The Private and Social Values of Education

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Economists (and others) have generally had little success in estimating the social effects of different investments, and, unfortunately, education is no exception.

—Gary S. Becker, Human Capital

The private monetary return to education is one of the most widely studied empirical magnitudes in economics. The consensus estimate is that the private financial return to acquiring an education is quite substantial—in the range of 8–15 percent per year of schooling. That is, an additional year of schooling typically raises an individual's earning power between 8 percent and 15 percent. Recent data indicate that four years of college education raise earnings by about 65 percent, a return of around 13 percent per year, compounded.

These returns are at least as large as typical returns on other forms of risky investment. No surprise there, as people have many ways to invest, and we expect returns to equalized across competing alternatives. Yet the magnitude of the private returns to investments in schooling presents an economic puzzle: If schooling provides such substantial returns to those who acquire it, *why is public funding of education virtually universal?* That is, if the financial rewards are so large, why do governments feel the need to subsidize it?

To an economist, a positive case for government subsidies to education, or public provision of education (or anything else), requires the *social* benefits of schooling to be larger than the private ones. In the presence of such an "externality," individual actors— who weigh private benefits and costs in deciding whether another year of schooling is worthwhile—will choose "too little" education compared to the social optimum. They ignore the social benefits received by *others* in making their decisions. Then government can improve things by subsidizing schooling or by other policies (such as minimum schooling requirements) that encourage individual investments in education. The near ubiquity of public educations suggests that these external benefits of education may be important. Yet as Becker's comment from 30 years ago indicates, hard evidence for a difference between private and social benefits of education is hard to come by.

These issues are also important for understanding the role of education and other forms of human capital in the process of economic development. Do countries or regions that invest heavily in human capital—say, by raising the average educational attainment of their workforces—enjoy unusually high rates of economic growth? The answer to this question appears to be yes, as I will show here. From this, it may appear that the path to local and national economic development is through public policies that encourage investments in education. This view would receive compelling support from evidence that the social returns to education—the measurable impact of raising average schooling of workers on productivity and earnings—exceeds the private return, and a number of recent empirical studies have argued this is the case. This paper provides contrary evidence, however, that indicates the social returns to schooling *as reflected in productivity and earnings* are not much larger than private ones. The conclusion is that a case for proactive public policies to encourage education does not get much support from data on growth of incomes and productivity.

PRIVATE AND SOCIAL RETURNS: A TAXONOMY

The efficiency of market outcomes typically turns on whether private benefits and costs are equal to their social values. The private returns to schooling can take many forms. The most obvious and most studied benefit is higher earnings, which economists typically interpret as a measure of the greater productivity of more educated individuals. But there are a number of plausible nonmonetary returns as well. Education may also increase productivity in nonmarket activities, such as home production; it may make parents into more efficient producers of children's human capital; and it may lead to more informed and effective consumption decisions. Other research shows that more educated individuals live longer—which itself has substantial economic value—and they report better health at any

particular age. Finally, education is itself often a consumption good, which, in turn, enables the consumption and enjoyment of human capital goods such as information, literature, and ideas. All of these benefits of education are enjoyed directly by the educated person, so they are elements of "private" returns that people would be willing to pay for.

Education Externalities

Recent economic research has emphasized the possibility of a divergence between private and social returns to education, which, in a nutshell, means that person A may benefit from person B's education. For example, an additional year of schooling for B may make A more productive. There are no consequences for efficiency when this type of "complementarity" occurs among employees of a firm, because the firm will take it into account in choosing how many people like B to hire and how much to pay them. Then the productivity effect is "internalized" by the firm, and outcomes are efficient. But Lucas (1988) and others have argued that A's gain from the greater education of B may be caused by social or other interactions that occur outside of firms: for example, in cities where ideas are "in the air." Then B's education confers a benefit on A—higher productivity and earnings—for which B is not compensated. Left to his own devices, B would choose too little schooling compared to the efficient outcome because the private value of a year of schooling (the financial gain to B) is smaller than its social value (the gains to A and B combined). Government intervention in the form of subsidies or minimal education requirements of citizens could make things better.

In this case, an additional year of schooling raises the level of economic activity more than its private return. For example, if the private return to schooling is 10 percent, and if average schooling in the workforce increases by one year, then private returns suggest that the economywide level of output will be 10 percent greater, all other things equal. But in the presence of this educational externality, the level of productivity will be even greater—say, 12 percent higher. The difference between the social return to a year of schooling (12 percent) and its private return (10 percent) is a measure of the external effect.

A related externality might affect economic *growth*. Because growth is largely determined by technological advances—new ways of doing things—and because more educated people may be better at producing and implementing new ideas, an increase in the level of education in an economy may increase the rate of economic growth. Individuals don't take this effect into account in making their educational choices, which can lead to too little education compared to the social optimum.

This discussion has focused on the productivity-enhancing effects of education, yet there are many other channels through which individuals' schooling choices may have external effects on others. Social insurance programs such as Medicare and Social Security collect taxes in order to pay for health care and retirement benefits. If more educated people are less likely to become ill, then additional schooling confers an external benefit on others because educated people are likely to require tax-funded medical care, so taxes are lower—a positive externality. But if they also live longer, they will collect more tax-funded retirement benefits—a negative externality. Empirical evidence also suggests that education reduces the likelihood that individuals will engage in criminal activities—a positive externality for those who are less likely to be victims of crime. Finally, to the extent that educated individuals are better informed, there are externalities through the political process as educated voters make "better" decisions.

When education creates positive externalities of the types just described, public funding or provision of schooling, or even compulsory schooling laws, can, in principle, move society closer to efficient outcomes. Left to themselves, individuals would choose too little schooling, and public participation in the process moves things in the "right" direction.

Can the Private Value of Education Exceed Its Social Value?

Economists are known for their ability to predict that almost anything can happen, and this area is no exception. Following Spence (1974), models of educational "signaling" conjecture that the private value of education could *exceed* its social value because employers use an individual's observed education to infer unobserved, innate characteristics, such as ability. Schooling can raise earnings (there is a private return to schooling investment) without raising productivity (there is no social return). Many of my MBA students at the University of Chicago firmly believe this is why they are in school: They are already much more productive than the next guy, they just need our degree to prove it to employers, who will pay them more for having an MBA. Evidence to support this theoretical possibility is scant, to say the

least, and it has lost favor among economists as a useful tool for analyzing educational choices or for policy analysis. My evidence also indicates that this effect is unlikely to be broadly important.

MEASURING PRIVATE RETURNS: A PRIMER

To make progress in calibrating the social returns to education, we need a benchmark estimate of the private returns. I will focus on evidence regarding the private *financial* returns to schooling, ignoring such issues as the value of education as a consumption good, its impact on health, and so on.

Estimates of the returns to schooling are typically garnered from data that record individuals' wages or earnings, years of schooling, and some measure of labor market experience. Assume that (1) the only cost of schooling is forgone labor market earnings while enrolled, and (2) the percentage increase in earnings caused by an additional year of schooling is constant over a person's lifetime. (These assumptions don't do too much violence to the facts.) Then the rate of return to an additional year of schooling is equal to the *percentage* increase in earnings caused by an additional year. So, if high school graduates earn 10 percent more than people with 11 years of education, on average, then our estimate of the rate of return is 10 percent.

The workhorse statistical model represented by this description can be written,

$$(1)\ \ln W_i = X_i\beta + S_i\rho + \varepsilon_i$$

where W_i is the wage of person i, S_i is the person years of completed schooling, X_i represents other observed factors (experience and the like), and ε_i represents unobserved determinants of wages. The parameter of interest is ρ, the private return to schooling, which is the percentage increase in the wage due to one more year of schooling. Equation (1) is probably the most-estimated econometric model in all of applied economics. Versions have been estimated for virtually any country and time period where data are available (graduate students have to earn PhDs, you know), controlling for various biases. Yet for all the effort applied to this question, the range of estimates is surprisingly small. A typical return to schooling is in the range of 5–15 percent, depending on country and time period, with somewhat higher returns in developing countries (Card 1999). As I have noted, these returns are comparable to returns on other forms of risky investment.

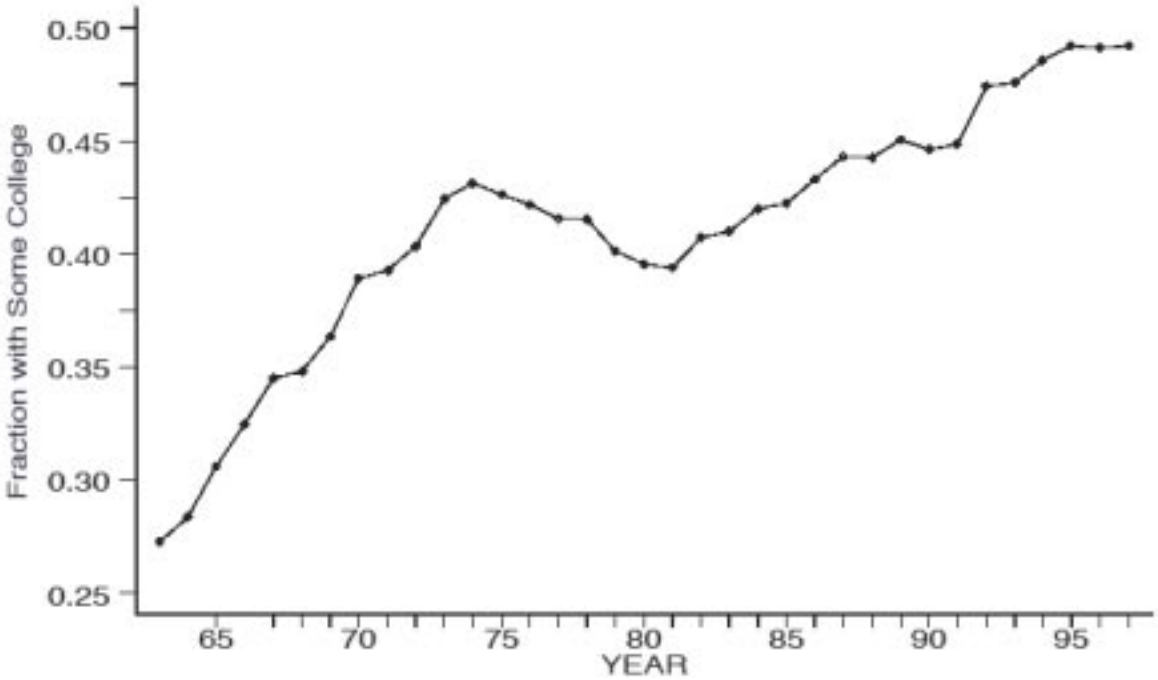
The recent economic history of wages in the United States provides a useful and important example for understanding the determinants of the private returns to schooling investments. Figure 1 graphs the percentage difference in wages between college-educated and high school–educated men in the United States since 1963. A telling feature of the data is the "break" that occurred around 1980: After 1980, the returns to schooling in the United States trended steadily upward and roughly doubled by the late 1990s. Calculating average annual rates of return from these data, the return to a year of college education rose from 7 percent in 1979 to over 14 percent in 2000. Other evidence (not shown here) establishes that these changes occurred at virtually all levels of measurable education and skill. For example, the increase in relative wages was even more pronounced among those with postgraduate education, whose wages rose sharply relative to graduates of four-year colleges. A large body of empirical research indicates that these changes in the relative prices of skilled (educated) workers are largely demand driven, reflecting technological changes that have favored skilled over less-skilled labor. Though I won't go into details here, this increase in the relative demand for educated labor is part of a broader trend toward increased wage inequality in the United States that began even earlier, around 1973.

When increased demand raises the return to skills, basic economics tells us that investment in skills will rise, just as more houses will be built when the demand for them rises. Here the predicted event is that more young people will attend college because the economic returns to a college education have risen. Figure 2 shows the proportion young people (ages 21–25) with at least one year of completed schooling, also beginning in 1963. After rising rapidly in the 1960s, this form of investment in human capital declined from the early 1970s to 1980—the period where the returns to college shown in figure 1 also fell. Beginning in 1980, however, the fraction obtaining college training steadily expanded, rising 10 percentage points by the late 1990s.

The response of educational investment illustrated in figure 2 is important because it suggests that the "problem" of rising wage inequality contains the seeds of its own solution. Rising inequality is evidence of the increased relative scarcity of skilled labor. But it is exactly

Figure 1: The College-High School Wage Premium

Figure 2: The Response of Educational Investment to Rising Private Returns to Schooling



Fraction of 21–25 Year-olds with Some College 1963–1997

this increase in the relative price of skill that provides the incentive for young people to invest in skills. In other words, the solution to the problem of rising inequality is to increase the relative supply of skilled workers, which, in the long run, would reduce the relative price (wage) of skilled labor. This requires investment—more people becoming skilled. Paradoxically, government efforts to combat rising inequality through redistributive tax policies or restrictions on wages will *reduce* the incentive to invest, which can only exacerbate the underlying forces that created inequality in the first place. The underlying problem is the scarcity of skilled labor; rising wage and income inequality is merely its symptom.

EDUCATIONAL EXTERNALITIES

If there are external benefits of private investments in education—as outlined previously—then the social returns to education will exceed the private returns. Efforts to measure these benefits have focused on the effects of education on productivity, income, and economic growth, so my discussion will ignore other nonmonetary returns. We then ask, if the private return to an additional year of schooling is, say, 10 percent, does the social return exceed 10 percent? To answer this question, we need a way to measure the social return, and, sadly, measuring social returns is not as straightforward as measuring private returns.

One approach, pursued in Topel (1999) and Lange and Topel (2004), among others, is to measure the returns to schooling in a national income growth accounting framework. Let y_{jt} denote output per worker in country j at date t, and let h_{jt} be the corresponding average amount of human capital (skills) per worker. With constant returns to scale, Lange and Topel (1999) write output per worker as

$$(2)\quad \ln y_{jt} = \kappa_j + \ln h_{jt} + \ln T_{jt}$$

where T_{jt} is total factor productivity in country j. According to equation (1), output per worker increases when workers become more skilled (more h) or when the state of technology in j makes workers of a given skill more productive (more T). Now let

$$(3)\quad \ln h_{jt} = X_{jt}\beta + S_{jt}\gamma^P + u_{jt}$$

and

$$(4)\quad \ln T_{jt} = S_{jt}\gamma^E + a_{jt}$$

In equation (3) S_{jt} is the average years of schooling per worker in country j, and X_{jt} is the other observable components of skill, such as experience. The parameter γ^P represents the private returns to schooling. If an additional year of schooling raises *individual* productivity by 10 percent ($\gamma^P = 0.10$), then an increase in the *average* years of schooling across all workers should increase the average productivity of workers by 10 percent as well. But if additional education creates positive externalities, the social return will exceed 10 percent, which shows up as an increase in total factor productivity. This effect is shown in equation (4), where the external benefit of an additional year of average schooling is represented by γ^E. The empirical question is whether $\gamma^E > 0$.

Combining equations (2)–(4) yields a tractable model of the effects of education on economic growth:

$$(5)\quad \ln y_{jt} = \kappa_j\ X_{jt}\beta + S_{jt}\ (\gamma^P + \gamma^E) + u_{jt} + a_{jt}.$$

In equation (5), $\gamma^P + \gamma^E$ is the social return to an additional year of schooling: the sum of the private and external effects of schooling on productivity. So equation (5) asks whether the impact of schooling on aggregate productivity is larger (or smaller) than its impact on individual productivity.

Table 1, taken from Topel (1999) shows estimates of $\gamma^P + \gamma^E$ derived from a sample of 111 countries at five-year intervals between 1960 and 1990.[1] In models that contain country and year effects, in column (3), the estimated social return to schooling is 0.10 per year of schooling. This is in the same range as the typical estimate of private returns, so there is no compelling evidence for positive educational externalities. On the other hand, table 1 provides little comfort to those who would argue that social returns are smaller than private ones, as implied by signaling models of educational choice.

Estimates of equation (5) are not an explicit model of economic growth, which can be achieved by taking first differences within a country:

$$(6)\quad \Delta\ln y_{jt} = \Delta X_{jt}\beta + \Delta S_{jt}\ (\gamma^P + \gamma^E) + \Delta u_{jt} + \Delta a_{jt}$$

Table 2 shows estimates for various specifications of equations (6)—again taken from Topel (1999)—where the growth interval is allowed to vary from five to 20 years. At a 20-year growth interval, the estimated impact of a one-year growth in average schooling per worker on average productivity is 0.246, which is vastly larger than

TABLE 1: THE EFFECTS OF EDUCATION ON LABOR PRODUCTIVITY FIXED COUNTRY EFFECTS, 1960–1990 (N=719)

	(1)	(2)	(3)	(4)
Avg. Years of Schooling	0.23		0.10	
	(22.67)		(6.21)	
Avg. Years of Primary Schooling		0.20		0.06
		(10.28)		(2.05)
Avg. Years of Secondary Schooling		0.28		0.14
		(7.62)		(5.76)
Country Effects	Yes	Yes	Yes	Yes
Year Effects	No	No	Yes	Yes
R^2	.46	.46	.58	.59

TABLE 2: THE EFFECTS OF EDUCATION ON PRODUCTIVITY AND GROWTH FIRST-DIFFERENCE ESTIMATOR AT VARIOUS GROWTH INTERVALS

(dependent variable: Δy_{jt})

	5-year growth (N=608)	10-year growth (N=290)	15-year growth (N=186)	20-year growth (N=101)	5-year growth fixed effects (N=604)	10-year growth fixed effects (N=290)
Δ Education:	0.115	0.115	0.155	0.246	0.022	0.086
ΔX_{jt}	(5.07)	(5.07)	(5.23)	(5.73)	(1.32)	(2.85)
Years of schooling	0.003	0.003	0.003	0.004	0.004	0.009
	(4.85)	(4.85)	(4.59)	(5.93)	(1.29)	(2.49)
Ln	–0.004	–0.004	–0.005	–0.009	–0.043	–0.047
output/worker:	(1.56)	(1.56)	(1.77)	(2.26)	(6.02)	(6.03)
$\ln y_{jt}\ \Delta X_{jt}$ x $\ln y_{jt}$	–0.060	–0.060	–0.041	–0.025	–0.020	–0.049
	(2.70)	(2.70)	(1.30)	(0.57)	(1.25)	(2.00)
R^2	.332	.332	.391	.399	.287	.493

Notes: t-statistics in parentheses. Based on Summers-Heston Mark 5.6 and Barro-Lee (1993) data. All models include year effects. Effects of ΔX_{jt} are evaluated at the mean level of $\ln y_{jt}$.

any estimate of private returns. This estimate implies implausibly large externalities, perhaps because other forms of investment are correlated with growth in average years of schooling.

Evidence from Local Data: States and Cities

A number of recent studies have sought evidence of human capital externalities from the spatial distribution of wages in the United States. The presumption in these studies (Rauch 1993; Acemoglu and Angrist 1999; Moretti 2003, 2004) is that the production externalities of education increase local wages. A prototype model of the wage of person i working and living in locale l is

$$(7)\quad \Delta \ln W_{li} = X_{li} B + S_{li}\,\gamma^P + \bar{S}_l \gamma^E + \varepsilon_{li}$$

where $\bar{S}_l$ is the average years of completed schooling for workers in l. Here the empirical question is whether greater *average* education in an area raises individual wages, after controlling for individual years of schooling, S_i. Evidence that $\gamma^E > 0$ is taken as evidence for externalities—the productivity of individuals is greater when those who work around them are more educated.

Lange and Topel (2004) argue that the assumptions needed to plausibly identify γ^E are unlikely to be satisfied, so that pretty much anything can happen. And it does—estimates of γ^E from various studies are all over the map, ranging from zero (Acemoglu and Angrist) to about 0.40 (Moretti 2004). The former estimate means there are noexternal benefits of education, while the

latter means that an additional year of average schooling raises the wage of the average worker about 50 percent. This is simply outside the range of plausibility.

Education and the Growth in U.S. States: 1940–2000

One of the most prominent facts about American economic growth in the second half of the twentieth century is "convergence." While real incomes in all areas of the United States grew dramatically, poorer states grew faster than rich ones, so that inequality of incomes *across* states and areas declined. This pattern of growth suggests three important questions. First, has growth in the education of the workforce contributed to growth in real incomes? The answer to this, almost incontestably, is yes. Second, can we explain the spatial convergence of real incomes as (at least in part) an outcome of convergence in levels of schooling? Again, the answer appears to be yes. Finally, related to externalities, has growth of education produced spillover effects that have raised productivity by more than the private returns to schooling? Here the answer appears to be maybe, but the evidence is not very compelling.

Figure 3 provides the most compelling evidence of convergence. It graphs the *change* in log real wages of men between 1940 and 2000 against the level of wages in 1940, based on census data.[2] The pattern is pretty obvious: Wages grew fastest in low-wage Southern states. The range of values indicates that growth among the poorest states in 1940 (Georgia, South Carolina, and Mississippi) was about a twice that of the richest states (California, Nevada, Michigan, and New Jersey). Suggestive evidence that education played a role is shown in figure 4, which is an identical graph for growth in average years of schooling of the workforce. The pattern is the same—states with low levels of schooling added about twice as many additional years of schooling over the 60-year interval as did those with the most schooling in 1940. Inspection of the graph reveals that the identities of the fast- and slow-growing states are roughly the same as in figure 3: Educational levels grew rapidly in the South, and these states were catching up with high-education states.

Figure 3: Levels and Growth of State Wages 1940–2000

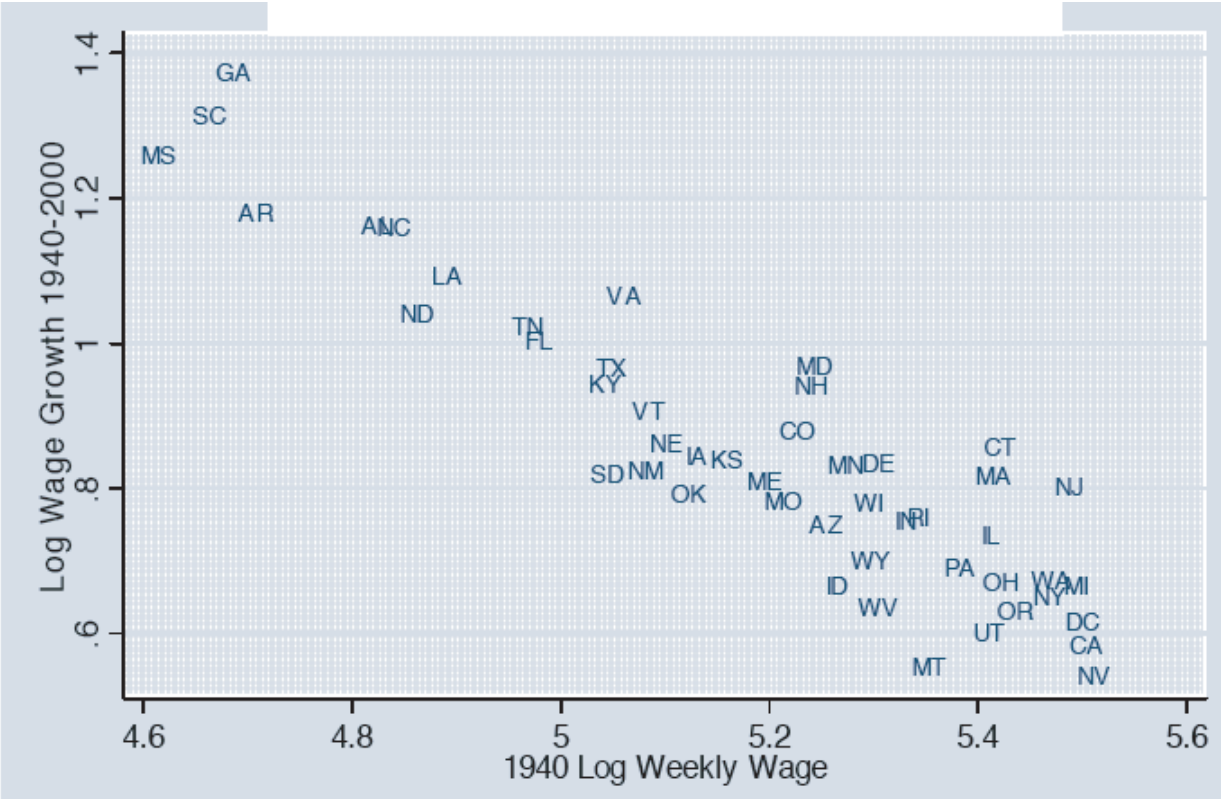


Figure 4: Levels and Growth of State Average Years of Schooling 1940–2000

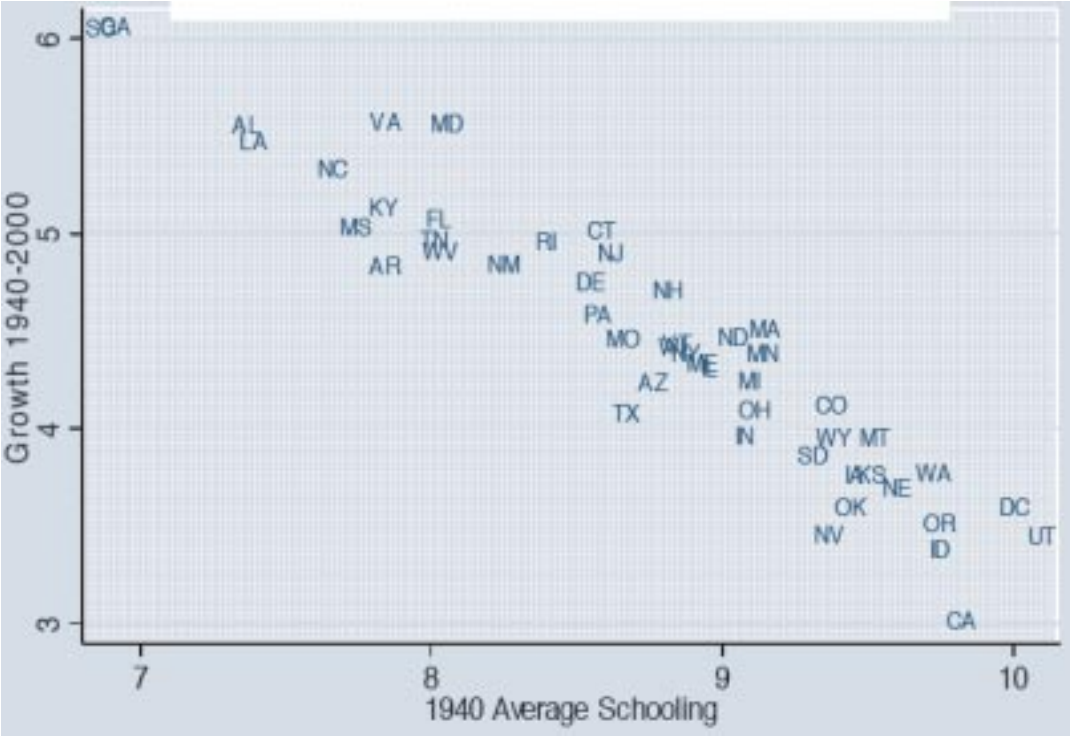


Figure 5: Growth in Education and Growth in Wages 1940–2000

The two patterns of convergence are related to one another in figure 5, which graphs wage growth against growth in average years of schooling. The data are fairly convincing that growth in schooling and growth in wages are closely related. A simple regression of growth in log wages on growth in schooling has a coefficient of .22, indicating that each year of additional schooling in a state is associated with productivity growth of over 20 percent. Thus, the data suggest that education "drives" growth, and that the social return to education substantially exceeds the private return. Yet growth in education may be correlated with other unmeasured factors that also contribute to productivity and wage growth. Obvious candidates are local changes in the demand for skills (though this seems unlikely over such a long period), improvements in the quality of education that are correlated with growth in educational achievement (likely), and changes in the unobserved talents of workers.

To explore these issues, Lange and Topel (2004) attempt to isolate local growth in total factor productivity and to control for local environmental factors that might affect the unobserved skills of workers, such as changes in schooling quality. They estimate a two-stage model of the following form:

$$(8)\quad \ln w_{ilt} = X_{ilt}\beta_t + T_{lt}\ \delta_{bc} + u_{it}$$

$$(9)\quad \Delta T_{lt} = \Delta\bar{S}_{lt}\gamma^{E} + \Delta\bar{\delta}_{lt}\beta^{\delta} + \eta_{lt}.$$

In equation (8), T_{lt} represents the level of total factor productivity in state l in year t, which we estimate by including state-by-year effects in a model of individual wages. The parameters δ_{bc} are birth-state-by-cohort effects that are meant to represent environmental factors, such as school quality, that have a common impact across young people in state b. Importantly, census data identify the state in which respondents were born, so these effects are identified by people who now live somewhere else. Intuitively, the effect asks whether individuals from "high-quality" environments earn higher wages, on average,regardless of where they now live and work. Equation (9) then relates the growth of total factor productivity between census years to growth in education and growth in the *average* quality of workers, where $\bar{\delta}_{lt}$ is the average value of δ_{bc} among workers residing in state l at date t. If unobserved quality matters, and if quality is determined by state-specific environmental factors, then we expect $\beta^{\delta} > 0$. Further, if unobserved environmental factors and average schooling attainment tend to grow together, as we might expect, then the inclusion of $\Delta\bar{\delta}_{lt}$ in equation (9) will reduce the estimated impact of schooling growth on total factor productivity.

This is, in fact, what happens. Figure 6 shows the relationship between long-run (60-year) changes in unobserved skills ($\bar{\delta}_{lt}$) and average schooling. States with greater schooling growth also experienced an increase in the relative quality of persons who were born in those states. This means that growth in education and growth in quality go hand in hand, so a simple regression of changes in productivity on changes in education may find externalities where none exist.

How big might this bias be? Table 3 shows estimates of equation (9) at various growth intervals for specifications that both exclude and include $\Delta\bar{\delta}_{lt}$ in the growth model. For each growth interval the first column shows the simple least squares regression relationship between educational growth and growth of total factor productivity. All of these estimates of γ^{E} are numerically large, with the biggest effects for the longest growth intervals. For example, the 60-year estimate is 0.081, suggesting that an additional year of education raises total factor productivity by 8.1 percent. Adding changes in unobserved labor force quality $\Delta\bar{\delta}_{l}$. reduces the impact of education in each case. For the longe st (60-year) interval, the point estimate falls from 0.081 to 0.023. None of the column (2) estimates are significantly different from zero by conventional standards—there is no persuasive evidence that education raises total factor productivity once growth in the unobserved quality of workers is accounted for.This evidence does not demonstrate that externalities are unimportant. But this evidence surely raises doubts about the importance of externalities, estimates of which are almost certainly overstated by least squares and other methods that have been applied in empirical studies. The evidence is that states with growing productivity and educational attainment also attract or produce "better" workers, and even a simple measure of labor force quality eliminates up to three-fourths of the alleged relation between education and total factor productivity. I conclude that the data on local wages and productivity do not provide strong reasons to believe in the importance of productive externalities from schooling.

Figure 6: Growth in Unobserved Skills and Growth in Schooling 1940–2000

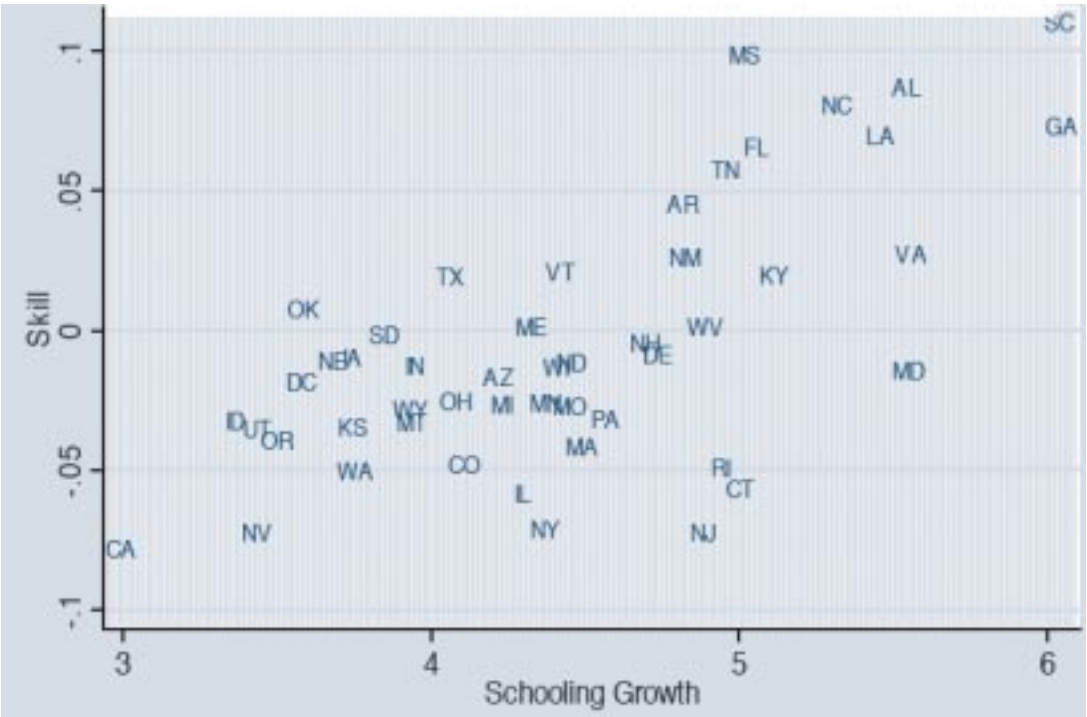


TABLE 3: EDUCATION AND PRODUCTIVITYGROWTH: U.S. STATES 1940–2000

$$\Delta T_{It} = B_{0t} + \Delta Educ_{It} B_1 + \Delta\bar{\delta}_{It} B_2 + e_{It}$$

	10 year growth		20 year growth[b]		30 year growth[c]		60 year growth	
$\Delta Educ$	0.46	0.26	0.68	0.40	0.67	0.36	0.81	0.22
	(2.70)	(1.44)	(3.57)	(1.90)	(3.94)	(1.80)	(3.86)	(0.91)
$\Delta\bar{\delta}_I$		1.23		1.08		1.01		1.35
		(2.86)		(2.76)		(3.06)		(3.64)
R_2	.894	.897	.952	.954	.978	.980	.248	.415

Notes:
a. T-statistics in parentheses.
b. 20-year growth intervals are 1940–60, 1960–90, 1980–2000.
c. 30-year growth intervals are 1940–70, 1970–2000.

THE SOCIAL RETURN TO SCHOOLING: WHERE DO WE STAND?

Most economists agree that human capital is central to economic growth and improvements in well-being. Yet the case for active public policies that encourage investment in human capital, particularly investments in education, rests on the seemingly plausible premise that social returns to human capital are larger than private ones. This paper has developed a framework for evaluating the difference between private and social returns to education, as measured by gains in wages and productivity. I find the evidence for excess social returns is mixed, at best. There is little compelling evidence for positive external benefits of schooling investments; instead, the data suggest that *individuals* are the main beneficiaries of their own schooling choices.

On a more positive note, there is no empirical support for the notion that social returns are *smaller* than private ones. This is not only evidence against the signaling view of schooling, but important evidence that growth in education has been an important contributor to the geographic convergence in incomes and productivities that occurred in the United States after 1940.

ACKNOWLEDGMENTS

This paper summarizes my keynote address to the Federal Reserve Bank of Cleveland Conference on Education and Education and Economic Development, November 19, 2004. My discussion draws heavily from joint work with Fabian Lange. I am grateful to conference participants for useful comments and discussion.

ENDNOTES

[1]Output and productivity data are from the Summers-Heston Mark 5.6 (1995) files, while information on educational attainment of the labor force was collected by Barro and Lee (1993).

[2]I use male wages because of vast changes in female labor force participation over this period.

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