8 THE CONTRIBUTION OF EDUCATION TO ECONOMIC GROWTH: INTERNATIONAL COMPARISONS

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Since the concept of human capital was invented (or perhaps reinvented) in the late 1950s, we have been flooded with papers written about the contribution of education to economic growth. The most often cited early references are Schultz (1961) for the United States, Denison (1967) for the United States and other advanced countries, and Krueger (1968) and Nadiri (1972) for less advanced countries. After a rather long pause in the 1970s, triggered by lack of economic growth and ambivalence about the role of education in development, the topic has begun attracting renewed interest. Thus we have the less known recent works of Hicks (1980), Wheeler (1980), Easterlin (1981) and Marris (1982).

In this paper I first summarize past efforts to estimate the contribution of education to economic growth. Then I augment and reinforce this evidence by examining recent related analyses of the role of education in society that do not formally come under the popular heading of "the contribution of education to economic growth." The paper concludes with a response to recent attacks on the economic value of education, especially with reference to developing countries.

THE EXISTING EVIDENCE

Traditionally, estimates of the contribution of education to economic growth are arrived at by using one or another variant of the same basic accounting

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framework. Assuming there exists an aggregate production function linking output (Y) to various inputs such as physical capital (K) and labor (L),

$$Y = f(K,L) ,$$ (8.1)

the observed average annual rate of growth (g_y) of the economy over a given time period can be disaggregated into capital and labor components (right-handed-side of equation (8.2), respectively),

$$g_y = \frac{I}{Y} r + g_L s_L ,$$ (8.2)

where I/Y stands for the investment-output ratio, r is the rate of return to investment, g_L is the average annual rate of growth of the labor force, and s_L is the share of labor in national income.[2]

Early attempts to empirically balance the two sides of equation (8.2) have resulted in the well known sizeable "residual," and it has since become a scholarly sport to try to reduce it by introducing other variables, such as education.

Education can enter into equation (8.2) either per Denison:

$$\Sigma_i \, {}^s L_i \, {}^* L_i ,$$

where L_i refers to labor with educational level i, or per Schultz:

$$\sum_i \frac{(I_i)r_i}{Y} ,$$

where I_i is the level of investment in the i type of education and r_i the rate of return to this type of education. The two methods are logically equivalent since they use wage differentials by level of education either as weights to derive the share of different types of labor to national income (Denison) or as income ratios to derive the rate of return to particular levels of education (Schultz).[3] Computational differences may arise in using the two methods because of discrepancies in the counting of physical increments of labor with given educational attainments (Denison) and the value invested in a particular type of education (Schultz).

First-Generation Estimates

Table 8-1 gives a compilation of the various first-generation estimates of the contribution of education to economic growth using one or another of the above accounting frameworks, expressed as the percentage of the observed rate of economic growth "explained" by education. It will be immediately noted that no easy generalizations can be made on the basis o

Table 8-1. The Contribution of Education to Economic Growth
(percentage).

Country	Growth Rate Explained
North America	
Canada	25.0
United States	15.0
Europe	
Belgium	14.0
Denmark	4.0
France	6.0
Germany	2.0
Italy	7.0
Greece	3.0
Israel	4.7
Netherlands	5.0
Norway	7.0
United Kingdom	12.0
USSR	6.7
Latin America	
Chile	4.5
Argentina	16.5
Colombia	4.1
Brazil	3.3
Equador	4.9
Honduras	6.5
Peru	2.5
Mexico	0.8
Venezuela	2.4
Asia	
Japan	3.3
Malaysia	14.7*
Philippines	10.5
South Korea	15.9*
Africa	
Ghana	23.2*
Kenya	12.4*
Nigeria	16.0*

*Estimates based on "Schultz-type" growth accounting.

Source: Psacharopoulos (1973: 116) and Nadiri (1972: 138).

Note: Unless otherwise noted, estimates are based on Denison-type growth accounting.

this table. Education seems to have contributed substantially to the growth rate of some highly advanced countries—such as the United States, Canada, and Belgium—as well as to the growth rate of African and Asian countries (with the exception of Japan). In Latin America, Argentina notably stands out from the rest with a much higher contribution of education to growth.

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Second-Generation Estimates

Characteristic of second-generation estimates is the use of econometric techniques relating inputs to output, rather than the growth accounting decomposition found in the work of Schultz and Denison. Such estimates cannot be easily summarized (as in Table 8-1), since each author followed a different estimating technique.

Hicks (1980) compared the growth rate of different countries in the 1960–77 period with each country's deviation from the 1960 expected literacy level. The latter was found by regressing the 1960 literacy level with the 1967 per capita income and its square in a sample of sixty-three developing countries. Table 8-2 shows that the top eight growth performers had clearly positive literacy deviations from the norm. In the case of the eight fastest growing countries, a 16 percent literacy advantage is associated with a higher growth rate of 3.3 percentage points. For all countries, Hicks found on the average that an increase in the literacy rate by 20 percentage points is associated with 0.5 percent higher growth rate.

Wheeler (1980) addressed the simultaneity problem inherent in previous analyses—namely, that the level of income might be influencing the level of education rather than the other way around. Pooling data from eighty-eight countries and working with differences in the variables (rather than levels) and simultaneous equation techniques, he found that education has an independent effect on income. For example, on the average, an increase of the literacy rate from 20 to 30 percent is the cause of an increase in real GDP by 8 to 16 percent. In the case of African countries the estimated elasticity of output with respect to literacy is double relative to the sample of all developing countries.

Table 8-2. Economic Growth and Literacy (percentage).

Top Eight Countries Ranked by Growth of GNP	Growth Rate of GNP Per Capita, 1960–77	Literacy Deviation from the Norm
South Korea	7.6	43.6
Hong Kong	6.3	6.4
Greece	6.1	7.5
Portugal	5.7	1.7
Spain	5.3	1.2
Yugoslavia	5.2	16.7
Brazil	4.9	8.6
Thailand	4.5	43.5
Average, top eight countries	5.7	16.2
Average, all LDC's	2.4	0.0

Source: Based on Hicks (1980), as cited in World Bank (1980: 38).

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Marris's (1982) work is in effect an extension of Wheeler's. Using data from sixty-six developing countries in the 1965-79 period and a chain model of output determination, he confirmed previous results that the benefits of education in terms of economic growth are very high—and in particular that general investment plays a weak role when not supported by education. Costing the coefficients of the model, he estimated benefit/cost ratios for education (measured by the primary enrollment rate) ranging from 3.4 to 7.4. The benefit-cost ratios for education stood in a class of their own as compared, for example, with the corresponding ratios for investment in physical capital, which ranged from 0.4 to 1.0.

Finally, it should be noted that in a recent Denison-type growth accounting exercise by Kendrick (1981) splitting the 1960-79 period into two subperiods, it was found that in seven out of nine industrial countries, the contribution of education to economic growth was higher during the slowdown period of 1973-79 relative to 1960-73.

AN ENLARGEMENT

This section argues that the above evidence, especially the first-generation evidence, underestimates the true effect of education on economic growth and on social welfare in general. This point is made by raising a number of issues and by examining supplementary evidence that does not formally come under the heading of the contribution of education to economic growth.

To start with, let us abstract from the so-called interaction effects or complementarities between human and physical capital. The simply additive decomposition of the economic growth rate in the first-generation estimates has necessarily disregarded the interaction between education and other independent variables in promoting economic growth. For example, in an extremely macro exercise Krueger (1968) has shown that three variables normally associated with the concept of human capital (education, age, and sectoral distribution of the population) can explain more than half of the difference in income levels between the United States and a group of twenty-eight developing countries. Education alone was found to contribute one-quarter to one-third in explaining income differences, and its interaction with other variables was nearly equal to its direct effect. And it has repeatedly been found that human and physical capital complement each other in the process of economic growth. Griliches (1969), Psacharopoulos (1973), and Fallon and Layard (1975), among others, report results consistent with the hypothesis that a higher stock of human capital enhances the rental value of machines. Of course, the complementarity argument could be interpreted the other way around—namely, that an increasing stock of

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physical capital boosts the efficiency of educational investment, although Marris (1982), using a recursive path model, found that general investment plays a weak role in economic growth when not supported by education.

I want to abstract from interaction effects and complementarities because a correctly measured marginal product of labor used as a weight in growth accounting captures the mutually enhancing effect of an increased quantity of any input on other inputs. Also, if there exist nonlinearities in the sense of a mathematically more sophisticated growth decomposition than the one derived from Euler's theorem, one could, in fact, explain a greater part of the residual. However, it is not easy to attribute the extra-explanatory power of the nonlinear formulation to a particular factor of production like education (Nelson 1981). Instead, let us proceed on safer ground and make a distinction between the contribution of education to measured economic growth on the one hand and to a wider concept of social welfare on the other.

Contribution to Economic Growth

Typical growth accounting exercises underestimate the total effect of education for the following reasons:

The Maintenance Component. Denison-type growth accounting, as commonly applied, underestimates the true contribution of education to economic growth because it neglects the educational maintenance component of a growing labor force. This is a fundamental distinction made by Bowman (1964) and Selowsky (1969) but that has not been followed up in the more recent literature. The distinction is important in the case of fast population growth developing countries where the educational system has a double burden: first, to maintain constant the level of educational attainment of the labor force and second, to augment its level of educational attainment. Denison-type accounting, as commonly applied, captures only the net increments of educated labor, neglecting the maintenance component. As shown in Table 8-3 the resulting underestimate errors of the contribution of education to economic growth are substantial, especially in developing countries.

The Educated Farmer. The basic link between education and economic growth in typical growth accounting exercises is the classification of wages of labor by level of schooling. These wages are derived mainly from employment surveys in the modern sector of the economy. In developing countries, however, the majority of the economically engaged population does not work for wages but makes a living from agriculture or from self-employment in the informal sector of the economy.

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Table 8-3. Downward Bias of the Estimated Contribution of Education to Economic Growth Because of Omission of the Maintenance Component (percentage).

Country	Downward Bias
Chile	58
Mexico	66
India	90
United States	38

Source: Selowsky (1969: 463).

Although the positive relationship between farmers' education and agricultural productivity was one of the first and repeatedly documented propositions in the empirical literature on human capital, such evidence has failed to be integrated into growth models. Landmarks of past analyses in this respect are the works of Griliches (1964) and Welch (1970) for U.S. agriculture and Hayami and Ruttan (1970) on cross-country comparisons. Thus, the output elasticities with respect to education in the United States are of the order of 0.3 to 0.5, as compared to 0.1 to 0.2 for land, fertilizer, and machinery. And nearly one-third of the difference in labor productivity between developed and less developed countries has been accounted for by differences in the human capital stock.

Of particular importance to this review is the recent work of Jamison and Lau (1982). Mastering the results of thirty-one data sets that related schooling to agricultural productivity, they concluded that, on the average, the latter increases by 8.7 percent as a result of a farmer completing four years of primary education. The importance of this finding stems from the fact that (1) productivity measurements in agriculture are in real (physical) output terms and (2) the usual objections raised when using wages as proxies for productivity in other studies have no relevance in a farm setting. Jamison and Lau also report that in Thailand the marginal effect of education on output is greater in rural than in urban areas. To the extent this is true in other countries, as one might reasonably suspect, past-growth accounting exercises using urban wage differentials must have underestimated the contribution of education to economic growth, especially in developing countries.

One of the prime indirect ways in which education contributes to economic growth is that it enhances the adoption and efficient use of new inputs. Whether the argument is cast in terms of the allocative efficiency of farmers (Schultz 1964) or the more general ability to "deal with disequilibria" (Schultz 1975), the literature is full of evidence that schooling acts as a catalyst in behavioral change conducive to growth. For example, Jamison and Lau (1982) report that in Thailand the probability of a farmer

adopting a technology using chemical inputs is about 60 percent greater if the farmer has four years of education rather than none. In traditional Denison-type exercises this source of the contribution of education to growth is lumped into the unexplained residual.

The Use of Public Sector Weights. The wage differentials by level of schooling used in typical growth accounting are heavily influenced by salaries paid by the civil service, especially in developing countries. Although the salary level for some categories of labor might be higher than its marginal product in the noncompetitive sector of the economy, the salary *differential* by level of schooling is not. Comparisons of public-to-private sector wage differentials by educational level have shown that the earnings advantage of the more educated is higher in the private sector (see Table 8-4). To the extent earnings in the competitive sector are good proxies for the marginal product of labor, typical growth accounting studies, by using flatter differentials as weights, must have underestimated the true contribution of education to economic growth.

The Case of Women. For a variety of reasons, women earn substantially less than men. Thus it would appear that using male earnings—as the only data available in growth accounting—would overstate the contribution of education. However, the opposite is likely to be the case. For what matters in growth accounting is the within-sex earnings differential by level of education, or the rate of return to women's education. To the casual observer it comes as a surprise that the profitability of investing in education is higher for women than for men (see Table 8-5 for some examples).

There are two reasons for this apparently paradoxical finding. First, in the case of females the effect of education is not restricted to just raising their earnings; it also increases their chance of participating in the labor force. For example, Table 8-6 shows that in Puerto Rico the chances of a woman being formally engaged in economic activity is three times as much

Table 8-4.   The Earnings Differential by Economic Sector.

Country	Economic Sector	
	Public	Private
Portugal	0.99	1.12
Brazil	1.59	1.92
Colombia	1.07	1.48
Malaysia	0.62	1.13

Source: Psacharopoulos (1982: Table 3).

Note: Figures are ratios of mean earnings of employees with primary and less than primary educational qualifications.

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Table 8-5.   The Returns to Education by Sex (percentage).

Country	Educational Level/Type	Rate of Return	
		Males	Females
Colombia	Vocational	35.4	39.8
Puerto Rico	Secondary	26.3	44.9
New Zealand	Secondary	19.3	25.3
Germany	Vocational	9.0	11.3

Source: Woodhall (1973: Table 1).

as if she has received some college education rather than one to four years of primary schooling. Second, females tend to have lower foregone earnings, and this raises the rate of return. A third possibility is that discrimination against better educated women results in female wages that are lower than their true marginal product. This proposition could be documented by shadow pricing female labor by level of schooling. But perhaps the most persuasive evidence comes again from agriculture. Moock (1976) studied 152 maize farmers in Kenya and concluded that the impact of schooling on output, other factors remaining the same, is greater for the women than for the men. Considerations such as those listed above suggest that the use of male wages as weights in growth accounting understates the contribution of education to economic growth.

The Use of an Ability Adjustment.   The cornerstone of the contribution of education to economic growth is the earnings differential between well-educated and less well-educated labor. Such observed earnings differential has been typically discounted by as much as 40 percent before entering the growth accounting equation to allow for effects other than education, like differential ability. Although the so-called alpha coefficient adjustment has been both plausible and intuitive, recent econometric evidence does not support its use.

Table 8-6.   Female Labor Force Participation by Level of Education (percentage).

Educational Level	Participation Rate
Elementary 1-4	16.3
Elementary 5-6	21.6
Elementary 7-8	23.5
High school 1-3	31.8
High school 4	38.6
College 1 +	53.6

Source: Shields (1977: 65).

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Earnings functions analysis using schooling and ability measures, such as IQ, point that the effects of education on earnings is substantial, even after controlling for ability (e.g., Griliches 1970). A review of the empirically derived alpha coefficient found that its value is more likely to be 0.90 rather than the originally assumed 0.67 used in typical growth accounting (Psacharopoulos 1975). Also, a recent study using nearly experimental data of farmers in Nepal found not only that education has a significant effect on increased efficiency in wheat production but also that its effect does not diminish when the farmers' family background and measures of ability were introduced as additional control factors (Jamison and Moock 1984).

On-the-Job Training (OJT). If "education" is given an all-inclusive definition encompassing all forms of formal and informal learning, then OJT should be included in growth accounting. In spite of Mincer's (1962) early findings, however, that (1) in terms of costs, investment in on-the-job training in the United States is as important as formal education and that (2) the rate of return to on-the-job training investment is of the same order of magnitude as the return to investment in conventional schooling, no efforts have been made to incorporate OJT in formal growth models.

The observed wage level of a given type of labor certainly includes returns to OJT. To the extent a higher formal educational attainment facilitates investment in OJT, it reinforces the view that observed wage differentials between categories of labor classified by educational level should be attributed to one or another form of human capital.

Furthermore, the Beckerian distinction between general and specific training raises the question of second-round interaction effects between formal education and the trainability of the employee, and also brings to the surface the unrecorded benefits later reaped by the firm that has invested in specific employee training (Bowman 1980). A well-known proposition in the economics of education is that in the case of specific training, posttraining wages are less than the marginal product of the employee, the difference being the returns to the investment made by the employer. Since the latter appears in capital profits, failure to take OJT into account results to an underestimate of the contribution of education to economic growth.

Life Expectancy. Once human capital is created via education or training it has to be preserved so that it yields a stream of benefits throughout its theoretical lifetime (which in this case is of the order of fifty years). Cochrane (1980) reports significant partial effects of literacy on life expectancy in a number of countries, after standardizing for the level of income. Also, Hicks (1980) reports positive deviations from norm life expectancy associated with a higher rate of growth of GNP per person. As shown in Table 8-7, a nine-year positive deviation of life expectancy from the income-

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Table 8-7.   Economic Growth and Life Expectancy.

Top Ten Countries Ranked by Life Expectancy in Relation to Income	Life Expectancy Deviation from the Norm, 1960	Growth Rate of GNP per Person, 1960-77
Sri Lanka	22.5	1.9
South Korea	11.1	7.6
Thailand	9.5	4.5
Malaysia	7.3	4.0
Paraguay	6.9	2.4
Philippines	6.8	2.1
Hong Kong	6.5	6.3
Panama	6.1	3.7
Burma	6.0	0.9
Greece	5.7	6.1
Average, Top ten countries	8.8	4.0
Average, eighty-three developing countries	0.0	2.4

Source: Hicks (1980) as reported in World Bank (1980: 38).

predicted value is associated with a 1.6 percent higher growth rate in per capita GNP. Typical growth accounting exercises neglect the indirect effect of education in lengthening the number of years during which individuals are productive; hence, they underestimate its real contribution to economic growth.

Migration.   Rural-urban and rural-rural migration is the process par excellence by which labor is reallocated to more productive uses. The migration literature is full of findings pointing at the positive relationship between education and the decision to move to another area (e.g., Greenwood 1975). This has been explained in terms of the "information hypothesis," which assumes that the economic attractiveness of a location is an increasing function of the level of education (Schwartz 1971). Growth accounting models do not take into account the effect of education on migration, hence they underestimate the indirect contribution mainly rural schools make to national output.

The Use of Literacy as Education Proxy.   Second-generation econometric estimates of the contribution of education to economic growth have typically used a basic education indicator, like the literacy rate of the population or the primary enrollment rate, as a proxy for the education variable. First-level education in developing countries carries a heavy weight in the construction of any educational quantity index (for an exception see Harbison and Myers 1964), and its benefits are more important relative to secondary and university education. On the other hand, the neglect of postprimary levels of schooling must underestimate the contribution of

education to economic growth. Of course, second-generation econometri<
growth models have necessarily traded off the availability of more observa
tions for the comprehensiveness of the education index.

Contribution to Social Welfare

The dependent variable in growth accounting exercises has typically bee
changes in the measured level of income (GNP or GDP). It is commo
knowledge, however, that part of the total income employed by household
is not captured in the national accounts statistics and that there exist othe
welfare indicators, such as per capita income and distributive equity, tha
could be used as dependent variables in explaining well-being. Such con
siderations point to additional reasons why classic estimates, such as thos
presented above, are likely to underestimate the true contribution of educa
tion to economic growth and social welfare in general.

Fertility. This is one of a long series of demographic effects of schooling
Education affects fertility through different channels, such as the deman
for children, contraception, and the child-bearing potential of women
Cochrane (1979) reports that the majority of case studies seem to conclud
that education has a fertility reduction effect (see Table 8-8). Thus educa
tion has an important effect in *per capita* income increases in otherwise fast
growing population that goes unrecorded in ordinary growth accounting.

Table 8-8. The Relationship between Education and Fertility:
Results of Case Studies.

Variable	Relation of Education to Variable	Probable Relation of Education through the Variable	Results (Number of Cases)	
			Supporting	Not Supporting
Age of marriage	Direct	—	59	12
Desired family size	Inverse	—	17	8
Perceived costs of children	Direct	—	2	0
Perceived costs to afford children	Direct	+	9	3
Contraceptive use	Direct	—	26	11
Knowledge of birth control	Direct	—	28	1

Source: Based on Cochrane (1979: 146).

Infant and Child Mortality.   Cochrane, Leslie, and O'Hara (1980) summarized evidence from a number of developing countries and reported partial effects of mother's literacy on infant and child mortality, as in Table 8-9. To the extent such considerations enter the social welfare function, they remain uncaptured in ordinary growth accounting.

Income Distribution.   If one is willing to accept a wider notion of development, the latter including not only the level of income but its distribution as well, education makes a further contribution to social welfare. Several studies in both advanced and developing countries have found that an increased level of educational attainment of the population or the labor force is associated with a more equal income distribution. For example, Marin and Psacharopoulos (1976) report that in the case of Mexico's giving primary education to 10 percent of those without would reduce the variance of the logarithm of earnings (a standard measure of income inequality) by nearly 5 percent. Also, Blaug, Dougherty, and Psacharopoulos (1982) found that the most recent (1972) raising of the minimum school-leaving age in England by one year, other things equal, is likely to reduce income inequality in a future steady state by 12 to 15 percent.

Household Production.   What households consume and the goods and services actually enjoyed by its members is not totally captured in national accounts statistics. This proposition is more relevant in developing countries where a great part of household income is in kind.

There are many ways a higher level of educational attainment of the members of the household contributes to income, other than through the labor market or agricultural production. For example, education embodied in nonformally economically active females is likely to have a great payoff in terms of household production activities, such as better sanitation conditions, more nutritious meals for the family, better educated children, and more efficient consumption behavior. Also, of particular importance is the effect of a more educated mother imparting early abilities to preschool age children (Selowsky 1982). Although the beneficial effect of education in this respect has been mainly documented in advanced countries (Schultz 1974;

Table 8-9.   The Effect of Literacy on Mortality, Per 1,000 Population.

Population Reference	$\dfrac{\partial (Mortality)}{\partial (Literacy)}$
Infants	−0.55
Children	−0.25

Source: Cochrane, Leslie, and O'Hara (1980: 86).

Michael 1982), one might validly extrapolate that the corresponding effect of education in developing countries must be even greater given the relative scarcities of human capital in the two types of countries.

Corroborating Evidence

For the results of macro-growth accounting models to be credible they have to agree with other evidence on the economic effect of education, such as microstudies at the individual plant level, the returns to investment in education, and evidence drawn from the economic history of nations.

Evidence from Microstudies. Detailed microstudies on the effect of schooling on individual employees at the firm level are not as abundant in the literature as the more popular Denison-type aggregate exercises. However, several of them have documented the positive effect of education and training on productivity. Thus Aryee (1976) found a positive correlation between output and the educational level of industrial entrepreneurs in Ghana, net of capital inputs. Fuller (1972) studied millers and grinders in two Indian factories and reported positive correlations between time taken to complete a given task and the educational level of the worker.

The Returns to Education. Evidence on the returns to investment in education in many respects complements, corroborates, and also highlights the possible underestimates of Denison-type growth accounting calculations. Furthermore, it increases our understanding of the particular types of education that are more likely to contribute to economic growth, especially in developing countries. Table 8-10 presents a summary of the available evidence on the returns to education around the world. The rate of return (*r*) figures have been arrived at by solving the following equation for *r*:

$$\sum_{t=1}^{n} \frac{(Y_{st} - Y_{s-1,t} - C_{st})}{(1 + r)^t} = 0$$

where Y_{st} is the earnings of labor with s level of education in year t, $Y_{s-1,t}$ is the earnings of the control group (lower level of schooling), and C_{st} is the direct cost of educational level s in year t. The difference between the private and social rates of return is that the latter are calculated on gross of income tax earnings and the direct cost includes the full amount of resources committed to a given level of education. The returns to primary education, although conservatively estimated, are the highest among the three levels that point to the relative importance of this kind of education for economic development. The absolute size of the private returns in

Table 8-10.   The Returns to Education by Region and Country Type (percentage).

Region or Country Type	N	Private			Social		
		Primary	Secondary	Higher	Primary	Secondary	Higher
Africa	(9)	29	22	32	29	17	12
Asia	(8)	32	17	19	16	12	11
Latin America	(5)	24	20	23	44	17	18
LDC average	(22)	29	19	24	27	16	13
Intermediate	(8)	20	17	17	16	14	10
Advanced	(14)	(a)	14	12	(a)	10	9

(a)Not computable because of lack of a control group of illiterates.

Source: Psacharopoulos (1981: 329).

Notes: N = number of countries in each group. Figures are not horizontally strictly comparable because in a given country the returns to education might not be available for all levels.

African countries: Ethiopia, Ghana, Kenya, Malawi, Morocco, Nigeria, Rhodesia, Sierra Leone, and Uganda.

Asian countries: India, Indonesia, South Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand.

Latin America countries: Brazil, Chile, Colombia, Mexico, and Venezuela.

LDC countries are all listed above.

Intermediate countries: Cyprus, Greece, Spain, Turkey, Yugoslavia, Israel, Iran, and Puerto Rico.

Advanced countries: Australia, Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, New Zealand, Norway, Sweden, United Kingdom, and United States.

general is consistent with the unsatisfied demand for school places, especially in poor countries. The declining pattern of the rate of return by educational level adds credibility to treating school expenditures and foregone student earnings as investment. And although the social returns are based mostly on observed market wages, shadow pricing and evidence from self-employment and agriculture lend support to the economic value of education, net of other influences.

Educational Quality.   The education variable has been measured in a great variety of ways in growth models such as the level of educational attainment of the population, the number of years of schooling of the labor force, the percentage of literacy in a given country or the primary enrollment rate. Although it might appear that reference to the labor force is most relevant to growth accounting, the general population educational attainment measures are also pertinent in the sense of capturing economic effects of education other than through the labor market, as in the case of females and household production mentioned above.

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One dimension that is typically missing in quantitative measures of education used in growth accounting is its quality, although other studies have shown that not only the quantity of education is productive but its quality is, as well. Regardless of whether educational quality has been measured in terms of school buildings, laboratories, textbooks, teacher qualifications, nature of the curriculum, class size, composition of the student body, or per-pupil expenditures, the evidence shows that such measures have an impact on student achievement and later earnings (Solmon 1975; Wachtel 1975; Rizzuto and Wachtel 1980). With respect to the former, the impact is greater in low-income countries (Heyneman and Loxley 1983).

Consideration of school quality might help explain the widening gap in economic performance between developing and advanced countries or the alleged failure of some economies to grow in spite of the rising educational attainment of the population. Jamison, Searle, Galda, and Heyneman (1981) report that whereas in 1960 the average OECD country invested sixteen times more per pupil than did any of the thirty-six countries with per capita income below $265, by 1970 the difference grew to 22:1, and by 1975 to 31:1. According to unpublished estimates this ratio stood at 50:1 by 1977.

The View of Economic Historians. Economic historians have often been intrigued by the relationship between education and economic development. Three pieces of evidence are worth citing. First, Landes and Solmon (1972) have found that minimum schooling legislation did not cause the observed increases in the level of schooling in late nineteenth and early twentieth century United States. This finding runs against the popular hypothesis that schooling follows economic development. Second, Saxonhouse (1977) in a study of the Japanese cotton spinning industry from 1891 to 1935 found that education, among other factors, had a large and significant impact on productivity growth. Third, Easterlin (1981) looked at the chicken-egg problem of the relationship between educational development and economic growth by examining historical data for twenty-five of the largest countries of the world. His conclusion was that the spread of technology in modern economic growth depended on the learning potentials and motivation that were linked to the development of formal schooling—or that the most likely causal link is from education to economic growth rather than the other way around.

CONCLUDING REMARKS

Without resorting to externalities, institution building, or other difficult-to-estimate but certainly positive effects of education in society, it is possible

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to substantially enlarge and reinforce the traditional evidence on the contribution of education to economic growth. This conclusion does not coincide with recent attacks on the role of education on productivity growth and income distribution. Screening for ability, job competition, labor market segmentation, nonclearing wages, nonprofit maximizing public sector pay scales, social class, and youth unemployment allegedly provide alternative explanations of the observed earnings advantage of the more educated or have been used to cast doubts on the social role of schooling. Such explanations are, at first sight, intuitively plausible and have often influenced the decision of policymakers and administrators against spending on schooling. Also, what might be partially true in the case of highly advanced industrial countries is often casually extrapolated to apply in developing countries.

To the careful reader of the literature, however, the challenges to the beneficial role of education in development are mostly superficial and in most cases have not been rigorously tested, especially in developing countries. Thus, the screening hypothesis (Taubman and Wales 1973) diminishes in importance when reference is made to the self-employed or the direct social product of education in agriculture (Jamison and Lau 1982). The job competition model (Thurow 1972) has never addressed or considered the possibility of a more educated person being more productive within a given occupational title.

The popular labor market segmentation or duality hypothesis (Gordon 1972) has faded away, following the critique by Cain (1976). When a distinction is made between nonclearing and competitive labor markets, as mentioned earlier, it is found that wage differentials in the public sector understate the true productive advantage of the more educated as the latter is measured by earnings differentials in the competitive private sector (Psacharopoulos 1982). In the sociological literature, social class is not the main determinant of earnings, net of the effect of education (Psacharopoulos and Tinbergen 1978). And unemployment does not permanently diminish the earnings advantage of the more educated because it is a sharply declining function of time since graduation, often measured in terms of weeks rather than years (Psacharopoulos and Sanyal 1981). When reference is made to developing countries, the argument for investment in schools and training becomes even stronger given the relative scarcity of human capital and the low score of such countries on any indicator of educational development.

NOTES

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2.   For a proof of this and related growth accounting derivations, see Selowsky (1969), Robinson (1971), and Psacharopoulos (1972).

3.   For a proof of this proposition, see Psacharopoulos (1973: 113-14). For the most elaborate discussion of the differences between the two methods, see Bowman (1964).

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