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P. Allerup

Rates of Return to Education

1. Introduction

The rate of return to investment in education is a measure of the future net economic payoff to an individual or to society of increasing the amount of education taken. As a measure of profitability, the rate is equivalent to the interest paid on savings or the rate of return to investing in a machine, real estate, or any other form of capital requiring a stream of investment over time and an income return over time.

The rate of return is found by setting the discounted value of costs and benefits over time equal to zero and solving for the implicit discount rate, r,

$$0 = \sum \frac{C_i}{(1+r)^i} + \sum \frac{B_i}{(1+r)^i} \qquad (1)$$

where what the individual spends for education or other costs incurred (C) in this equation are negative and the additional income or other benefits the individual gains from the education (B) are positive.

From the individual's standpoint (the private rate of return), the benefits of the additional education are the additional income the individual earns because of it, the nonpecuniary consumption benefits educational investment provides over a person's life, such as greater enjoyment of cultural activities or higher social status, and the direct consumption derived from taking the education. However, in measuring private rates of return, economists have limited themselves to the earnings benefits of education. They have assumed that such a measure underestimates the real rate, since consumption benefits are considered positive (see *Consumption Benefits of Education*). Yet, in practice, the direct consumption effect of attending school could be highly negative for those children who are not particularly successful or are members of a lower status minority. A negative unmeasured consumption effect implies that earnings differences would overestimate the true rate of return.

Private costs of education include the income forgone by students while they attend school or other educational activities, the additional expenditures associated with taking education, such as uniforms, books, transportation, and fees, and possibly a negative consumption effect of sitting in classes.

Since costs occur early in the temporal stream of costs and benefits, they necessarily have a much greater weight both in the educational investment decision process and in the estimated rate of return. However, private costs are much more difficult to measure than private benefits (e.g., how great is the amount of income forgone by teenagers in developing countries?), and direct private costs are usually significantly underestimated. Families in many countries bear a large proportion of the total cost of even public primary school (see *Private and Public Costs of Schooling in Developing Nations*).

From society's point of view (social rate of return) the benefits of additional education are the additional productivity of those who have taken more schooling and engaged in other educational activities, the collective consumption value of the education, and the "externalities" of education (see *External Benefits of Education*) accruing to society in nonmaterial forms, such as more civilized collective behavior, a more productive environment, and a wiser choice of political leadership. The social costs of additional education equal the private costs plus any costs borne collectively through taxes or voluntary donations used for public spending on education.

Although the social benefits of education are usually estimated by using the same average earnings streams as in the private rate estimates but corrected for income taxes, such approximations of social benefits are problematic. Earnings differences do not necessarily equal productivity differences, especially when a significant percentage of those with certain levels of education, such as university, work in the public sector or in oligopolized sectors of private industry and services. From a private individual's standpoint, it makes little difference what the additional earnings represent, since private investment decisions are based on expected returns. If employers pay higher salaries to those with more schooling, the benefits as seen by individuals are the additional wages, whatever the reason for paying them. Yet for society, the reason behind higher incomes makes a difference in assessing whether to invest in more education or not.

One way in which economists have approached the productivity/earnings quandary is to correct estimated earnings streams for factors other than education and experience (Thias and Carnoy 1972, Blaug 1972). For the private individual, it makes sense to look at the educational benefits and costs for his or

95

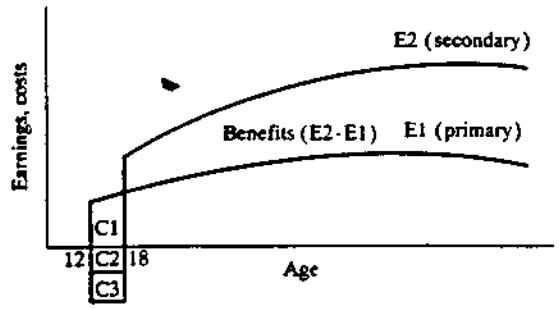

Figure 1
Earnings streams by level of education

her gender, race, or ethnic group, assuming that these differences are structural and persistent (see *Race Earnings Differentials; Gender Differences in Earnings*). However, earnings corrected for race and gender differences may result in "misleading" estimates of social rates, since such corrections may reflect political power relations rather than productivity differences.

2. Estimating Rates of Return

There are two principal methods used in estimating rates of return to education, known respectively as "traditional" and "Mincer." The traditional method uses calculated annual costs and earnings by education level (see Fig. 1). Earnings forgone are estimated as the income the individual could have earned while attending school (C1 in Fig. 1). Direct costs borne by the family (C2) are added to earnings forgone for the private rate of return estimate. Public costs (C3) are added to earnings forgone and direct private costs to estimate annual social costs (C1+C2+C3) for the social rate of return estimate. Costs are estimated over the length of the schooling period. If the average primary school student takes 8 years to finish 6 years of primary school because of repetition, for example, costs should be calculated over 8 years, not 6. This also means, however, that more advantaged pupils may have lower costs of schooling than less advantaged students. Annual private and social benefits are calculated from the difference in average earnings of those who have different levels of education (E2 minus E1 in Fig. 1). The year-by-year costs and benefits are inserted into Eqn. (1) above to estimate the discount rate that equalizes costs to benefits.

Usually, such annual benefits and costs are estimated directly from average earnings calculated at various ages for men and women in the labor force and the estimated direct private and public costs of schooling. Yet they have also been estimated from log earnings regressions for different education groups (Carnoy 1965, Hanoch 1967, Thias and Carnoy 1972). This has allowed for "corrections" of the education coefficients for each age group for other factors, such as social class background, region, and time worked (Eckaus 1973). The "corrected" earnings streams yield rate of return estimates "corrected" for these other factors (Thias and Carnoy 1972).

In either case, the average income difference (negative in the case of income forgone and positive in the case of income benefits) between two proximate schooling levels is estimated for each year from the initial year of schooling at the level being evaluated—for example, the first year of upper secondary, if upper secondary completion is being compared with lower secondary completion. Direct costs are added to income forgone during the school years to obtain the private rate, and other costs are added to private costs to obtain the social rate. Income differences are estimated net of taxes for the private rate, but not for the social rate. Table 1 shows a typical cost and benefit stream calculation. The rate of return is estimated by putting such costs and benefits into Eqn. (1).

The Mincer method uses regression analysis to fit a Mincerian human capital earnings function to individual data on earnings (Y), years of schooling (S), and years of labor market experience (E)—equal to age minus years of schooling minus age of starting school—in a semilogarithmic form (Mincer 1974). The average private rate of return to schooling is estimated as the estimated (b) regression coefficient of schooling from the log income regression equation:

$$LnY = a + bS + cE + dE^2 \qquad (2)$$

The reasoning of this procedure is that partial differentiation of LnY with respect to S gives the definition of a "short-cut" method-calculated rate of return:

$$b = \frac{\partial LnY}{\partial S} \qquad (3)$$

or in discrete form for expository purposes

$$b = \frac{LnY_s - LnY_o}{\Delta S} \qquad (4)$$

where Y_s and Y_o refer to the earnings of those with s and o years of schooling, respectively.

Marginal rates of return to particular levels of schooling can be estimated from Mincerian regressions by substituting a string of dummy variables for each level of schooling. In this case, the coefficient of the dummy variable will yield the total return to that level minus the excluded dummy. For example, if the excluded level is "no schooling," the coefficient of the "high school completed" dummy represents the total return to all the years of schooling up to completion of high school. To estimate an

96

Table 1
Cost–benefit stream for typical private rate of return estimate comparing secondary school completion (12 years of schooling) to primary school completion (6 years of schooling)

Year	Age	Income 1[a]	Income 2	Benefit[b]	Direct cost	Total
1	13	345	0	−259	−100	−359
2	14	350	0	−262	−100	−362
3	15	370	0	−278	−100	−378
4	16	400	0	−300	−150	−450
5	17	450	0	−338	−150	−488
6	18	500	0	−375	−150	−525
7	19	600	900	300		300
.						
.						
27	39	800	1300	500		500
.						
.						
47	59	750	1600	850		850

a Hypothetical incomes provided by author b Income forgone calculated as 0.75 of Income 1

annualized rate of return, the coefficient must be divided by the number of years of schooling (in this case, primary plus lower secondary plus higher secondary).

In both methods, the earnings by experience and education are generally estimated using cross-sectional rather than longitudinal cohort data. In other words, earnings are estimated for different age groups of income earners with different amounts of education in the labor force in a given calendar year. On the one hand, this is a fair representation of what private individuals consider when deciding to invest in additional education or not—they use what older individuals earn at that point in time as a single best estimate of what they might earn in the future. On the other hand, it is a misleading indicator for both private and public investment, since cross-sectional earnings represent the payoff to past schooling, past economic growth rates, and past income distribution policies (see *Education and Earnings*). They may or may not be accurate estimates of future earnings, or hence of future payoffs to education.

In light of these limitations, researchers have attempted to find more dynamic measures of rates of return. Longitudinal rates have been estimated for the United States using cohort earnings across census years. These estimates suggest that longitudinal rates are affected by the economic growth rate (Carnoy and Marenbach 1975). Another way of getting around the cross-sectional problem is to estimate a series of rates of return based on cross-sectional earnings in the same country over time. Using a time series of rates provides a historical picture of changing payoffs to different levels of schooling. Although such time series do not predict short-term fluctuations in rates based on short-term fluctuations in the relative earnings of more and less educated groups, they do suggest secular trends in payoffs to different levels of schooling. On the basis of these trends, insights can be gained into the effect on the relative value of different kinds of educational investment as the economy and educational system expand.

3. Empirical Results

3.1 Cross-sectional Rates

Rates of return to education have been estimated for a large number of countries, by level of schooling, by gender, and—for some countries—over time. Table 2 shows the latest summary of rates (Psacharopoulos 1985). They should be interpreted with some care, since they are averages of estimates using different kinds of data, different assumptions about costs, and referring to different populations.

These estimates show that the rates to primary education are higher than the rates to secondary and higher education, that the rates are higher in developing countries than in advanced industrial countries, that the rate of return to women's education may be higher than to men's even though women are paid less in absolute terms than men, and that the rates to studying social sciences in universities are as high or higher than the rates to medicine and engineering.

3.2 Rates of Return over Time

The more interesting estimates of rates are those made in the same country over time (see Psacharopoulos 1989). They reveal not only the differing payoffs to different levels of schooling, but also pro-

97

Table 2
Rates of return by country type, level of education, gender, and university subject studied (in percent)

	Social			Private		
	Primary	Secondary	Higher	Primary	Secondary	Higher
Region						
Africa	28	17	13	45	26	32
Asia	27	15	13	31	15	18
Latin America	26	18	16	32	23	23
Country type						
Intermediate	13	10	8	17	13	13
Advanced	—	11	9	—	12	12
Gender						
Male				19	16	15
Female				17	21	14
Subject						
Economics			13			
Law			12			
Social sciences			11			
Medicine			12			
Engineering			12			
Sciences, mathematics, physics			8			
Agriculture			8			

Source: Psacharopoulos 1985 Tables 1, 5, and 7

vide insight into how school expansion affects payoffs under varying economic conditions.

Although time-series within-country rate of return estimates using comparable data over time are available for only a few countries, the results there indicate that rates fall with expanded schooling, and that they fall first at lower levels of schooling as the educational system expands.

In the United States, for example, the annualized social rate of return to secondary education for males fell from 18 percent to 11 percent between 1939 and 1969 during a period of major expansion in secondary enrollment and graduation (Carnoy and Marenbach 1975). The social rate to college completion remained constant at about 11 percent over the same period (Carnoy and Marenbach 1975) but then fell sharply in the early 1970s and rose again in the 1980s (Murphy and Welch 1989). This suggests that rates of return to lower levels of schooling fall relative to higher level rates when the school system expands. Except for the fall in college rates in the early 1970s with the Vietnam War bulge in college attendance and graduation, rates to college have remained stable, but the absolute number of male college graduates has grown slowly since 1975.

Rates of return measured over time in other countries have shown a similar tendency. Estimates in Bogota, Colombia (Mohan 1986) show that in a period of relatively rapid growth during the 1970s (1973–78), the estimated private rate to each level of education fell, and that even at the beginning of the period, the rate of return to primary education was lower than to secondary and higher education, and remained so throughout the decade (Mohan 1986 Table 8-3). Private rates to secondary education fell significantly and more rapidly than those to higher education in these 5 years, so that the secondary rates end up lower than higher rates by 1978. Chung's research in Hong Kong (1990) shows payoffs to primary and secondary education falling below the rate of return to investment in university and dropping more rapidly than the rate of return to university in the late 1970s and early 1980s, a period of rapid industrialization and educational expansion. Two separate studies in Kenya (Thias and Carnoy 1972, Knight and Sabot 1990) suggest that private and social rates of return to primary school fell rapidly in the 1960s and rates to secondary education then fell in the 1970s, in the face of bottom-up rapid expansion of education over the two decades.

However, the most convincing evidence for sequential declines (primary, then secondary, then university) in rates of return as the economy grows and the educational system expands comes from South Korea. A number of rate-of-return estimates are available for the past 20 years (see Psacharopoulos 1985, 1989), but they are generally not appropriate for intertemporal comparisons because of inconsistent treatment of the data and different methods used. Nevertheless, recent studies of Korean rates do specifically make intertemporal comparisons using the same data source for all years (Ryoo et al. in press). Table 3 presents the Mincer private rates of return estimates for Korea, by level of schooling, gender, and year. They show that in Ryoo's and Nam's estimates both for all Koreans employed and for those employed in manufacturing, the Mincer rates of return to investment in middle

school were already low in 1974, but declined further in the 14 years of rapid economic growth from 1974 to 1988. This was true for both males and females. Rates to investment in higher secondary school in 1974 were much more equal to rates to investment in four-year college. However, secondary rates dropped sharply in the mid- and late 1970s for both males and females so that by the 1980s, they were much lower than college rates. The Mincer rates to investing in junior college appear to have risen in the 1970s (or at least stayed constant) and fell in the 1980s. Junior college private rates by the late 1980s were not much higher for males than the low rates to investing in high school, but remained much higher for females, especially outside manufacturing. The private rates to college completion remained fairly constant or may have even increased until the late 1980s, when they, too, began to fall. College rates were already as high or higher in 1974 than rates to investment in other levels.

3.3 *Implications of Patterns of Rates of Return over Time*

The rate of return estimates for comparable groups taken as a series of cross sections over time in various countries (United States, Colombia, Hong Kong, Kenya, and Korea) suggests that where there is rapid industrialization and simultaneous rapid expansion of schooling toward the universal completion of primary, junior and senior high school (lower and upper secondary school), rates of return to various levels of schooling decline over time, and tend to decline first at the primary level, then at the secondary level, and finally at the university level. There is evidence that in almost all these countries this process has left the rates to university higher than those to secondary, and those to secondary higher than those to primary.

The pattern of rate changes revealed by these time comparisons has several implications: (a) earlier conclusions regarding relatively high rates to primary education and low rates to higher education may be relevant only to economies and educational systems at the early stages of development; (b) rates of return estimated over time using comparable groups are valuable for understanding changes in the economic and social role that education plays at various points in historical time; and (c) during periods of rapid industrialization and expansion of the educational system, the main restriction on students taking further education may not be self-selection as suggested by the pattern of declining rates from primary to higher education in earlier cross-sectional comparisons. Rather, it may reflect imposed selection, either through highly imperfect capital markets, or restrictions on the number of places available in secondary school in some countries or four-year colleges in more advanced countries. Hence, where rates rise with education level (as in Korea, Hong Kong, and Colombia), schooling may well act as a screening mechanism.

Table 3
Republic of Korea: Mincer (private) rates of return, by level of schooling, gender, and year, all employed and manufacturing workers 1974–88 (in percent)[a]

	All workers							
	MS/PS[b]		HS/MS		JC/HS		COL/HS	
Year	M	F	M	F	M	F	M	F
1976(N)[c]	2.4	1.6	9.1	11.9	13.6	19.2	16.8	19.6
1981(N)	1.7	1.2	6.5	9.1	13.0	26.6	15.4	19.4
1986(N)	2.8	3.4	4.6	5.6	8.3	17.3	14.4	19.3
1988(N)	1.9	2.7	3.9	5.2	6.5	14.0	12.2	15.0
	Manufacturing sector							
	MS/PS		HS/MS		JC/HS		COL/HS	
Year	M	F	M	F	M	F	M	F
1974(R)[d]	8.0	7.5	14.8	14.8	12.5	20.2	16.5	15.1
1976(N)	3.2	1.6	8.7	9.3	14.7	15.8	17.5	16.7
1979(R)	6.1	3.1	11.7	12.4	15.0	17.4	17.8	18.8
1981(N)	2.9	1.0	6.0	6.5	12.8	19.3	16.1	18.7
1986(R)	4.2	2.2	10.0	9.0	12.2	15.4	17.8	20.3
1986(N)	3.4	2.3	4.6	4.0	9.0	8.5	13.4	20.0
1988(N)	2.7	1.8	4.4	4.4	6.3	6.2	11.0	11.8

Sources: Ryoo 1988, Nam in press. Human capital regression estimates from Occupational Wage Survey, 1974, 1976, 1979, 1981, 1986, 1988
a The rates are annualized coefficients of education in human capital regression equations. Ryoo used educational dummy variables, experience and experienced squared in his equation; Nam used education dummies, experience dummies, tenure in the firm (years) and tenure squared. The difference in the definition of the human capital equation accounts for at least part of the difference in Mincer rates for the one year (1986) in which both Ryoo and Nam estimate rates. The annual rates were obtained by dividing the coefficients of education dummies by the number of years of schooling associated with that level of education b MS/PS: middle school (3 yrs)/primary school; HS/MS: high school (3 yrs)/middle school; JC/HS: junior college (2 yrs)/high school; COL/HS: college (4 yrs)/high school c (N) = estimates by Nam d (R)=estimates by Ryoo

See also: Education and Economic Growth: Education and Productivity; Benefits of Education: Education, Occupation, and Earnings; Education and Earnings: Cost–Benefit Analysis; Consumption Benefits of Education

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M. Carnoy