per worker.

This raises a micro-macro puzzle, as it implies that the growth of education has a strong *negative* association with conventionally constructed growth-accounting measures of TFP based on the "micro" estimates of education returns. The aggregate data, far from showing positive, at least appear to suggest *negative* externalities.

I discuss three possibilities for reconciling the macro and micro evidence and explaining the differences across countries in the growth impact of education. First, schooling quality may have been so low it did not raise cognitive skills or productivity. This could even be consistent with higher private wages if education serves as a signal to employers of some positive characteristics like ambition or innate ability. Second, expanding the supply of educated labor in the presence of stagnant demand could cause the rate of return of education to fall rapidly and hence the *ex-post* contribution to output to be much smaller than the *ex ante* returns would have suggested. The third possibility is (metaphorical) piracy: that education raises productivity, and that there has been sufficient demand for this more productive educated labor to maintain returns, but that the demand for educated labor comes from individually remunerative yet socially wasteful or counter-productive activities. In this case individual wages could rise with education even while increases in average education would cause aggregate output to stagnate, or even fall.

Along with many others, I strongly believe that *every* child in the world has a fundamental human right to a quality basic education. But education is no magic bullet. Showing that education is not a sufficient condition for growth does not lessen its importance for children--but rather raises the importance of identifying and undertaking those complementary reforms in the non-education sector that will lead education to pay off.[3]

I) Expansion of education and growth accounting regressions

Data

There are two recently created cross national, time series data sets which use different methods to estimate the educational attainment of the labor force. Barro and Lee (1993) (BL)

3 This paper highlights what is acknowledged in the World Bank's policy paper on education, that the payoff to education is not a given, but is conditional on the economic policy environment: "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*." World Bank, 1994b.

estimate the educational attainment of the population aged 25 and above using census or labor force data where available and 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) (NSD) use 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.

Using these estimates of the years of schooling of the labor force I create a measure of *educational* capital[4]. By analogy with the micro specification used by Mincer, I assume the natural log of the wage (or more generally, earnings per hour) is a linear function of the years of

$$(1)\ \ln(w_N) = \ln(w_0) + r * N$$

schooling,

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. 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:

[4] One should not be too facile about the association between the years of schooling (and educational capital measures derived from them) and "human capital," which is a much broader concept. An individual's marketable human capital can be defined to be the annualized value of the difference between the individual's wage and the wage for raw labor. Beyond formal schooling this would include: productivity from better health and physical strength (Fogel 1994); formal and informal occupational (but not firm) specific training programs (such as apprenticeships); firm specific training programs for employees; returns to seniority (from on the job learning not due to training) and rents to special acquired skills and talents, like artists, musicians, athletes, etc. Since wage regressions in the US (and elsewhere) with every conceivable individual specific observable characteristic (age, education, sex, race, location of residence) typically explain 40 percent or less of wage differences, if "human capital" is a concept invoked to explain wage differentials there are clearly large amounts of human capital not captured by education.

$$(2)\quad HK(t) = \sum_t^T d^t * (w_N - w_0)$$

where w_0 is the wage of labor with no education. After substituting in the formula for the educational wage premia into this definition and taking natural logs, the proportional rate of

$$(3)\quad \dot{hk}(t) \cong d\ln(\exp^{rN(t)} - 1)/dt$$

growth of the stock of educational capital is approximately:[5]

where lower case for HK is natural logs, N(t) is the years of schooling at time t, r is the Mincerian coefficient, and the "." is the time rate of change. Based on existing surveys of the large number of micro studies I use an r of 10 percent[6], constant across all years of schooling.[7]

In addition to the measures of educational capital I use two series created by a perpetual inventory accumulation of investment and an initial estimate of the "capital" stock (based on an

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[5] There are two reasons this is only approximate. The discount factor is assumed constant and hence is factored out in 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 but should not affect estimates because that component of ln(w_0) due to capital growth will be controlled for in the regression and other components rightly belong in the residual.

[6] A survey by Psacharopulus (1993) shows wage increments by region of: SSA 13.4 percent, Asia 9.6 percent, Europe, Middle East and North Africa, 8.2 percent, Latin America 12.4 percent, OECD 6.8 percent, an unweighted average of 10.1. In any case, the cross national differences in the growth rate of educational capital is very robust to variations in the value of r.

[7] One (of the many) confusions in this literature is between the wage increment and the rate of return to education. The often repeated assertion that "returns are higher to primary schooling" (such as those reported by Psacharopolous (1993)) is not because the increment to wages from a year of primary school are *higher* than other levels, but because the opportunity cost of a year of primary schooling is much *lower*. This is because the typical foregone wage attributed to a primary aged unschooled child is very low (Bennell, 1994). What is relevant to growth accounting is the increment to wages, not the cost inclusive return.

estimate of the initial capital-output ratio). As I have argued elsewhere, these should cannot be treated as estimates of the physical capital stock relevant to the production function, as there is no underlying theoretical or empirical justification for doing so (Pritchett 1996, 1999). I call these series by a descriptive acronym: CUDIE (CUmulated, Depreciated, Investment Effort). The main difference in the two CUDIE series is that the King and Levine (KL) (1994) use the Penn World Tables, Mark 5 (Summers and Heston, 1991) investment data while Nehru and Dhareshewar (1993) (ND) use World Bank investment data. The two series are highly correlated and give similar results. The dependent variable of interest will be the growth of GDP per worker from PWT5. This is more appropriate than GDP per person or per labor force aged person[8] as a productivity measure because these would have to assume that labor force participation is equal across countries, which is false.

B) Regression growth accounting.

Mankiw, Romer and Weil (1992) extend the Solow aggregate production function framework to include educational capital:

4) $Y_t = A(t)* K_t^{a_k} * H_t^{a_h} * L_t^{a_l}$

Assuming constant returns to scale, normalizing by the labor force, and taking natural logs suggests estimating an equation in levels. But if a "levels" specification is valid, this equation could also be estimated in rates of growth. Since estimation in levels raises numerous problems (to which I return below), I will estimate the following equation in per annum growth rates

[8] 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.

calculated over the entire period:[9]

5) $\hat{y} = \hat{a} + a_k * \hat{k} + a_h * \hat{h} + e$

The results for the entire sample of countries[10] are reported in column 1 table 1. The partial scatter plot is displayed as figure 1.[11] The CUDIE results look entirely reasonable with a large and very significant coefficient. The CUDIE estimates correspond reasonably well to national accounts based estimates of the capital share (although .52 is somewhat on the high side). Very much on the other hand, the estimate of the impact of growth in educational capital on growth of per worker GDP is *negative (-.049)*. Adding the initial level of GDP per worker (column 2) has no impact on the negative estimates of the effect of education (-.038). Before making too much of this, I first show this result is robust to sample, data, technique, and is not the result of "pure" measurement error or adjustment for school quality.

C) Robustness (sample, data, technique), measurement error, quality

To ensure robustness against outliers, individual observations identified as influential were sequentially deleted up to 10 percent of the sample size with no qualitative change in results.[12]

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[9] Growth for each variable 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.

[10] 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 NSD data report an average of 16 years of schooling (immigration wreaks havoc with their numbers), and Norway because BL reports an impossible increase of 5 years in schooling over a period of 5 years.

[11] The partial scatter plot is the scatter plot of the dependent (growth rate of GDP per worker) 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.

[12] Observations are identified as influential based on the difference in the estimates with and without the

Moreover, the negative coefficient on schooling growth persists if: (a) only developing countries are used, (b) all the observations from Sub-Saharan Africa are excluded or (c) regional dummies are included. The estimated coefficient is not the result of a few extreme or atypical observations.

The results are also robust to variations in the data used for education, capital stocks, or GDP. All regressions in this paper were also estimated using the NSD estimates of educational capital and were similarly negative.[13] Estimates using World Bank local currency, constant price, GDP growth rates instead of the PWT5 GDP data give similar results. Using growth of GDP per person or per labor force aged population produces an even larger negative estimate for education. Relaxing the assumption of constant returns to scale does not alter the negative estimate on educational capital. Using weighted least squares with either (log of) population, GDP per capita, or total GDP as the weights also gives nearly identical results.

Pure measurement error. While both sets of educational attainment data have been roundly criticized on a number of legitimate grounds (Behrman and Rosenzweig, 1993,1994) the negative coefficient on educational capital is not because the estimates of years of schooling used are bad estimates of the years of schooling of the labor force. I have found that for some reason the simple point that pure attenuation bias cannot make a positive coefficient negative is not sufficiently compelling so I implemented the standard econometric solution to measurement

observation included (Belsley, Kuh, and Welch, 1980). Temple (1999) working on a different data set finds substantial parameter homogeneity and finds that a significant fraction the sample must be dropped to recover a significant positive coefficient on education.

[13] These are reported in the working paper version Pritchett (1996). The basic OLS regression using the other

error: instrumental variables (IV) estimation. Using the growth of the NSD educational capital as an instrument for BL educational capital (the correlation of the growth rates of the two series is .67) the coefficient becomes slightly more negative -.12 (column 4 of table 1) versus -.09 for OLS on the same sample.[14]

In addition to using the two education capital stocks as instruments for each other I also matched each country with a "similar" country, usually picking the geographically closest neighbor, as educational capital growth rates in similar countries are likely correlated (the actual (ρ=.316) while the pure measurement error in similar countries' reported enrollment and attainment rates is plausibly uncorrelated (and certainly less than perfectly correlated). This IV coefficient in column 5 of table 1 almost equal to (-.088) the OLS estimate (-.091). Taken together, the correlation of the two measures of educational capital growth and the IV regressions suggest that the signal to signal plus noise ratio is as low as 70 percent.[15] However, as expected, correcting the impact of this measurement error makes the estimates more negative, and hence only deepens the puzzle[16].

While differences in educational quality can account for *heterogeneity* in the impact of schooling, it does not explain the low *average* impact. In fact, due to the "general underlying positive covariance between quantity and quality of schooling" (Schultz, 1988) one would expect that excluding quality would bias the

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data set was $\hat{y} = c + \underset{(15.4)}{.501}\,\hat{k} - \underset{(2.07)}{.104}\,\hat{h},\ n = 79,\ r^2 = .557\ (t-statisticsin\ paentheses)$

[14] While the IV estimates will only be consistent if the measurement errors are uncorrelated, even where measurement errors are correlated the IV estimates should move towards the true value (Ashenfelter and Card,).

[15] The ratio of OLS to IV, which is an estimate of the magnitude of measurement error is .roughly .7, roughly the same as the correlation of the growth rates of educational capital using BL and NSD measures.

[16] My findings differ from the much more recent findings of Krueger and Lindahl (1998) who claim that measurement error is important, in three ways. First, I only use long-period averages while their results suggest measurement error is especially important in short period data. Second, they examine primarily the data of Kyriacou, which in any case I did not use. Third, their specification is linear while mine is based on a definition of capital stock and a standard Cobb-Douglas production function. In any case their unconstrained IV estimates are statistically insignificant.

estimated return *upwards*, as more schooling is accumulated where quality is high and hence has a higher impact. Behrman and Birdsall (1983) show that in Brazil not controlling for quality leads the impact of years of schooling to be *overestimated* by factor of 2. In order for lack of quality adjustment to explain the results or quantities in the aggregate there would have to be a very strong inverse relationship between quality and the expansion of quantity, a relationship for which there is no evidence.[17]

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

D) Relationship to other empirical results on schooling

As surprising as these results may seem they are similar to what other researchers have found when they have examined the growth/education relationship using either growth on growth or level on level regressions[18]. Benhabib and Spiegel (1994) and Spiegel (1994) use a standard growth accounting framework which includes initial per capita income and estimates of years of schooling from Kryiacou, 1990 and find the coefficient on growth of years of schooling was negative.[19] Lau, Jamison and Louat (1991) estimated the effects of education by level of schooling (primary versus secondary) for five regions and found that primary education had an estimated negative effect in Africa and MENA, insignificant effects in South Asia and Latin America, and was only positive and significant in East Asia. Jovanovic, Lach and Lavy (1992) use annual data on a different set of capital stocks and the NSD education data and find negative coefficients on education in a non-OECD sample. Behrman (1987) and Dasgupta and Weale (1992) find that changes in adult literacy are not significantly correlated with changes in output. The World Bank's World Development Report on labor also reports the lack of a (partial) correlation between growth and education expansion (World Bank, 1995, figure 2.4).

[18] There is also a new literature using growth on growth regressions in panels, usually with an estimating technique that allows for country effects. These studies (Islam (1995), Casselli, et. al. 1998, Hoeffler, 1999) consistently find *negative* signs schooling variables. I do not find this particularly interesting because the dynamic properties of the evolution of educational attainment, which changes only very slowly, are so different that the rapidly changes in growth rates over short periods due to transitory and cyclical effects that I do not believe these identify an education impact in any case (see Pritchett, forthcoming).

[19] Spiegel (1994) shows the finding of a negative effect of educational growth is robust 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 machinery investment, inward orientation) and samples.

However, there is evidence that appears to be contradictory from two sources: growth regressions using enrollment rates, and regressions in which the *growth* of output is specified as a function of the *level* of schooling. However neither of these is relevant.

Enrollment rates. A literature exists showing that enrollment rates are correlated with growth rates (Barro, 1991, Mankiw, Romer, Weil, 1992, Levine and Renelt, 1992). The justification for enrollment rates in growth regressions has been either that enrollments rates, by analogy with investment rates, proxy for the growth of the stock of educational capital of the labor force, or alternatively, they proxy for the steady state level of educational capital.[20] The assumption that current average enrollment rates proxy countries' steady state stock is true only if enrollment rates are constant over time across countries. This contradicts one of the most well known and striking features about development: the massive recent expansion of schooling (Schultz, 1988).

The other argument, that enrollment rates proxy the growth of years of schooling is empirically false as the correlation between either of the estimates of the actual growth of stock since 1960 and the primary or secondary enrollment rates in 1960 is strong and *negative.* The correlation of the growth of educational capital with primary enrollment rates is -.48 and -.41 for secondary enrollment rates. This is because the *growth* of educational attainment depends not on the current enrollment rate but on the *difference* in the enrollment rate between the cohort leaving the labor force and the cohort entering the labor force. Comparing Korea and Great

[20] 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, their use of only secondary enrollments as a proxy cannot be defended.

Britain provides a simple illustration. 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 average years of schooling expanded massively from 3.2 to 7.8 by 1985 while Great Britain's expanded only modestly from 7.7 to 8.6, even though Great Britain enrollment rate was higher than Korea's for most of the period.[21] Enrollments rates are a *worse than terrible* proxy for the growth of educational capital.

Initial level of schooling. A second literature includes the lagged level of the stock of education. This is curious, as an augmented Solow production function would suggest regressing the *level* of output on the *level* of physical and educational capital. The level-on-level regressions results in column 6 of table 1 show that CUDIE is definitely too high (.62) while educational capital estimate is still quite small (.12), but now marginally statistically significant. However, there are many reasons why both coefficients will be biased upwards in levels on levels regressions. If the educational capital results are biased upward by as much as the CUDIE results appear to be then the negative levels from the growth-growth regressions are consistent with the small positive coefficients in the level-level regressions.

[21] 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.

If the initial level of education is added to a growth accounting regression the education *level* is positive while the mildly negative impact of education capital *growth* persists. This finding of a level effect is actually much more puzzling than is generally acknowledged and does not resolve the puzzle of the absent "growth on growth" impact in any case. The "spillover" effects of knowledge that might be captured by an effect of the level of education should be *in addition to* rather than *instead of* the usual direct productivity effects. Finding *only* a spillover impact is grossly inconsistent with the micro data: if the entire return to education at the aggregate level is spillover effects then why is the wage premia observed at the individual level?

The time series properties of regressing growth rates on the level of education are also problematic. Growth rates are stationary and without upward trend (or decelerating) while the stock of education is non-stationary and secularly increasing. Hence there cannot be a stable relationship between the growth of output and the level of education alone (Jones, 1997).[22] What growth specifications with levels are implicitly doing is estimating an error correction model. This rationalizes the inclusion of a non-stationary variable (education levels) on the rhs by the co-integration with another rhs variable (the level of income) such that the linear combination is stationary. This approach when fully implemented, while getting the dynamics right, still begs

[22] 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 co-integrated , 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 Maddison's historical data that growth rates are stationary after allowing for one structural break. 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 while growth rates are stationary (Jones, 1995).

the original question as one must still estimate the co-integrating relationship between schooling and output.

II) How much should educational capital matter?

So far I have shown that a simple, but standard and widely accepted, growth accounting framework provides no support for the idea that faster expansion in the schooling of the labor force accelerated the rate of economic growth in the "typical" country. I have shown that this result is not the result of simple measurement error of years of schooling and is robust to a wide range of samples, data sets on growth or education, and estimation technique. I have also shown that widely accepted evidence about the importance of education for macroeconomic growth is far more problematic and ambivalent than is often acknowledged.

There are typically two reactions to the above results. One, usually from microeconomists, is disdain. They ask, "why would anyone want to use noisy macroeconomic data and ill-specified aggregate models to demonstrate that education is productive? What is needed are clever identification strategies on individual data (like using twins or mandatory enrollments) to estimate the *true* impact on earnings of a year of schooling." The other reaction, generally from macroeconomists, modify the functional form or adjust the sample until they find a positive (or at least non-negative) impact of schooling[23]. Both these reactions miss the point that the most interesting question for policy is the *difference* between the micro and macro based estimates and hence *both* are necessary.

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[23] Krueger and Lindahl (1998) for instance, are able to recover a positive and significant coefficient on their human

The question or whether education increases worker's productivity *is* a question that is best left to the micro evidence—but is a question that is policy irrelevant. Demonstrating with aggregate data that more schooling leads to higher output is also policy irrelevant. Showing that the investments of private firms raise output would lead no self-respecting economist to conclude governments should promote investment.[24] If one wants to justify public intervention for schooling (without invoking a merit goods) the policy question is "will a given policy intervention that raises an individual's education by one year raise or lower total *aggregate* economic welfare?" While there are plausibly market failures that might lead to sub optimal investment, if individuals are already making optimal investment choices than in the absence of positive spillover an intervention may well raise education but lower welfare. For the question of spillovers the individual level data alone are obviously by themselves inadequate.

There is a second, very deep, problem with using the micro data, which is that when the economy and/or the market for educated labor are deeply distorted, there is no reason to believe that gains at existing wages and prices reflect social welfare gains. To infer an increase in aggregate welfare from an increase in wages requires the claim that prevailing market and social marginal products are equal (or at least not too unequal). But this claim about the similarity of

capital term by either excluding physical capital altogether or imposing a value on the physical capital coefficient of .35, even though this value is strongly rejected by the data. This approach seems justified principally by a very strong prior.

[24] Although this exact mistake for education is quite common at the World Bank, where evidence showing "social" returns which are lower than "private" returns is routinely and perversely used as evidence for *increasing* public spending on education. This is because estimates of the supposed "social" returns make no effort to capture any positive externalities of education. Just as a footnote (within a footnote) to the intellectual history of World Bank statements it is important to understand that all Psacharopolus originally intended to accomplish with the tables showing "social" and "private" returns to education was to show that education was "productive" investment for the public sector, even taking cost into account. This narrow objective was necessary because the World Bank, as a lending institution, was limited by its Articles of Agreement to finance "productive" investments. Showing that an investment is "productive" is of course completely irrelevant to the question of whether there is a rationale for *government* to undertake that investment, a distinction that was, at the time, simply and widely ignored.

private and social returns is precisely what the individual data alone can never show (and, incidentally, is almost certainly wildly false)[25]. 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.

The policy relevant questions require aggregation, as to show spillovers, either positive or negative, or to show individual gains translate to social gains requires going beyond the individual level data to some higher level of aggregation (which need not be national but could be local or regional). So, while micro evidence is strong for individual level questions, if we want to ask about aggregate social welfare (and I think for policy purposes economists do) we are stuck with using the aggregate data, however weak.

[25] 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 1960-1990, in which most developing countries were riddled with massive distortions. Just think of the largest developing countries, is this correspondence of actual prices and social returns true on average of China? India? Egypt? Turkey? Brazil? Nigeria? Pakistan?

A) How much should education matter? the Augmented Solow model

The benefit of taking the extended Solow approach is that this model facilitates simple non-regression based estimates of how much the expansion of educational capital "ought" to matter. Since the weights in the aggregate Cobb-Douglas production function represent the factor shares of national income, the coefficient on educational capital in a growth regression ought to be equal to the share of educational capital in GDP, for which plausible guesses can be made. A physical capital share of around .4 is consistent with a variety of evidence: the estimates from national accounts,[26] the estimates from regression parameters, and with capital output ratios (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). This implies the labor share is .6, how much of that is due to human or educational capital?

One simple way estimating the human capital share of wages is using 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.[27] A similar calculation based on the distribution of wages in Latin America estimates the human capital share of wages between 50 and 75 percent.[28]

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[26] 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).

[27] 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.

[28] Using data on the distribution of worker's earnings (World Bank, 1993) we take the ratio of the average wage

Another approach to estimating the educational capital share is assume a wage increment to education (taking the micro evidence discussed below at face value) and use data on the fraction of the labor force in each educational attainment category to derive the educational capital share. Table 2 shows the results of two calculations. The top half shows the fraction of the labor force in various educational attainment 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

$$(6)\quad Educational\ capital\ share = \frac{\sum_{i=0}^{K} (w_i - w_0) * g_i}{wL}$$

educational attainment using equation (6)

where i represents each of the seven educational attainment categories and g_i are the shares of the labor force in each educational attainment category. Row A of table 2 shows the share of the wage bill that is educational capital in various regions assuming the wage increment to a year of schooling is 10 percent at all levels of education. 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 a year of primary has a higher wage impact than secondary, and secondary than tertiary. Under this assumption, the share is almost exactly

only 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 that other estimates, these are estimates of all human capital, not just educational capital.

half, 49 percent, for all developing countries and varies from 38 percent (in SSA) to 73 percent (in the OECD).

Table 2: Share of educational capital in wage bill							
	Wage premia by educational attainment under assumption:		Share of work force by educational attainment, 1985				
			Developing Countries	Sub-Saharan Africa	Latin American and Caribbean	South Asia	OECD
	A	B					
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 educational capital in total wage bill under assumptions:							
A) Assuming that the Mincerian wage increment is constant at 10%			36%	26%	43%	30%	62%
B) Assuming the Mincerian wage increment 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).							

While both these methods are rough, together suggest that the educational capital share of the wage bill should be between .35 and .7 and hence share of educational capital in GDP should be between .21 and .42[30]. Hence the growth accounting regression coefficient on educational capital ought to be in this range, say.3.

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[30] One noticeable feature is that the human capital share does appear to be substantially higher in the wealthier countries. This does mean that we are imposing in estimation what the micro evidence does not support: a constant share of human capital across all levels. Three points. First, Judson 1993 also finds an increase in the human capital/ output ratio. Second, in this case the result is an artifact of assuming equal wage increments across countries, modest declining wage increments as income increases could reverse this. Third, the constancy of factor shares is a condition that has been imposed in nearly all Solow type regressions. However, even when I relax the assumption by allowing an interaction between levels and growth rates the same type of results on changes emerge.

I *define* the growth rate of TFP to be:

$$(7)\quad \hat{TFP} = \hat{y} - a_k * \hat{k} - a_h * \hat{h}$$

where $\hat{y}, \hat{k}, \hat{h}$ are the growth rate of output per worker, CUDIE per worker, educational capital per worker respectively, and the value of the shares of physical (a_k) and educational capital (a_h) are derived from non-regression data.[31]

B) TFP regressions

Columns 8 and 9 of Table 1 show the results of regressing TFP growth on the growth of CUDIE and educational capital. In column 8 the assumed shares are .4 (physical) and .3 (educational) and the growth of educational capital shows a large and very statistically significant *negative* effect on TFP growth. In column 9 I assume that the physical capital share is on the high side at ½ and that the share of educational capital in the wage bill is on the low side, at 1/3, so that the educational capital share is as low as it can reasonably be (1/2 * 1/3=.167). It is still the case that educational capital accumulation is strongly and statistically significantly *negatively* related to TFP growth. Of course, except for fixing the capital share, this TFP regression is equivalent to a t-test that the estimated human capital share is equal to .167, which by using the

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[31] By saying I define TFP in this way I am admitting to ignoring several whole large and important literatures on what productivity really is, how aggregate TFP can (or cannot) be rigorously derived from micro production functions, and how it can be consistently estimated, not to mention waving away my own recent research undermining the notion that TFP can be measured using CUDIE (Pritchett, 1999). I am simply, for purposes of discussion, associating the concept TFP with the non-regression growth accounting residuals, by *fiat*.

results of column 1 would give a value of 3.63 (.167/.046), a convincing rejection.

In the augmented Solow model the TFP result is a simple, but useful arithmetic trick. This trick is useful because it changes a typically uninteresting “failure to reject” to a convincing rejection of an interesting and policy relevant hypotheses. The only reason to use aggregate data to estimate the impact of schooling at all is to show that the impact is higher (or lower) than what would have expected from the microeconomic data and hence provide some indication of the presence (or absence) of spillovers, externalities, or distortions. To be of interest growth research using aggregate data, must demonstrate not only that the educational capital coefficient is not zero but it is higher than value that is “expected” given micro evidence applied to a plausible growth model. This is a seemingly modest and obvious standard, but one that has never been met.[32]

III) Why (and where) does schooling matter less than it could?

Several recent papers (Temple, 1999) have demonstrated parameter homogeneity in estimates of the impact of educational capital. Not at all surprisingly, when unconstrained, the data do not say that schooling has contributed to output in exactly the same degree in Korea, Zaire, Paraguay, and Hungary. Parameter homogeneity does not change the fact that the unconstrained estimates are well below the expected level on average and hence there is a large range (well more than half) of countries for which education appears to have had *less* than the expected “zero spillover,

[32] 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 using enrollment rates 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.

no distortion" growth impact. Moreover, allowing heterogeneity suggests there is a number of countries for which the impact of increased education on *growth* (not just on TFP) has been negative. However, parameter homogeneity is conceptually the *beginning* of a solution: why *has* the impact been different in different countries? At this stage, a typical growth paper would now "solve" the empirical problem by creating simplistic one- good aggregate model with aggregate actors ("consumers" or "government") interacting in an identical environment and then "verify" this model by inserting some new variable (or interaction term) that is "significant." But rather than pretending that there is a single solution (and that I have found it) I explore three classes of explanations that take the micro and macro evidence seriously and focus on the economic conditions in the developing countries: the educational system, the labor market, and the existing institutional environment. There are three places "where the education (might have) gone" which would explain its low impact in come countries:

- year of education went into poor quality schooling that created little or no educational capital,
- that the supply of educational capital has outstripped demand so that education had no where to go and the returns to schooling declined rapidly, and
- that newly created educational capital went into piracy: privately remunerative, but socially unproductive activities.

These are not mutually exclusive options and all three are likely present in different measure in every country.

A) Did schooling create skills?

What if little or nothing is learned in school? There are two possibilities. If there is no observed return at the microeconomic level, then the "low of schooling" explanation is easy to invoke (although this low observed return is also consistent with stagnant demand for educated labor). The second possibility is that nothing is learned in school but there is a demonstrated microeconomic return but no apparent macroeconomic impact. The most plausible explanation of the micro data consistent with education having no impact on productivity and yet having a large impact on wages is a labor market signaling model. What does the evidence say?

School quality. The quality of schooling across countries is impossible to measure without internationally comparable test examinations of comparable groups of students and these, unfortunately, exist for very few countries.[33] Using the existing data Hanushek and Kim (1996) find that the level of test score performance does have a positive and statistically significant coefficient in a growth regression when included as an independent variable. However, one could easily suspect that any variable, like test scores, on which countries like Singapore (the highest, 72.1) and Hong Kong (71.8) do well and countries like Nigeria (38.9) and Mozambique (27.9) do badly might well be capturing more in a growth regression than just labor force quality.

[33] One possible way out of the lack of quality measures is to use proxies for quality. However, 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. Hanushek and Kim (1996) explore the connections between these indicators and test scores in order to be able to extrapolate a quality when it is not available, but with little success. 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 ambivalent results (Filmer and Pritchett, 1997, Hanushek 1986, 1994).

The expected functional form when schooling quality matters would be an interactive effect (so that the impact of an additional unit of educational capital is higher the higher the quality of schooling). When I use the single data point on test scores for each country provided by Hanushek and Kim 1996 (normalized to a mean of one) to interact with the growth of the educational capital stock. As shown in column 7 of table 1 while the estimated impact of education is higher with higher quality, it is still the case that, evaluated at the average level of quality, the education impact is still less than zero.

Third, a number of researchers have defined human capital in a way that *assumes* that either more spending or higher average levels of education lead to higher levels of human capital for a given year of schooling. Judson (1993) creates a new educational capital variable in which educational capital is valued at its cost of creation across countries and her estimate of the educational capital contribution is not negative. However, her measure of educational capital attributes greater value to educational capital when the cost per pupil of a years of schooling is high, which is a dubious proposition. 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). Using costs to proxy for quality seems ill advised given both the findings about the large differences across countries in the efficacy of their educational spending (Filmer and Pritchett, 1997) and the large differences in relative prices of teachers.

Some have simply defined human capital such that more is created in higher average level of education countries. However, while learning might be higher this ignores the valuation problem—that human capital is the contribution to earnings. The micro wage studies do not show significant rises in the wage premia in countries with higher average human capital, if anything, the reverse.

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).

Signaling. Spence (1974) has a model in which education has no impact on skills, but if workers with high initial (or innate) ability have an easier time investing in school than workers with low initial ability, employers will pay more for high schooling workers even though schooling has no impact on productivity. The empirical difficulty with answering this objection is having measures of innate ability, and cognitive skills and schooling and wages. However, whenever the requisite data have been available there has been little support for the signaling model. In the US a variety of samples have been exploited to identify the pure education effect, and at least some of those studies conclude that there is no evidence that the estimated rates of return to schooling are biased by signaling.[34] 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

[34] 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.

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 to explain away the effects of schooling on private wage even in the face of no learning is the amply demonstrated impact in a large number of countries of maternal education on non-wage outcomes, like child mortality and fertility, in which market signaling cannot be the explanation (Hobcraft, 1993). In data from the Demographic and Health Surveys (DHS) from sixteen Sub-Saharan African countries, where one might suspect educational quality is very low, women with primary education have 24 percent lower child mortality than women with no education and among women with a secondary education child mortality is 50 percent lower. 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).

B) Was demand for educated labor stagnant?

A second explanation for varying aggregate returns is that the *marginal* return to adding an additional year of schooling economy-wide can be dramatically different from the *average* returns estimated from a cross sectional Mincer regression at a single point in time, depending on the shift in the demand for and supply of educated labor and mechanism of labor market adjustment. The market wage premia varies over time in different ways. Striking not falling, but in of the most advanced economies, where educational levels are the highest, the returns to education are rising. Bushinksy (1994) shows Mincer coefficients in the US have increased (at the median) from .063 to .096. Montenegro (1995) presents estimates on Chilean data for every year from 1960 to 1993 and finds the Mincer coefficient varies between .095 to .167, falling then rising then falling again over the period. Funkhouser (1994) runs Mincer regressions for five Central American countries over several years quite stable returns. The returns in Egypt fell significantly in the 1980s (Assad, 1997).

There are two basic stories to explain demand for educated labor (including by the self-employed): education makes labor more productive or that educated individuals are able to adapt more quickly to disequilibrium (Schultz, 1975, Nelson and Phelps, 1977). In the first case the demand for educated labor will rise when the skill intensity of the economy rises. In the second case the demand for educated labor will rise with greater magnitude of gains from rapid adaptation to disequilibrium. These are difficult to distinguish empirically as both are difficult to observe, and would tend to be observed together. Conceptually this suggests impact of growth of educational capital on output growth would vary: (a) with sectoral shifts as economies develop (or not), (b) with policies that encourage creation or assimilation of knowledge, and (c) with exogenous technological change.

Schooling returns by sector. The returns to schooling differ sharply by economic activity. Nearly all Mincer regressions are based on wage data, principally because incomes of the self-employed (including, and especially, farmers) are so difficult to estimate. While many studies show an increment for wage earners of 10 percent per year of schooling, the increase of farmers' incomes due to a year of schooling is very much smaller—especially where technological change is not rapid. In an extensive review of the literature Jamison and Lau (1982) find that the output of farmers (holding inputs constant) is typically higher by only around 2 percent for each additional year schooling, less than a fifth the 10 percent increment in samples of wage earners.

Table 3: 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.
Enrollment growth positive, wage employment falling				
Zambia	446	-4.3	---	13.1
Cote d'Ivoire	323	-7.7	--	9
*Enrollment growth exceeds wage employment growth by an **order of magnitude***				
Sierra Leone	257	8.9	29	4.9
Uganda	225	13.2	17	4.7
Ghana	1312	80	16	3.8
Burkina Faso	351	35.4	10	3.8
Lesotho	142	14.9	10	5.4
Enrollment growth higher by factor of 4				
Senegal	180	45.4	4.0	5.5
Kenya	1709	436	3.9	14.1
Malawi	546	143	3.8	13.7
Rough equality of enrollment and wage sector growth				
Botswana	157	122	1.3	50.4
Zimbabwe	135	111.1	1.2	36.6

Source: Bennell, 1994, table 5.

These sectoral differences in educational returns are important because in many poor countries wage employment is a very small fraction of total employment. Hence, if wage employment does not expand rapidly (or if returns to education outside wage employment do not rise rapidly) demand for educated labor would be a short of the expanding supply and hence marginal returns to educated labor could decline very rapidly. Table 3 shows that in Africa where the expansion of newly educated laborers has often exceeded the expansion of wage employment by more than an order of magnitude. In countries in which there has been little sectoral change and the demand for educated labor was stagnant, the dramatic expansion of supply would erode the wage premia, so that *ex post* growth accounting will show much lower impacts than would have been expected from early cross sectoral studies.

Policies and educated labor. If policies determine the development path then one would also explain the differences in returns as a result of the interaction of policies, demand for labor, and hence the returns to schooling. Countries which have had closed regimes which did not create an expansion in the demand for skilled labor will are more likely to have had low growth and low returns to schooling.

Education and disequilibria: Exogenous technical progress The third explanation of cross national difference in education returns derives from the underlying view that the primary reason that education increases productivity is that it increases a workers ability respond to a changed environment. Schultz (1975) argues that in a technologically stagnant agricultural environment the production gains from education would be zero, as even the least educated could eventually reach the efficient allocation of factors. In case only when new technologies and inputs are available does education pay off and then only in transition to the new equilibrium. Rosenzweig and Foster (1995) find the return to five years of primary schooling versus no schooling in the average Indian district studied was 11 percent (446 rupees increase in average farm profits), similar to the 2 percent per year of schooling for agriculture in the literature review above. However, Rosenzweig and Foster emphasize the interaction of returns to schooling with the exogenous increases in technology in those districts whose agricultural conditions were intrinsically conducive to the adoption of Green Revolution technologies (proxied by the increase in average farm profits). In a district with farm profits one standard deviation above the average, the returns to primary (versus no) schooling was 32 percent. However, the converse of high returns with rapid progress is that the estimated returns to schooling were *negative* in those districts in which progress was less than average profits by 2/3 of a standard deviation or more.[35] While schooling paid off handsomely in those areas in which the Green Revolution brought technological advances while in technologically stable areas education was not an exogenously important impact of growth.[36] Rosenzweig (1996) (uses data across these same districts of India to show the pitfalls in cross sectional regressions when technological progress varies exogenously. In a cross section of Indian districts the education is correlated with economic growth. But Rosenzweig shows that once varying exogenous technical progress is introduced this technological progress explains both the higher economic growth and higher returns to education as the higher returns leads to greater expansion in supply of education in those districts with more rapid growth. The apparent impact of education disappears.

C) Are cognitive skills applied to socially productive activities?

A final possibility to explain the small average and differential impact of education on

[35] 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.

[36] This explanation of the interaction of demand and supply for education due to different rates of technological progress might suggest that the reason education appears not to have paid off in places like Sub-Saharan Africa. Several recent studies have found very little return to education in farming in Africa (Gurgand, 1995, Joliffe, 1995). If that there has been little exogenous change in the technical production functions appropriate to African agriculture for more educated farmers to adopt, as the Green Revolution innovations were not adaptable to African conditions.

aggregate growth is that social and private rates of return to education diverge. North's (1990) powerful metaphor of piracy suggests the problem. Rent seeking and directly unproductive (DUP) activities can be privately remunerative but socially dysfunctional and reduce overall growth. If the improved cognitive skills acquired through education are applied to these activities, this could explain both the micro returns and small macro impact. The theory of the second best says that in a sufficiently distorted environment pretty much anything can happen most economists would accept that there exist, in theory, institutional and incentive environments in which investment in schooling can actually worsen welfare. What is surprising is *not* that it is *possible* for education not to pay off, but that the economic distortions in many developing countries over the past three decades were, such that education did not *in practice* pay off in sustained aggregate growth.

Murphy, Shliefer 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.[37] They find that in a growth regression the fraction of higher level (tertiary) students in engineering increases while fraction of higher level students in law decreases economic growth.[38]

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[37] 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 all 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. They were educated, but not stupid.

[38] One way to distinguish the models of productive education from the signaling and distortion hypotheses about micro and macro returns is that the usual model is the MIT "engineering" metaphor in which education is subsequently used

There is other evidence that the impact of education on economic growth is conditional on the magnitude of distortions. The 1991 World Development Report shows that, among countries with "low policy distortion" countries with rapid growth in education, GDP grew at 5.3 percent those with slow growth in education GDP growth was 4.0 percent. In contrast amongst "high policy distortion" countries with a rapid increase of education grew at only 3.5 percent, nearly the same as the 3.4 percent growth countries with slow growth in education.

Another piece of empirical evidence that misallocation of skills might account for the negative growth impact of education in some countries comes from Judson (1993). She estimates the growth returns to education differentiated by type (primary, secondary, and tertiary) and by initial level of income. In the poorest two quartiles of countries primary education had a positive effect, however in those countries secondary and tertiary education, which are more likely to be filtered into rent seeking, had no significant impact at all, with some point estimates negative.[39]

In many developing countries the public sector has often accounted for a large share of the expansion of wage employment in the 60's and 70's (see table 4). Gelb, Knight, and Sabot (1991) build a dynamic general equilibrium model in which government responds to political pressures from potentially unemployed educated job seekers and becomes the employer of last

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in innovation. The signaling model can be thought of as the "Harvard MBA" metaphor of education in which nothing is really learned but wages are higher because a highly ambitious group is pre-selected for employers. The "Harvard Law" metaphor is that in which wages are higher because real, privately valuable, skills are really learned, but these skills are of dubious social product.

[39] This pattern of results across levels of schooling in low-income countries is similar to the findings of Mingat and Tan (1997), although since they use enrollment rates it is difficult to compare their results with studies using stocks.

resort of educated labor force entrants. In this model they show that when both employment pressures are strong and the government is highly responsive to those pressures 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.

Table 4: Fraction of wage employment growth accounted for by public sector growth in selected developing countries.

Country:	Period:	Average growth (% per annum) of wage employment			Public sector % of total increase
		Public	Private	Total	
Public sector growth positive, private growth zero or less					
Ghana	1960-78	3.4	-5.9	-0.6	
Zambia	1966-80	7.2	-6.2	0.9	418
Tanzania	1962-76	6.1	-3.8	1.6	190
Peru	1970-84	6.1	-0.6	1.1	140
Egypt	1966-76	2.5	-0.5	2.2	103
Brazil	1973-83	1.4	0	0.3	100
Public sector more than half of total employment growth					
Sri Lanka	1971-83	8	0.9	3.9	87
India	1960-80	4.2	2.1	3.2	71
Kenya	1963-81	6.4	2	3.7	67
Public sector faster, but less than half of total growth					
Panama	1963-82	7.5	1.8	2.7	45
Costa Rica	1973-83	7.6	2.8	3.5	34
Thailand	1963-83	6.3	5.5	5.7	33
Venezuela	1967-82	5.1	3.4	3.7	27
Unweighted mean		5.5	0.3	2.4	

Source: Derived from Gelb, Knight, and Sabot, 1991, table 1.

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 employ a fixed quota each year. The result is legendarily over staffed enterprises and bureaucracies. In 1998 the government or public enterprises employed 70 percent of all university graduates and 63 percent of those with education at the intermediate level and above.[40] This obviously induced large economy-wide distortions in the supply and demand for educated labor (Assad, 1997).[41]

Education can lead to the persistence of damaging policies. Many of the growth inhibiting policies typical in 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.[42] More education might lead to a reinforcement of these policies

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[40] This number is probably not atypical, although most labor force surveys only calculate employment by economic sector, not employer. Gersovitz and Paxson (1995) calculate that in 1986-88 in Cote d' Ivoire, 50 percent of all workers between 25 and 55 that had completed even one grade at the junior high level worked in the public sector.

[41] 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 in the government.

[42] 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)

as the newly educated protect their gains rather than risk reform.[43]

Conclusion

The recent growth literature stressing the importance of human capital seems quaintly naïve of the basic facts in developing countries. Nearly all countries saw education attainment grow rapidly – even as many saw their economies collapse. While education expansion was at historic highs in developing countries growth in the 1980's and 1990's economic growth in large parts of the developing world fell to historic lows. The cross national data show that – on average – education contributed less to growth than expected "no spillover, no distortion" level in the standard augmented Solow model. Where did all they education go?

Education has not had the same impact in every country and the coefficient in a cross-national regression masks enormous heterogeneity in the impact. There are three of explanations for the differences in the impact:

- Schooling has in some countries been enormously effective in transmitting knowledge and skills while in other countries it has been essentially worthless and created no skills.
- The rate of growth of demand for educated labor (in part due to different sectoral shifts, in part due to policies (such as openness to the world economy in part due to exogenous differences in technological progress)) has varied widely across countries so that can be that the marginal return has fallen dramatically, staged constant, or risen.

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

- In some countries schooling has created cognitive skills and these skills were in demand, but to do the wrong thing. In some countries institutional environment was sufficiently bad that bulk if newly acquired skills were devoted to privately remunerative but socially wasteful, or even counter-productive, activities some countries just had better educated pirates.

All countries do not follow the same mold and each of these explanations contributes different amounts to explaining the overall impact of schooling on growth in different countries.

None of the arguments in this paper suggest that governments should invest less in basic schooling, for many reasons. First, most, if not all, 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—a position I share. To deny a child an education because the expected economic growth impact is small would be a travesty. Second, schooling has a large number of direct beneficial effects beyond raising economic output, such as lower child mortality. Third, the evidence is clear that education (especially if done well) does raise cognitive skills. The implication of a poor aggregate payoff from increasing cognitive skills in a perverse policy environment is not "don't educate" but rather "reform *now* so that investments (past and present) in cognitive skills will pay off."

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Table 1: Growth Accounting Regressions of GDP per worker growth with educational capital and CUDIE per worker g

Dep. Variable:	Per annum growth of GDP per worker (GPDPW)						Level GDPP
	1 OLS (entire sample)	2 OLS With initial GDPPW	3 OLS (on just IV sample)	4 IV (w/ NSD educ. capital data)	5 IV (w/ similar country)	7 OLS (sample of countries with test scores)	8 OLS (on leve 1985, wl sampl
Growth of educ. capital per worker[a]	-.049 (1.07)	-.038 (.795)	-.091 (1.61)	-.120 (1.42)	-.088 (.593)	.058 (.229)	.136 (1.97
Growth of CUDIE per worker[a]	.524 (12.8)	.526 (12.8)	.458 (10.19)	.460 (10.18)	.527 (12.42)	.592 (6.78)	.612 (14.8
Ln (initial GDP per worker)		.0009 (.625)					
Test Score (normalized, mean=1)						.014 (1.31)	
Test Score* EK						-.485 (1.27)	
Number of countries	91	91	70	70	77	25	96
R-Squared	0.653	0.655	.611	--	--	.71	.909

Notes: t-statistics in parenthesis.

a) except in column six, which uses levels.