Productivity or Signaling?

Why does education lead to higher earnings? The human capital perspective is that education raises the productivity of the individual. Alternatively, one can see education as a screening device.

At hiring firms are uncertain about the applicants, level of productivity. Education serves as a screening mechanism of the applicant’s underlying productivity. It is not that schooling makes the worker more productive but more productive workers are more likely to acquire more schooling. So schooling is correlated with ability, and firms can use the level of schooling to select the most able workers (on average).

Example, let there be two groups, a low ability group, \( L \) with \( MRP_L = 5 \), and high ability group, \( H \) with \( MPR_H = 10 \). Assume that \( L \) and \( H \) are the same size, and each represents half the applicant pool. Then with no other information, a firm would randomly select individual, with an even chance the person is of either ability pool. The expected MRP (marginal revenue product) is

\[
MRP = 0.5 \times 5 + 0.5 \times 10 = 7.5
\]

In a competitive labor market, \( W = MRP \).

Now assume that firm uses past experience and finds that workers with more education are more able. Thus, the firm can use education as a signal about type. A firm can use education as a mechanism by which to distinguish the low– and high–ability types. A firm that can perfectly distinguish between low– and high–ability workers can then hire only the high–ability workers, and pay them the market wage \( \$7.50 \). For each worker hirer, the firm receives \( \$2.50 \) in profit or \( 33\% \). However, all firms have an incentive to do so, and competition among firms will raise the wages of the high–ability workers. In equilibrium, if firms can distinguish among types (low and high ability) then workers must be paid equal to their marginal revenue product. (Firms must make zero economic profits.)

Consider figure 1. \( C_L \) and \( C_H \) are the cost of education for worker types low and high–ability. \( PV_H \) and \( PV_L \) represent the present values of lifetime earnings at wage levels \( \$10 \) and \( \$5 \). The horizontal axis is education beyond high school. So \( e = 0 \) corresponds to high school.

Individuals maximize their lifetime wealth when the difference between \( PV \) and the cost of education is the largest. As drawn, the low ability individual makes the most when they select \( e = 0 \), no education; any positive level of education beyond high is costly but only serves to reduce their gain. So, the low ability types select \( e = 0 \).

Now consider the high–ability individuals. They, of course, have the option of acquiring no additional education. If they do they will appear as the low–ability individual to the firm and will be paid \( \$5 \). However, if the high ability worker acquires education equal to \( e^* \) they receive a larger
gain. However, type–H workers have no incentive to have education beyond $e^*$ because it reduces their gain.

In this economy, low–ability workers acquire no education and receive the low wage, and the high–ability workers acquire education $e^*$ and receive the high wage. And this is an equilibrium as no one has an incentive to deviate.

Are the workers better off under the separating equilibrium than under the pooling equilibrium (i.e., when the firms can not distinguish their type and each receives the expected marginal revenue product of $7.50? \textbf{Answer:} No. Under the pooling equilibrium the low–ability workers are unambiguously worse off. Their wage declines from $7.50 to $5.00. The high ability workers receive a higher wage and so can be better off. However they can be worse compared to a pooling equilibrium if education is not a signal. It depends on $C_h$, if greater than 2.5 at $e^*$ then worse off. But with the possibility of a separating equilibrium have to invest in education because lose more if do not (will be lumped in with low–ability). \textbf{Draw in $E[W]$ in graph and label $e_1$.}

Is the equilibrium unique? For example, is there only one threshold of education that will serve to separate the two groups? \textbf{Answer:} $Ee_1$. Any education above $e_1$ will support a separating equilibrium. And $e_1$ is a \textbf{Pareto} improvement over $e^* 1$. (Low types are indifferent, while high–ability types strictly prefer threshold $e_1$ to $e^*$.)

Moreover, a change in the configuration and trash the equilibrium. Consider, \textbf{figure 2}. Here, now the high ability types have costs of education that are only slightly lower than the low–ability types. In this configuration, no one will acquire education as both are better offer with $e = 0$. Clearly, it

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure2.png}
\caption{Graph showing the equilibrium with and without education.}
\end{figure}
Depends on the cost of acquiring the signal. If the cost of L–types make it impossible to acquire more than $e^*$ years of schooling, then signal is effective. (Can have infinite cost if have immutable characteristic.) While if there is no cost, everyone can acquire signal, pass the hurdle, and the screening device will offer no screening. Or less extreme, if the high–ability types have a small advantage the gap between low and high–types may not be large enough to support a separating equilibrium. **Key** point is that the cost of acquiring education has to be negatively related with ability.

**Criticism of Education as Screening**

Several criticisms of perspective of education as screening.

1. Equilibrium is fragile and disconcerting that there can be none, one or an infinite number of equilibria, some are separating while others are pooling.

2. Costly to separate groups, costs imposed on individuals. Remember education is assumed not to be productive; it serves **only** to redistribution income between the $L$ and $H$ types. Do not cheaper ways exist to separate groups? Instead of subsiding student loan programs, invest those resources say in aptitude or personality tests. For a few billion expect to develop a good product. Save the wasteful resources on education. (SAT)

3. If individuals would prefer no education, why do some acquire education? Employers able to use education as a signal only if some workers get educated. But in a pooling equilibrium, workers may not have an incentive to acquire education. There can be some time consistency problems.

**Assessment**

The economics of information of which the signaling is a leading early example emerged 30 years ago. Plenty of work done attempting to empirical assess its claims and perspectives. Hard, virtually impossible to distinguish between education as screening and education as productivity enhancing.

I think both theories have their place and it doesn’t have to necessarily be either–or. Certainly at low levels of schooling, education enhances productivity. Literacy, writing, arithmetic – the basics skills. Basic notions of logic of problem solving etc. Clearly these forms of knowledge are productivity enhancing and schooling is not screening. But nor do I want to argue that *all* education is productivity enhancing. At higher end of the education, screening becomes more salient.

There are many training programs and classes for certification that strike me as having an element of signaling. Professional programs have a screening aspect as do Ivy League schools (brands). They’re certainly more expensive, but is the value–added knowledge worth the additional cost? Yes, as the contacts etc that accrue to their graduates can be seen as a form of “social capital.” And it is true that an important aspect of education is the interaction with peers. So, Ivy League and other elite institution may serve as an efficient mechanism to assemble high–ability types. That is, there are complementarities in production and they learn more if they compete against other really good people.
Same for MBA programs and other professional schools (law, medicine). Again, it is too extreme to say the degrees only serve as a signaling mechanism. I obtained an MBA to differentiate “my product” I learned critical ideas of finance — the time value of money, basic elements of portfolio theory, and basics of statistics and quantitative analysis. So, I can list many elements of knowledge that increased my productivity, but there was an important screening component.

Training programs and certifications I think also have a major signaling component. Years ago and it may still exist but I don’t hear about it from the systems people any more, is the MS Certification. People would take classes to become certified as a MS engineer and become deeply knowledgeable out MS operating systems. Knowledge enhancing or a signaling device for people to show they are willing to work hard, invest in themselves, “pay their dues” sort of speak. It is not the knowledge they learn in class that’s valuable perhaps, but the signal it sends to employers.

Social Versus Private Returns

We have discussed the two investment rules:

1. Invest in all projects that have $NPV > 0$ for the given cost of funds, $r$.

2. Invest in all projects that have $\hat{r} > r$, where $\hat{r}$ is the IRR and $r$ is the cost of funds.

In the examples that developed these ideas we developed the cash flows and tabulated the individual’s costs and payoffs of the investment. We have calculated the private return to schooling (investment in human capital). This is reasonable as individuals make the sacrifice and receives directly only the private payoffs/benefits.

Calculation of the social returns does a bit different accounting of the costs and payoffs. To the individual, an educational subsidy lowers the direct cost of schooling and thus raises the private return. However, to the society the loan or subsidy is just a transfer from one person to another or from one group to another. Thus, subsidies that offset costs to the individual investor are costs to the society.

The payoffs to the person is the increased earnings produced by additional education. And in the presence of taxes, the individual returns are all net of taxes. But to the society, those taxes get distributed to support others students or other programs. The society cares about the increased output, not the net of tax, as the later is just a transfer; a redistribution of income. But increased education increases productivity and thus output.

Moreover, there may be spillover effects or externalities — benefits that accrue to others but do not work through the market. Individuals with more education have better health, and have healthier children. And in developing countries, education (of the mother) lowers fertility (education delays the timing to the first child and the times between children increase with education, allowing more resources for the newborn) and also lower mortality. So, while the individuals may value only the direct payback in earnings, education may have an effect on outcomes. Besides generating the increased earnings supporting the enhances private returns there be social returns that benefit society.

The study (Hanushek et al 2007) concentrates on the private labor market returns to education quality (achievement tests) and mention only in passing the evidence on social returns. “The most
common argument is that the social returns will exceed the private returns because of the positive effects of education on crime, health, fertility, improved citizen participation and (as we discuss below) on growth and productivity of the economy of the whole. “(pp. 5-6) In footnote 3 they cite evidence of externalities as reduced crime (Lochner and Moretti (AER 2004)), improved health of children (Currie and Moretti (QJE 2003)) and improved civic participation (Dee (J. Pub. E. 2004)); Milligan, Moretti, and Oreopoulos (J. Pub. E. 2004). Continuing footnote 3, the evidence on direct production spillovers of education among workers is more mixed, with Moretti (AER 2004) and the studies cited therein finding favorable evidence and Acemoglu and Angrist (NBER Macroeconomics 2000, [evidence of compulsory schooling laws]) and Ciccone and Peri (RE Stud 2006) finding no evidence of spillovers.

We can ask. what motivates all the subsidies given to education — revenues from the state (property tax) to support K–12 and tertiary schooling. And all the Federal student loan programs such as the Stafford GSL. Generally, we don’t see that of public support for other forms of investment. International capital markets regulated to provide interpretable reports of financial gain and financial status. Government subsidies for particular industries, yes but they are the exception than the rule. Why the huge investments in education?

The answer is two-fold. The first is that human capital is embodied in the individual. There are laws against slavery, and the buyer can only rent the services produced by the human capital. So, there is in a sense a missing market. Lenders can not write contracts that garnish future wages. People would be willing to indenture themselves as collateral to secure a loan. But laws prohibit and the courts support the prohibition of such contracts. The embodiment of human capital in the person leads to a set of incomplete markets. The role of the government education subsidies can be argued to over come the incomplete markets. There are productive investments to be made in people. Commercial institutions can not write contracts to support the investments, so the government fronts the funds. And the government has powers to enforce contracts that firms do not.

Second, the positive externalities of education on other outcomes, such as reduced infant mortality (among parents receiving the additional education), reduced crime (so localities can diverge resources to other uses besides jail and protection of the citizenry). If the social returns are higher than the private returns then there is too little investment. Yet, private individuals can not internalize the social returns, but the government can.

And of course, not related to efficiency, but governments (societies) may subsidize education for equity (equal opportunity) reasons.