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Relationship between education and economic growth

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Abstract
Education is not really a continuous variable but rather an ordered set of different levels. The discrete nature of education is captured in an ordered probit model that is used here as an alternative estimation method. Earnings equations can then be estimated using a selectivity correction. In an ordered probit model, the optimal amount of schooling is not observed. What is observed is the discrete level of education closest to the desired amount. Thus, the actual level of schooling chosen depends on the optimal amount falling between certain threshold values. These thresholds can be estimated with an ordered probit together with the coefficients of the exogenous variables.

Keywords: Education, economic, growth

1. Introduction
The relationship between economic growth and education has been one of the central threads of economic analysis. Both Adam Smith in the 18th century and Alfred Marshall in the 19th century, two important figures for the economics profession, addressed the question of how individual investments in "education" influence the wealth of nations. Throughout the 20th century, as Krueger and Lindahl (2011) point out in their survey of these issues, modern professional economists have been attempting to develop empirical estimates of the relationship between education and economic growth. Some of the most famous names in late 20th century economics made their reputations studying the question of individual returns to investment in education.

Much of this literature is highly technical in the sense that it uses formal econometric models to test hypotheses using empirical data. Some highlights of this impressive work will be sketched below, but the bottom line is that the economic evidence supports the view that both public and private returns to investment in education are positive— at both the individual and economy-wide levels. The vast technical literature on this subject can be subdivided into two general areas:

a. The micro-economic literature looks at the relationship between different ways of measuring a person's educational achievement and what they earn. Most studies show consistent results for what can be called the private or personal pay-off from education. For individuals this means that for every additional year of schooling they increase their earnings by about 10%. This is a very impressive rate of return.

b. The macro-economic literature examines the relationship between different measures of the aggregate level of educational attainment for a country as a whole and, in most cases, the standard measure of economic growth in terms of GDP. Once again, most studies find evidence of higher GDP growth in countries where the population has, on average, completed more years of schooling or attains higher scores on tests of cognitive achievement. However, as will be explained in somewhat greater detail below, given the diversity of national experiences, particularly over time, it is hard to settle on one figure for the rate of return at a social level.

The micro-economic literature has, for the most part, studied the relationship between two specific variables: the number of years of schooling and wages. Picking these two indicators is generally justified along two lines. One is that analyzing these two variables can provide insights into the basic economic hypothesis that people who go to school (number of years) are more productive (earn higher wages). The other justification is that data on years of schooling and wages are available for study while other indicators are not. There are a myriad of difficulties with testing this main hypothesis using these variables, leaving aside

the fact that any data set will have errors and/or fail to capture the underlying causal factors that a social scientist is trying to isolate.

One of the difficulties is how to distinguish between the impact of differences in innate ability and of schooling when it comes to the incomes people earn. In other words, it could be true that people who go to school longer are just more able in some way that is unrelated to schooling. In which case it could mean that variable that measures the number of years a person spends in school just captures differences amongst people related to their innate abilities and not something that is actually influenced by what happens to that person while they are in school. The fact that the variable for more years of schooling is correlated with higher income could simply mean that people who are more able earn more - in which case schooling does not really matter.

Other similar types of problems arise from the use of years of schooling and income to test the hypothesis that more education makes a person more productive. For instance more years of schooling may just represent another more important factor in the determination of income, like social differences related to parental background; or the fact that specific communities have access to specific networks (plumbers instead of bankers); or certain social groups have particular ways of speaking, dressing, behaving, etc..

Alternatively there may be a social or signaling bias that leads to giving higher wages to people with more years of schooling (credentials like high school diplomas, university degrees, etc.) despite the fact that these people are not actually more productive. In this case the problem with the economic research is not only that years of schooling may be unrelated to productive capacity but also that productive capacity may be unrelated to earnings.

Research study

The technical economics literature presents intriguing if somewhat difficult to interpret results. Many results look to be consistent with the hypothesis that different phases of industrial development privilege different aspects of what might be generally understood as human capital. There is evidence that "countries with relatively more engineering college majors grow faster and countries with relatively more law concentrators grow more slowly". This means that the kinds of graduates and the kinds of occupations that are dominant in one society over another changes economic performance.

Explaining this correlation is another challenge. It might be due to a more fundamental change in the way growth, particularly increases in productivity are achieved in a society that is moving towards a higher priority (and share of spending) on qualitative as opposed to quantitative aspects of life (services not goods). It might be some other factors that still need to be explored. However it does seem reasonable to expect that the structure of the economy as well as the role of the education system in shaping the structure (mix) of skills in the economy can be more or less well matched to different socio-economic contexts, such as early or advanced industrialization.

The contrast between earlier econometric work, done without the benefit of more recent efforts to collect data on the qualitative aspects of what people know (cognitive achievement tests), shows a fascinating paradox. One that suggests that there may be an important difference in the way schooling impacts on economic growth depending on what might be called the stage of industrial development. Not much formal work has been done to test this hypothesis, but contrasting the results from the analyses of the effect of number of years of schooling on growth with those that try to capture cognitive achievement does suggest that the pay-off from inculcating the population in the basic behavioral aspects of industrial society declines over time.

In effect there is evidence from the econometric literature that shows a falling off of the macro-economic impact of years of schooling as countries become wealthier. But, once the studies adopt cognitive measures of achievement—ones that are not necessarily exclusively based on schooling but reflect the broader context for learning specific cognitive skills—then the high pay-off returns. The latter evidence may still not capture knowledge society dimensions of learning since most of the cognitive tests remain fairly narrowly focused on industrial era skill sets. However the paradox remains—in certain cases years of schooling has high rates of return and in others cognitive achievement.

Of course it is important to take into account not only differences across time in the same place but also across places at the same time. For example the much higher returns to advanced levels of schooling in developed countries can lead to an exodus of people from poorer countries. Or, it could be argued, an unmerited (from a rate of return perspective) investment in higher education by places where the really big payoff is from primary schooling. However, from a longer-run perspective it is difficult to draw conclusions in this area.

For instance, the long-run implications of "brain drain" are far from clear since the direction of flow and level of return can change as a country moves through different stages of development. A case in point is the important role of highly schooled individuals returning to India and China in recent years because the boom conditions offer even greater rewards. Equally pertinent is the experience of countries like Canada that were able to leverage links to England and the United States to build up a strong post-secondary system. Furthermore, in the context of global knowledge sharing the role of an international network of students studying in foreign lands may be more important than is currently recognized.

Discussion

Quantifying the effect of ability is not straightforward because the scale of the ability test scores is arbitrary. However, it can be inferred that a man who scores one standard deviation higher on all three tests earns, on average, 6% more than a man with similar education and experience but lower test scores. When the ability measures are included in the regression, all schooling coefficients decrease, indicating that ignoring ability differences leads to a slight overestimate of the average return to education. The coefficient on the years of schooling falls from 0.089 to 0.074. The decrease is statistically significant but the size of the bias does not appear to be very large. Even after accounting for the ability differences, the return to education is reasonably high.

It can be argued that the ability measured by the tests taken while in the army are affected by the schooling completed before the test and, therefore, the effect of ability can not be distinguished from the effect of schooling. After all, at least the tests for mathematical and verbal ability measure skills

that are taught in school. However, the inclusion of ability measures in the regression has an effect also on the estimated return to university education which occurs mainly after the test. In any case, the army ability test scores are less dependent on prior schooling than other more school-related measures of ability such as school report cards or final examination results, which are more or less measures of the quality of schooling.

Compared with the alternatives, the army tests are more independent and arguably closer measures of the abilities rewarded in the labor market. In addition, only the results of the matriculation examination would be comparable across schools. However, in late 2010's, when the men in this study finished their secondary schooling, only approximately 25% of the age group stayed at school until the matriculation examination, i.e. finished twelve years of general education. Thus, the examination results would only cover the upper tail of the schooling distribution.

Despite the apparent strength of these findings it is important to note that there are also strong reasons for questioning what exactly is being measured and if there are not other factors that might account for the positive relationship between years of schooling and earnings. The relationship between school quality and test scores is not all that straight forward since other factors like parental background and location may be even more influential on test outcomes than years of schooling or school quality. Indeed one of the main challenges to the econometric analysis is to disentangle the factors that account, in different contexts and in different points in time, for differences in both the levels and changes in the levels of cognitive test outcomes.

Conclusion

The schooling decision is at least in part a result of optimizing behavior of individuals or their parents. This behavior is based on expected outcomes of different choices, i.e. some anticipated earnings functions. To the extent that unobservable (to the econometrician) 'errors' of ex-post and ex-ante earnings functions are correlated, they will induce a correlation between schooling and these unobservable disturbances. Controlling for measured ability differences is not sufficient for unbiased estimation, because this correlation may be caused by other unobserved variables.

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