IV.A. EDUCATION

Note IV.A.1. Three Views of the Contribution of Education to Economic Growth

It is possible to think of the role of education in a production process in at least three different ways. These correspond to three different views of how education contributes to economic growth.

First, we can think of uneducated and educated workers as perfectly substitutable inputs to production. Two workers who have completed primary school, say, are equivalent to one worker who has completed secondary school. Put differently, labor is homogeneous and can be measured in terms of "efficiency units." Holding constant the number of actual workers, an increase in the average level of education of the labor force increases the size of the labor force measured in efficiency units. This increase in the number of efficiency units per worker generates greater output per worker since labor is an input to production. Growth in the average years of schooling per worker is thus associated with growth in output per worker.

Second, uneducated and educated workers can be seen as imperfectly substitutable inputs to production. In constructing a suspension bridge, say, three (or 30) workers with a primary school education cannot replace one civil engineer. With educated and uneducated labor treated as different inputs, different production processes can be thought of as making more or less intensive use of educated relative to uneducated labor. If the aircraft and the apparel industries face the same costs of hiring educated and uneducated labor, the aircraft industry will employ a higher ratio of educated to uneducated workers because of the nature of its production process compared with that of the apparel industry. As we saw in Selection III.A.2 by Deardorff and in the following Comment, increasing the number of educated workers helps a country to "move up the ladder" to production of more technologically sophisticated goods. Consider the following newspaper report on Thailand (Stier 1993):

> In the past decade, Thailand's economic growth has been fueled by export-oriented industries dependent on an abundance of low-skilled, low-wage workers. But those industries have lost much of their competitive advantage because Thai wage increases have outpaced labor costs in other developing Asian nations—including China, Indonesia, Vietnam and India—that are now competing in international trade. Thus within a relatively short period of industrialization, Thailand is under pressure to make a transition to more sophisticated, higher-skilled industries. . . . A serious problem for Thailand in taking the economy to a higher level is that the education and skill of the work force has not kept pace. More than 80% of Thai workers in a labor force of 34 million has a primary school education or less. Only about 4% of school-age youth make it through universities. Thailand has a shortage of skilled workers across the board—from doctors to auditors and engineers to middle managers. . . . Analysts say it could be years before Thailand's education system produces enough skilled workers for the next stage of industrialization.

Lack of educated workers is also seen as an obstacle to the continued rapid economic growth of Thailand in Selection IV.A.2 by the World Bank.

An industry's production process could make intensive use of educated labor because it requires sophisticated monitoring and quality control, say, or because technology is rapidly changing and highly educated workers are needed to learn it. Generalizing from the latter case, the role of educated labor in any production process can be seen as learning or creating technology that generates more output holding levels of inputs constant, rather than as an input itself. This leads to the third view of the contribution of education to the economic growth of less developed countries: it helps them absorb foreign technology.

Jess Benhabib and Mark M. Spiegel (1994) report evidence in favor of this third view and against the first view that education is a direct input to production. In cross-country regressions they found that growth of GDP per capita from 1965 to 1985 was not significantly af-

fected by *growth* in average years of schooling in the labor force during that period, but was positively affected by the *level* of average years of schooling in 1965. They interpret the positive effect of the initial level of education as measuring the ability to absorb technology from abroad and create appropriate domestic technologies during the following 20 years, and interpret the lack of any effect of growth of education as showing that education is not a direct factor of production like physical capital. However, other research has cast doubt on both the results of Benhabib and Spiegel and their interpretation. Alan B. Krueger and Mikael Lindahl (2001) show that the measure of the growth of schooling used by Benhabib and Spiegel is unreliable, tending to bias estimates of its impact on growth of per capita GDP toward zero. Lant Pritchett (2003) argues that the failure of per capita GDP growth rates to increase despite the continued increase in the average level of schooling (see Exhibits I.B.1 and I.B.2) means that Benhabib and Spiegel's finding of a positive association between the initial level of education and subsequent growth must not reflect a true causal relationship.

In the international trade literature there is considerable evidence that as less developed countries catch up to the education levels of more developed countries, they "move up the ladder" from exports of products that intensively use uneducated workers to exports of products that intensively use educated workers (see, e.g., Romalis 2004). Yet little work has been done to connect this international trade evidence to growth in output per worker in manufacturing and ultimately to growth in GDP per capita. In conclusion, we judge that the three views of the contribution of education to economic growth described in this Note are as yet insufficiently precisely formulated and inadequately tested to inform educational policy.

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Selection IV.A.1. Economic Impact of Education*

In this paper I review the evidence on the economic impact of education produced in the past thirty years and compile a number of lessons from the literature that might be useful to policy makers. And since no field is without controversy, I also review the major debates that have surrounded human capital theory and its applications.

The Evidence

The evidence on the economic impact of education can be divided into two distinct types: micro and macro.

Micro

If expenditure on education is a kind of investment leading to the formation of human capital, either for the individual or for society at large, one should be able to estimate the rate of return to this investment. In its most simplified form, the rate of return to investment in education (r) can be estimated by dividing the permanent annual benefits stream due to education ($Y_1 - Y_0$) by the cost of obtaining such education ($Y_0 + C_1$),

$$r = \frac{(Y_1 - Y_0)}{S(Y_0 + C_1)}$$

In this case Y_1 and Y_0 could refer to the mean earnings of workers who are literate and illiterate, respectively, S to the number of years of schooling it takes for someone to become literate, and C_1 to the annual cost of keeping someone in school. Note the appearance of Y_0 in the denominator of the expression, representing the opportunity cost of attending school rather than working in the labor market.

There are several ways to examine rates of return to education: by whether the returns refer to the individual investor or to society at large, namely, the private or social rate of return; by the country's level of economic development; by the type of curriculum—say, general or vocational secondary education; by type of economic sector the worker is in, say, modern wage employment or self-employment; and by gender.

Hundreds of studies have been conducted in the past thirty years on the profitability of investment in education in a large number of countries across the dimensions cited above (for a summary see Psacharopoulos 1985). Figures 1 and 2 offer an impressionistic summary of the results of these studies. The figures are impressionistic in the sense that I want the reader to focus on the structure of the returns to education rather than the exact percentage points represented by the vertical axes. As a point of reference I give an illustrative 10 percent opportunity cost of capital or alternative discount rate. This might be more realistic in a developed country than in a developing country, although the 10 percent rate could be defended in a developing country setting if the country could borrow internationally for investment in education at this interest rate.

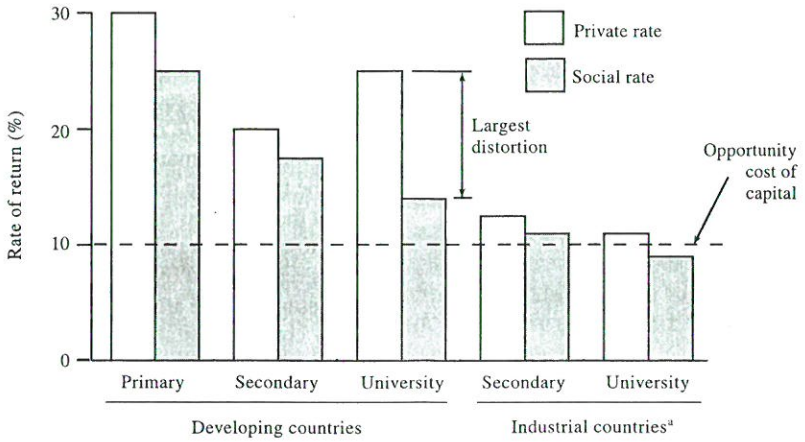
The first notable result of the application of rate of return studies to education is that the rates are not far off the yield of more conventional investments. The returns to investment in education in advanced industrial countries are roughly the same as those of investment in physical capital. By contrast, the returns to education in developing countries stand at a much higher level relative to industrial countries. This reflects both the continuing scarcity of human capital in poorer countries and barriers to the allocation of funds to human capital investment, so that the returns to any kind of capital (physical or human) equalize at the margin.

A typical pattern, found since the early days of rate of return estimation in education, is that returns decline by level of schooling. Thus, returns to primary education are higher relative to returns to secondary education, and the latter are higher than returns to university education. This finding, corroborated in study after study, has fundamental policy implications.

Another result worth noting is the difference between social and private rates of return. Because of the public subsidization of education in all parts of the world, private rates are typically several percentage points higher than social rates of return. By definition, the cost in a private rate-of-return estimation refers only to what the individual pays out of his or her pocket, whereas the cost in a social rate of return estimation refers to the full resource cost of someone attending school. The distortion incurred by the public subsidization of education means that, in some instances, individuals will find it profitable to pursue education to a given level whereas, from the point of view of society, this investment is not profitable. The maximum distor-

*From George Psacharopoulos, *The Economic Impact of Education: Lessons for Policymakers* (San Francisco: ICS Press, 1991), pp. 8–15. Reprinted by permission.

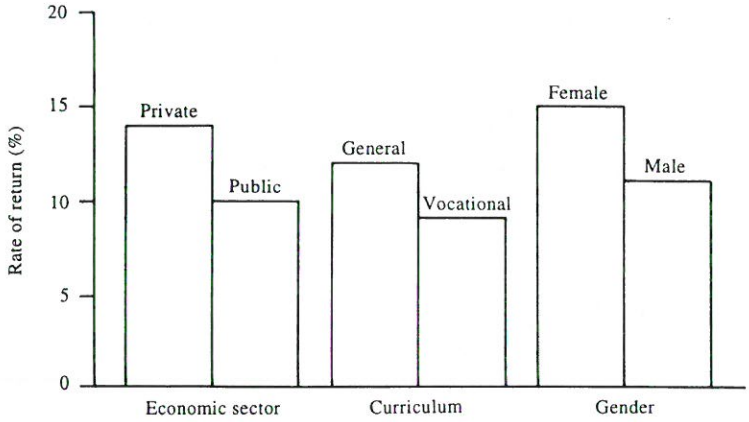
Figure 1. The returns to investment in education by level and country type.



[a]The rate of return for primary education in industrial countries is undefined because of universal enrollment at this level of schooling.

Source: Based on Psacharopoulos 1985.

Figure 2. The returns to education by economic sector, curriculum type, and gender.



Source: Based on Psacharopoulos 1985.

tion between the private and the social rates refers to education at the university level. This level is more heavily subsidized in most countries relative to any other level.

Figure 2 presents three additional rate-of-return patterns that have been found in studies in many countries, irrespective of whether the rate of return is social or private. The first comparison shows that the return to education is typically higher in the private or competitive sector than in the public sector. It is well known that the public pay structure is very compressed, leading to a lower rate of return relative to estimates based on earnings in the private sector, where there is no limit to rewards. To the extent that private sector earnings truly approximate a worker's productivity, rates of return based on earnings in the competitive sector provide a better fix for the scarcity of human capital than rates of return based on civil service pay scales. The latter, however, are very important for explaining the private behavior of individuals in seeking different levels and types of education. Given the dominance of the public sector in hiring university graduates in any kind of country, a private rate-of-return estimation using civil service data is very appropriate, if not a must, in understanding the demand for university education. However, a private earnings base would be more appropriate for setting priorities for educational investment in a given country.

The second pattern in Figure 2 provides a well documented yet highly counterintuitive finding:

within a given level of education, say, secondary schooling or university education, the more general the curriculum the higher the returns to education. This startling finding is due to two factors. First, the unit cost of vocational education, at any level, is higher than that of general education, because of the more specialized faculty and equipment that vocational education entails. Second, graduates of general programs are more flexible in fitting a wide spectrum of occupations—and perhaps are more easily trained on the job—than graduates of vocational programs that are earmarked to enter a particular occupation (to put it at the extreme, mechanical watch repairers).

The last pattern presented in Figure 2 refers to the worker's gender. Investment in the education of females often yields a higher rate of return than investment in the education of males. This finding could also be considered counter-intuitive, in the sense that males typically earn much more than females. One must remember that the rate of return to investment in education is a *relative* concept, comparing the *difference* between more- and less-educated workers with the cost of their education. A major component of the cost is the forgone earnings of the worker while studying, which can lead to a higher rate of return for females than for males.

Macro

If investment in education yields returns at the individual or social level, this must be reflected at the level of the economy. Growth accounting in the post-World War II period was based on the so-called aggregate production function.

$$\text{Output} = f(\text{Land, Labor, Capital})$$

expressing a country's output (measured by gross domestic product) as a function of the traditional triad of factors of production: land, measured in terms of cultivated area; labor, measured in terms of the number of persons or man-hours worked; and capital, measured in terms of the value of the physical plant in operation. Fitting the above relationship to time-series data for the United States left a huge unexplained residual, named "the coefficient of our ignorance." Output grew much faster than increases in the traditional factors of production could account for. Relabeling the residual "technical change" was simply begging the question "what determines technical change?"

It was then that Schultz (1961) and Denison (1967), using computationally different although conceptually similar approaches, introduced the quality of labor or human capital into the traditional production function. Schultz, for example, plugged in the amount of investment represented by expenditures on education and explained a great part of the previously puzzling residual. The macro approach has been replicated by others over the past thirty years with similar results.[1]

Figure 3 shows that in Africa, investment in education explains nearly twice the proportion of economic growth that it does in more affluent Europe and North America. This macro result essentially replicates the rate-of-return structure by country type presented above, given that human capital is much scarcer in the poorer countries.

Beyond the results cited above, which have been generated by econometricians, economic historians took a stab at the matter by taking a much longer-term view than sophisticated statistical analysis permits. Thus it has been established that bouts of long-term economic growth were preceded by increases in the population's literacy level. The examples of Japan and Korea are the classic cases in which an educated population base has provided the necessary infrastructure for industrial advances to take place at a later date (see Saxonhouse 1977 and Easterlin 1981).

Wider Social Impact

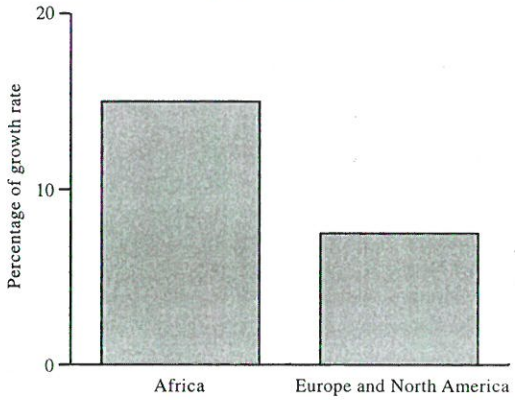
Beyond the above "strict" or monetary impact of education, investment in human beings also has many other social values. Some come under the heading of externalities—namely, values captured by persons other than the individual investor. Others are labeled "nonmarket effects" (for a superb account of this see Haveman and Wolfe 1984). And others are simply means or mechanisms by which the overall impact of education is realized.

When a person becomes literate, this person will enjoy a higher lifetime consumption path, according to statistics for a large number of countries. Others will also benefit if the country has a more literate population—through lower transaction costs than if they were dealing with illiterates, for example.

Many educated females may choose not to participate in the labor force. This does not mean, however, that such females are not more productive (relative to their less educated counterparts) in the variety of goods and services produced within the household that are not readily marketable. For example, they may provide better sanitation conditions for all members of the family and more nutri-

[1]For a review see Psacharopoulos (1984).

Figure 3. The contribution of education to economic growth by continent.



Source: Based on Psacharopoulos 1984.

tional meals. Such effects should be counted as part of the social impact of education.

Education increases the opportunity cost to a woman staying in the household and induces her to participate in the labor market. This contributes to overall efficiency in the economy to the extent that her market wage is higher than her implicit, shadow wage of being engaged in household activities.

Migration is an illustrative example of the means by which the returns to education are realized. To the extent that education makes the worker aware of employment opportunities elsewhere, or simply makes him or her employable in other contexts, it will instigate a more efficient allocation of labor to the most productive uses.

Health status is a very important part of human well-being. Several studies have shown that literacy and other measures of education are more closely correlated with life expectancy than per capita income is. The mechanism of this relationship is that education helps determine both the level of knowledge about how to combat disease and the ease with which it can be transmitted and utilized (Cochrane, O'Hara, and Leslie 1980).

The relationship between education and fertility is a very complex one, although most observers would agree that the link is negative—that increased literacy and school attendance in general delay marriage and increase the opportunity cost of having children. Consequently, families desire and have fewer children. This has been clearly demonstrated in urban areas on a global scale (see Cochrane 1979).

Last but not least, another often mentioned wider effect of education is that of having a more informed body of consumers and a literate electorate, leading to democratic government.

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Comment IV.A.1. Updated Estimates of Returns to Investment in Education

The author of this selection, George Psacharopoulos, has updated his findings twice: first in George Psacharopoulos, "Returns to Investment in Education: A Global Update," *World Development* 22, no. 9 (1994): 1325–1343, and second in George Psacharopoulos and Harry A. Patrinos, "Returns to Investment in Education: A Further Update," World Bank Policy Research Working Paper No. 2881 (September 2002). For the first update he concludes, "The results of this update are fully consistent with and reinforce earlier patterns. Namely, primary

education continues to be the number one investment priority in developing countries, educating females is marginally more profitable than educating males, [and] the academic secondary school curriculum is a better investment than the technical/vocational track" (p. 1335). These conclusions are not changed by his second update.

In both updates Psacharopoulos takes care to distinguish between the returns to investment in education, as defined in this selection, and the percentage increase in earnings due to an additional year of schooling, which is conventionally called "the return to education" in the economics literature. The latter is equal to the coefficient on years of schooling in a regression of the logarithm of earnings on years of schooling and control variables. Neither the private nor the social cost of schooling is taken into account in these estimates of "the return to education."

Comment IV.A.2. Ability Differences, Spillovers, and the Returns to Investment in Education

The returns to investment in education reported by Psacharopoulos in Figure 1 of the preceding selection are computed using the differences in average earnings between workers with and workers without a given level of education. These computations are based on the implicit assumption that the average innate abilities of the more and less educated groups of workers are the same, and therefore have no effect on the average earnings differential. This assumption is accurate if the only cause of differences in educational attainment is differences in the resources to which the workers had access when students: for example, whether or not primary schools were present in their villages, as in Selection IV.A.3 by Esther Duflo. Suppose, to the contrary, that another cause of differences in educational attainment is differences in ability: high-ability students graduate from secondary school, say, while low-ability students drop out. In this case part of the higher earnings of secondary school graduates reflects their higher ability, and the return to secondary education is overestimated.

The ability bias argument suggests that the social returns to investment in education may not be as high relative to those on alternative investments as Figure 1 in Psacharopoulos's selection implies. However, this argument probably does not work against Psacharopoulos's claim that social returns to investment are greatest for primary education and least for university education. If anything, one would guess that ability bias in estimates of the return to education increases with the level of education, since the extent to which school attendance is compulsory decreases. We should also note that in the article from which Selection IV.A.3 is drawn, Esther Duflo finds no evidence of ability bias in the conventional estimates of the "return to education."

One can also argue that earnings differentials *under*estimate the social return to investment in education. People learn from those around them, so if I have an education I improve the learning environment for my co-workers. This positive spillover or "human capital externality" is not captured by the computations behind Figure 1 in Psacharopoulos's selection. Evidence for the existence of such spillovers in the United States is given by James E. Rauch, "Productivity Benefits from Geographic Concentration of Human Capital: Evidence from the Cities," *Journal of Urban Economics* (November 1993). He finds that workers earn more, the higher is the average level of education in their city, controlling for their individual characteristics and other important attributes of the city. Again, the implications of this argument for the relative returns to investments in different levels of education are unclear. If this spillover is most important for learning new technology it may have the greatest impact on the social return to university education.