# Commentary: Human Capital and Economic Growth

*Lawrence F. Katz*

Robert Barro has written an extremely informative paper that explores the role played by human capital as proxied by educational attainment in explaining cross-country differences in economic growth rates. Previous research has been hampered by the lack of comparable data on educational attainment for a large sample of countries. Barro's innovation in this paper is to use improved data on educational attainment to compute a measure of the average years of schooling of the adult population for a large number of countries for the 1960-85 period. This new data, constructed by Barro and Jong-Wha Lee, allow him to more carefully examine the links between human capital and growth than has previous research.

The major empirical finding is that the educational attainment of a country's adult population is strongly positively related to that country's subsequent growth rate of per capita gross domestic product (GDP). A 10 percent increase in educational attainment is associated with an increase in the growth rate of 0.2 percent a year. Barro finds that increased educational attainment increases growth by three primary routes. First, education has a direct effect on growth even after controlling for measures of a nation's fertility rate and rate of investment in physical capital. This direct effect is likely to reflect a positive effect of a more educated labor force on a nation's ability to adopt and develop new technologies. Second, increased educational attainment is associated with increased physical capital investment. This factor may be of greater importance in the future since the skills of a nation's labor force are likely to be crucial in attracting internationally mobile

capital in an increasingly globalized economy. Third, a more educated population tends to have a lower fertility rate and plausibly more intensive parental investment in each child.

These findings are quite similar to those of previous research using enrollment rates for primary and secondary schools as crude proxies for more direct measures of adult educational attainment (for example, Barro [1991], Mankiw, Romer, and Weil [1992]). The evidence is potentially consistent both with the standard neoclassical growth model and with endogenous growth models, such as the model developed by Lucas (1988), that emphasize the importance of human capital externalities. The cross-country data basically imply that human capital and physical capital investment tend to go together and are both associated with faster national growth conditional on initial income. Although the positive association of educational attainment and growth seems robust, one must be somewhat cautious in providing a causal interpretation to this relationship since national educational policies are almost certainly strongly related to many omitted variables likely to be related to economic growth.

I will attempt to make three primary points in the remainder of my discussion. First, rnicroeconomic and macroeconomic research on the links between education and productivity appear quite consistent with each other and are strongly suggestive of a causal interpretation of Barro's finding of positive effects of educational investments on economic growth. Second, rnicroeconomic evidence on neighborhood effects on educational attainment provide some support for the view that human capital externalities may play a role in the strong empirical relationship between education and growth. Third, widespread investments in education appear not only to be associated with faster growth but also with a more egalitarian distribution of the fruits of economic growth.

## How productive are educational investments? Microeconomicevidence

Much microeconomic research by labor economists has attempted to find plausible empirical approaches to determine the extent to which formal education improves worker productivity and the extent to

which the productivity effect of education depends on the inputs in the educational system (school quality). A huge empirical literature exists documenting a strong positive relationship between years of schooling and earnings. More educated workers earn more, and the implied rate of return is as large as estimates for investments in physical capital. Nevertheless, the usual cross-section regressions do not necessarily answer the causal question of whether education increases productivity and earnings. It has often been argued that the results are driven by selection: the more able get more education and would earn more than others even in the absence of more education. Education is often portrayed as a signal rather than as an investment that increases productivity. The major problem in micro empirical work is that it is difficult to completely control for worker ability.

There has been a recent revolution in micro empirical work on education and earnings that uses *credible natural experiments* to assess effects of education on earnings and hence productivity. This work attempts to get around the ability bias problem by using variation in education that can plausibly be argued to be uncorrelated with innate worker ability.

One excellent example is work by Angrist and Krueger (1992) using the Vietnam-era draft lottery as a natural experiment to estimate the return to education. In the early 1970s, priority for military service was randomly assigned to draft-age men in a series of lotteries. Many who were at risk of being drafted managed to avoid military service by enrolling in school and attaining an educational deferment. Thus variation in an individual's draft-lottery number generated variation in incentives for additional educational investment that is almost certainly not correlated with underlying worker ability since draft numbers were drawn at random. Angrist and Krueger find that an extra year of schooling acquired in response to the lottery is associated with a substantial increase in earnings similar to standard cross-section estimates of the returns to schooling.

Other plausible recent approaches taken to identifying the effects of education on earnings include the use of the differential constraints imposed on individuals born in different months of the year by compulsory schooling laws (Angrist and Krueger [1991]) and the use

of twins to control for unmeasured family background factors (Ashenfelter and Krueger [1992]). The new studies all seem to find large effects of schooling on earnings that appear best explained by a human capital interpretation that schooling directly raises worker productivity. In fact, estimates of the returns to schooling are greater from new natural experiment approaches than from traditional ordinary least square estimates of earnings functions.

Another area where the new research approach has made progress is the analysis of the effects of school quality on the outputs of the education system. The traditional view is that there is no solid evidence that inputs into public schooling improve student performance and outcomes (for example, Hanushek [1986]). Family background variables and school quality measures tend to be highly collinear so that the independent effects of school quality are difficult to determine. Better designed new evidence examining both earnings and test scores as output measures shows strong, plausible effects of inputs (pupil/teacher ratios, teacher quality, length of school year) on earnings, educational achievement, and test scores.

For example, Card and Krueger (1992) use arguably exogenous variation in educational inputs, arising from segregated schools in the South in the first half of the twentieth century and mandated improvements in the relative school quality of black schools, to assess the effects of school quality on earnings. They find that reduced pupil/teacher ratios, increased term lengths, and higher relative wages of teachers are associated with increased economic returns to education for students. Furthermore, a large-scale randomized study of class sizes in Tennessee finds that reductions in the pupil/teacher ratio for elementary school students significantly increase test scores on reading and math tests (Finn and Achilles [1990]).

The micro evidence and macro evidence appear consistent. Schooling appears to increase productivity and earnings at the individual level, and thus can plausibly be related to increased growth at the national level. The cross-country evidence also indicates that one of the routes by which education increases national growth rates is by facilitating increased greater investment in physical capital and new technologies. The micro cross-section evidence again is consistent

with this inference since industries and firms that invest more in new technologies (especially computer-based technologies) are also those that tend to have highly-educated labor forces (for example, Berman, Bound, and Griliches [1992]).

## Human capital externalities

Robert Lucas (1988) and other contributors to the "new" growth theory have developed models of economic growth with human capital externalities that help explain some aspects of international capital flows and factor ratio differences that are puzzling for the standard Solow growth model. The basic idea is that the productivity of a worker at any skill level is increased by working in an environment where other workers have greater human capital.

The microeconomic counterparts of the aggregate human capital externalities emphasized by the new growth theorists are the "neighborhood effects" emphasized by sociologists such as William Julius Wilson and the "social capital" concept associated with James Coleman. Recent empirical research using data sets that combine information on individuals with the socioeconomic characteristics and behaviors of their residential neighbors, family members, and schoolmates provides fairly strong empirical support for the notion of significant neighborhood effects in educational attainment and other measures of human capital accumulation and labor market performance (for example, Case and Katz [1991] and Crane [1991]).

Although one must worry whether strong findings of spillovers in neighbor's outcomes and investments could be the spurious result of the mechanisms by which families get selected into residential neighborhoods, a recent natural experiment provides some evidence that causal factors may be at work. The Gatreaux program in Chicago helps low-income black families move from public housing to low-income private-market housing in the Chicago metropolitan area. The program provides no counseling, training, or services; it simply helps families move from public housing to new neighborhoods. Some families get moved to neighborhoods in the central city; others get moved to more affluent neighborhoods in the suburbs. Because participants usually take the first apartment offered and unit availability

usually provides no choice of geographic location, there are essentially no systematic differences between suburban and city movers. Evaluations of this program find that relocation to suburban neighborhoods rather than city neighborhoods has significant benefits for mothers and their children (Rosenbaum and Popkin [1991] and Jencks [1992]). Since this natural experiment provides essentially random assignment to neighborhoods, it provides strong evidence of the potential importance of neighborhood effects.

The existence of human capital externalities suggest that education, health, and other human capital investments may have quite high social returns and are supportive of acausal interpretation of the strong link between education and growth uncovered by Barro.

## Education, growth, and distribution

Broad-based investments in mass education not only appear to be associated with rapid economic growth but also with a widespread distribution of the benefits of economic growth.

A stylized fact from development economics is the "Kuznets curve" relationship in which industrialization initially leads to widening income inequality and eventually leads to a narrowing of income inequality. But recent work by Juan Luis Londoño (1990) indicates that a key factor in the link between economic development and income inequality is the rate of investment in schooling. A rapid increase in the supply of more educated workers tends to narrow wage differentials by skill. Industrialization can be associated with a more equal distribution of economic resources if accompanied by increased access to education. Countries that invest heavily in widespread education, such as Taiwan and South Korea, appear to grow extremely rapidly and to generate much more equal income distributions than do countries that industrialize in a more unbalanced manner with heavy investments in physical plant and equipment and less emphasis on education. Thus increased investments in education have the potential to produce a "win-win" situation of strong economic growth and a more equitable distribution of economic resources.

The relative earnings of college graduates and other measures of

educational wage differentials have expanded substantially in many Organization for Economic Cooperation and Development (OECD) countries during the last decade (Katz, Loveman, and Blanchflower [1992] and Davis [1992]). These increases in skill differentials are associated with a strong secular shift in relative labor demand favoring more educated workers and workers with problem-solving skills (Katz and Murphy [1992]). This shift in labor demand is driven by two primary forces. The first is the increased globalization of OECD economies and the ability to transfer many production and routine clerical tasks abroad. The second is skill-biased technological changes largely arising from the "computer revolution." Countries, such as Germany and Japan, that invest heavily in the education and training of large segments of their labor forces, including non-college workers, appear to have been able to adjust to these changes without the sharp increases in wage inequality observed in the United States.

The relative wage trends and employment shifts observed in most OECD nations strongly suggest that the returns to increased educational investments are currently very high. One approach, at which the United States has been successful, is increasing the fraction of young people that get college educations. Nonetheless, we need to invest more heavily and more wisely in the education and training of those that don't go to college to make sure the benefits of economic growth are broadly shared in the future.

# References


Angrist, Joshua D. and Alan B. Krueger. "Does Compulsory Schooling Affect Schooling and Earnings? ***Quarterly Journal of Economics*** 106 (November 1991), pp. 979-1014.

_____ and _____. "Estimating the Payoff to Schooling Using the Vietnam-Era Draft Lottery." NBER Working Paper #4067, May 1992.

Ashenfelter, Orley and Alan B. Krueger. "Estimates of the Economic Return to Schooling from a New Sample of Twins." NBER Working Paper, #4143, August 1992.

Barro, Robert J. "Economic Growth in a Cross Section of Countries." ***Quarterly Journal of Economics*** 106 (May 1991), pp. 407-43.

Berman, Eli. John Bound, and Zvi Griliches. "Changes in the Demand for Skilled Labor within U.S. Manufacturing Industries: Evidence from the Annual Survey of Manufacturing." Unpublished paper, Harvard University, August 1992.

Card, Davidand Alan B. Krueger. "School Quality and Black-White Relative Earnings: A Direct Assessment," ***Quarterly Journal of Economics*** (February 1992), pp. 151-200.

Case, Anne C. and Lawrence F. Katz. 'The Company You Keep: The Effects of Family and Neighborhood on Disadvantaged Youths," NBER Working Paper #3705, May 1991.

Crane. Jonathan. "The Epidemic Theory of Ghettos and Neighborhood Effects on Dropping Out and Teenage Childbearing." ***American Journal of Sociology*** 96 (March 1991).

Davis, Steven J. "Cross-Country Patterns of Changes in Relative Wages," NBER Working Paper #4085, June 1992.

Finn, Jeremy D. and Charles M. Achilles. "Answers and Questions about Class Size: A Statewide Experiment," ***American Education Research Journal*** 27 (Fall 1990), pp. 557-77.

Hanushek, Eric. 'The Economics of Schooling: Production and Efficiency in Public Schools," ***Journal of Economic Literature*** 24 (September 1986). pp. 1141-77.

Jencks, Christopher. "Can We Put a Time Limit on Welfare?" ***The American Prospect*** (Fall 1992), pp. 32-40.

Katz, Lawrence F., David Blanchflower, and Gary Loveman. "A Comparison of Changes in the Structure of Wages in Four OECD Countries." Unpublished paper, NBER, July 1992.

_____ and Kevin M. Murphy. "Changes in Relative Wages, 1963-1987: Supply and Demand Factors," ***Quarterly Journal of Economics*** 107 (February 1992): 35-78.

Londoiio, Juan Luis. "Income Distribution during the Structural Transformation: Colombia, 1938-1988." Ph.D. dissertation, Harvard University, 1990.

Lucas, Robert E. "On the Mechanics of Economic Development," ***Journal of Monetary Economics*** 22 (1988), pp. 3-42.

Mankiw, N. Gregory. David Romer, and David N. Weil. "A Contribution to the Empirics of Economic Growth," ***Quarterly Journal of Economics*** 107 (May 1992), pp. 407-37.

Rosenbaum, James E. and Susan J. Popkin. "Employment and Earnings of Low-Income Blacks Who Move to Middle-Class Suburbs?" in C. Jencks and P. Peterson, eds., ***The Urban Underclass.*** Washington, D.C.: The Brookings Institution, 1991, pp. 342-56.