Returns to Education in Korea

Funkoo Park*

The main objective of this paper is to estimate private and social rate of return to investment in different levels of education in Korea. The main body of the data used in this study is supplemented with information on individual history of labor market experience. We utilize this information to see how different amount of schooling would affect one's earnings level with the specific conjecture that besides inherent function of education in enhancing productivity potential of individual, people with higher level of education is often characterized with less turn-over and more stable job security which would further increase one's earnings. It will be attempted to see how different level of schooling would affect one's formation of post-school labor market experience and thereby earnings. A modest attempt to solve this problem empirically will be carried out and analyzed in the course of estimating the rate of return to education in Korea.

In the actual estimation of the rates of return to schooling, the basic calculation involved are: a comparison of expected lifetime earnings differentials due to additional amount of schooling projected from the cross-sectional age-schooling earnings data and the total costs of education to society as a whole, thus giving the social rate of return to education; and a comparison of expected life time earnings differentials and the costs of education borne by the individual, generating the private rate of terurn.

When expected future earnings profiles for different levels of schooling are estimated, one conventional way is to look at the mean values of the reported earnings for each age-schooling cohort.[1] Others

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1 Hansen (1963).

have used various forms of earnings function to estimate expected earnings profiles with the contention that all the other factors that affect earnings besides schooling, such as ability, socio-economic background, post-school investment in human capital, etc., should be held constant to measure the true earnings differentials attributable to different levels of schooling.[2] It is intended in this paper to find earnings profiles which are adjusted for the post-school labor market experience using an earnings function developed to accomodate a particular set of information available from the Occupational Wage Sruvey in Korea.

1. Earnings Function

Occupational Wage Survey of 1973 provides specific information concerning individual work experience with respect to occupation and employing firm. For each individual workers, it gives us years of employment within the current type of occupation and the year of employment within the current employing firm. To develop a model of earnings function which specifies the relationship between labor earnings and human captal as hypothesized by human capital theory in terms of above variables, the following sequence of segments of working life of individual is designed. Individual's working life is divided into three segments representing different phases of working life and thereby designating different types of work experience. They are: (1) the years, t1, prior to being employed in current type of occupation after the completion of formal schooling, which is to be called as the years of "general experience"; (2) the years, t2, of employment within the current type of occupation but outside of the firm currently being employed, which is to be called "outside occupational experience"; and (3) the years, t3, of employment within current type of occupation within the firm currently being employed, which is to be called the years of "firm specific experience".[3]

With such a segmentation of working life of individual, a specification of earnings function in the following functional form can be developed in terms of number of years of each experience variables. In the human capital earnings function developed by Mincer, earnings of an individual with s years of schooling and t years of work ex-

2 Hanoch (1967).

3 The segmentation can be illustrated with the following table:

I	I	I	I	I
Formal School	$t1$	$t2$	$t3$	

Note that t^2 may take a negative value if one changes occupation within the firm employed. In practive, however, it seems a rare case.

perience during which the post-school investment are made are specified in a functional form such as:[4]

$$\ell nE_{ts}=\ell nE_0+r_s s+r\sum_{i=1}^{t} k_i$$

where k_i is the post-school investment ratio measured in time-equivalent units and E's are the gross earnings. If we assume that the pattern of post-school investment in different segments of working life differs so that the investment ratio in the i th period is $k_i=a_i+b_i t$

where a_i is the initial investment ratio and b_i is the rate of change of the investment ratio during the i th segment of the working life, the above earnings function can be rewritten as:

$$\ell n\ E_{ts}=\ell nE_0+r_s s+r\sum_{i=1}^{3}\int_0^{e_i}(a_i+b_i t)\,dt,$$ [5]

where e_i is the duration of the i th segment. Integrating the above equation and substituting the e_i's with t_i's which were defind earlier, the specification of earnings function with the type of segmentation of working life shown above becomes:

$$\ell n\ E=\ell nE_0+r_s s+r\left(\sum_{i=1}^{3} a_i t_i+\frac{1}{2}b_i t_i^2\right)$$

If we further assume that the difference between observed earnings, Y, and the gross earnings is negligible, only the intercept is to be affected, so the form above holds for log of observed earnings.[6]

2.1. Estimation of Earnings Profiles

From the above earnings function, earnings profiles for five major levels of schooling in Korea are to be estimated. When earnings for each age-schooling cohorts are estimated from the earnings which include age, schooling, and other variables as explanatory variables, all factors except schooling are held constant at an appropriate mean values for a given age cohort to measure the net earnings differentials due to additional amount of schooling. In the case of the earnings

4 . Development of earnings function in the framework of human capital theory can be found in Mincer (1974).

5 Σe_i = Age-years of schooling -6.

6 Then, the actual regression equation for the earnings function becomes:

$$\ell ny_i=a_0+a_1 s_i+a_2 t1_i+a_3 t2_i+a_4 t3_i+a_5 t1_i^2+a_6 t2^2{}_i+a_7 t3^2{}_i+u_i$$

where u_i is the statistical residual.

function utilized in this paper, this process of "holding constant" causes certain complication because of the possible correlation between schooling and other experience variables. The nature of the problem can be illustrated with the following calculation. As postulated, earnings, y, is a function of s, and t's such that:

$$y = f(s, t1, t2, t3).$$

Total differentiation of both sides of the above equation yields:

$$\frac{dy}{ds} = \frac{\partial f}{\partial s} + \frac{\partial f}{\partial t1}\frac{dt1}{ds} + \frac{\partial f}{\partial t2}\frac{dt2}{ds} + \frac{\partial f}{\partial t3}\frac{dt3}{ds} \quad \cdots\cdots (1)$$

By the definition of the years of general experience, t1 can be written as t1 = A-s-6-Ox, where Ox is the years of occupational experience which, in turn, is the summation of t2 and t3 and A is age. Therefore, dt1 = -ds-dt2-dt3 at a given age. Then the above equation can be written as:

$$\frac{dy}{ds} = \frac{\partial f}{\partial s} + \frac{\partial f}{\partial s}\left(-1 - \frac{dt2}{ds} - \frac{dt3}{ds}\right) + \frac{\partial f}{\partial t2}\frac{dt2}{ds} + \frac{\partial f}{\partial t3}\frac{dt3}{ds}$$

$$= \frac{\partial f}{\partial s} - \frac{\partial f}{\partial t1} + \left(\frac{\partial f}{\partial t2} - \frac{\partial f}{\partial t1}\right) dt2/ds + \left(\frac{\partial f1}{\partial t3} - \frac{\partial f}{\partial t1}\right)\frac{dt3}{ds} \cdots (2)$$

In equation (2), when dt2/ds=dt3/ds=0, i.e., years of occupational experience and firm specific experience are independant of schooling,

$$dy/ds = \partial f/\partial s - \partial f/\partial t1.$$

Since the additional years of schooling will offset the years of general experience by the exact length of period, effect of additional years of schooling, dy/ds, on earnings can be decomposed into two parts: positive effect of additional schooling on earnings and negative effect on earnings from the reduction in the years of general experience which are foregone while attending additional schooling.

Since the question being asked is: what values of t1, t2, and t3 are to be entered in the earnings function to measure the net earnings differentials attributable to additional schooling at a given age level, and if dt2/dt3/ds=0, then, t2 and t3 should be held constant at some value over the all levels of schooling and t1 should be adjusted for different schooling groups such that years of additional schooling offsets t1 by the same number of years.

On the other hand, if years of schooling is related to years of occupational experience and firm experience, respectively, schooling will affect earnings directly – say, more schooling, higher productivity potential and higher earnings – and indirectly through influencing the formation of working life by affecting years of occupational and firm specific experience.

Since a major portion of higher education is often career oriented and frequently involves occupational specific types of training, we expect that changing from one type of occupation to another during the course of one's working life will be more expensive for those workers with longer years of schooling. Consequently, we expect to observe longer years of employment within current occupation – years of occupational experience – for the workers with more years of schooling, on the average, at a given length of time spent in the labor market. Years of schooling may also affect years of firm specific experience. Workers with higher level of education tend to get more firm specific training than others and therefore more firm specific types of skills and knowledge. This will reduce incentives for those workers to move to other firms and for the employer to fire those workers. Therefore, we expect to observe longer years of firm specific experience for the workers with higher level of schooling at a given length of time spent in the labor market.

We can postulate how years of schooling may affect a particular composition of work experience in the labor market for individual workers, but is another matter to exactly identify the factors and correctly specify the relationships that determine these experience variables. To mention a few, such factors as kinds of education received through the years of formal schooling – vocational, academic, types of college, etc., preference of individual workers, family background, cyclical changes in unemployment rate, will affect how individual working life is spread among specific types of labor market experience. Theory does not tell how those variables work together to determine individual working life histories, nor do we have any information on those variables.

However, an extended model of earnings determination incorporating the simultaneity among earnings, years of schooling, and years of experience variables can be expressed by the simultaneous equations model described by a set of following equations:

$$y = f(s, t1, t2, t3) + u_1 \quad (a)$$

$$Ox = g(s, A\text{-}s\text{-}6; Z1) + u_2 \quad (b)$$

$$Cx = h(s, A\text{-}s\text{-}6; Z2) + u_3 \quad (c)$$

$$t1 = A\text{-}s\text{-}6\text{-}Ox \quad (d)$$

$$t2 = Ox\text{-}Cx \quad (e)$$

$$t3 = Cx \quad (f)$$

where Ox and Cx are the years of occupational and firm specific experience, respectively, u's are the disturbance terms, Zi's are the sets of exogeneous variables that affect Cx and Ox, respectively, which are independant of years of schooling and age, and the last three equations being the definitional equations. If we further assume that the disturbance terms in the first three equations are uncorrelated with

each other, i.e., E ($u_i u_j$)=0 for i=j, i=j, i.j=1,2,3, the above model becomes recursive, and each equation can be estimated by OLS to obtain unbiased estimates of the coeffcients.

However, we do not have enough information to correctly estimate the equations for Cx and Ox. Our main concern here is to see how years of schooling affect years of occupational and firm specific experience given a period of work experience in the labor market. To this end, the following linear regression equations are proposed to estimate dt2/ds and dt3/ds:[7]

$$Cx = (A\text{-}s\text{-}6)\ (a_0+a_1 s)+u_2$$
$$Ox = (A\text{-}s\text{-}6)\ (b_0+b_1 s)+u_3$$

In the above equations, constant terms are restricted to be zero since the values of Cx and Ox cannot exceed zero when A-s-6=0, i.e., at the moment of starting career in the labor market after the completion of formal schooling. For the same reason, schooling cannot enter in the equations as a single term. The above specification is derived from the intention that Cx and Ox start from the origin of the planes (Ox and A-s-6) and (Cx and As-s6), respectively, and the years of schooling is to affect slopes of each line such that the higher the level of schooling, the larger the slope becomes. Equations estimated are shown below.

$$Cx = (0.027+0.016s)\ (A\text{-}s\text{-}6) \qquad R^2=0.20$$
$$\quad\ (3.2)\quad (17.1)$$
$$Ox = (0.082+0.023s)\ (A\text{-}s\text{-}6) \qquad R^2=0.33$$
$$\quad\ (6.2)\quad (16.3)$$

Where numbers in the parentheses below the coefficients are t-values.[8]

What remains to be done is to estimate earnings at each age-schooling cohort using the earnings function estimated and the estimated equations for Cx and Ox. Since we cannot exactly identify Cx and Ox from the above estimated equations, these equations are used to estimate how Cx and Ox are affected by the years of schooling; i.e., to estimate dt2/ds and dt3/ds.

Following procedures are adopted to estimate earnings profiles for five different levels of schooling in Korea; no schooling, 6 years of elementary school, 9 years up to junior high school, 12 years up to high school, and 16 years to college:

(1) at a given age level, the values of t1, t2, and t3 for the

7 This may leave many readers unhappy. But, since the major concern is dCx/ds and dOx/ds, the following may have to be only alternative formulation at hand. There seems no superiority of having quadratic terms in the equations.

8 These equations were estimated from the sample of 2423 male workers randomly chosen from the orignal survey sample.

group of workers with 6 years of elementary education are estimated by observing the mean values of Cx and Ox of the group in the sample and using the definitional equation of each experience variables;[9]

(2) for the other schooling groups in that age level, Ox and Cx are measured by adding to or subtracting from the values of Ox and Cx of the group of 6 years of schooling the appropriate values of dOx/ds and dCx/ds measured from the estimated equation of Cx and Ox. Then the values of t1, t2, and t3 for each schooling group can be measured from the definitional equations;[10]

(3) finally, the values of t1, t2, and t3 measured as above for each schooling group in a given age level are substituted in the earnings function estimated.

Earnings function used for the estimation of earnings profiles was obtained from the sample of 2423 male workers with the dependant variables using monthly regular earnings. Among the cash earnings reported in the Survey,[11] it seems that regular earnings will be best explained by the human capital earnings function since it excludes variations in earnings among workers due to different amount of labor supply. it seems also as a better approximation of long-run productivity of individual workers diversed from year to year variation in the profitability of a particular firm or industry. The regression equation estimated is:

$$\ell n\ Y = 7.87 + 0.105s + 0.046t1 - 0.007t1 + 0.059t2 - 0.001t2^2 + 0.119t3^2 - 0.003t3^2.$$ [12]

Earnings profiles thus estimated are reported in Table 1.

2.2. Estimation of Rates of Return to Education

The marginal internal rate of return to the with level of schooling, r_i is calculated from:

$$\sum_{j=1}^{k} \frac{E_{ij} - C_i}{(1+r_i)^j} = 0 \qquad (3)$$

where E_{ij} is the earnings differentials attributable to the ith level

9 6 years of elementary school group was chosen for the base level mainly because those from the largest bulk of the workers.

10 Cx and Ox for those with no education were calculated by subtracting the values of dCx/ds and dOx/ds from the values of the group with 6 years of schooling

11 Cash earnings reported in the Survey were monthly regular earnings, overtime earnings, and annual bonus earnings.

12 All the coefficients estimated are significant at 95 percent confidence level. R^2 was observed to be .40.

Table 1

Adjusted Monthly Earnings Profile for Different Level of Education

Age	No-School	Elementary School	Junior-High School	High School	College
15	2,922	5,472			
16-17	3,384	6,273	7,855		
18-19	3,932	7,719	9,145	12,088	
20-22	4,822	8,795	11,720	14,574	
23-25	6,057	11,059	14,913	19,890	24,735
26-30	7,122	13,711	18,920	26,423	39,695
31-35	7,840	15,093	21,504	29,260	45,615
36-40	8,621	16,587	23,506	33,624	53,423
41-45	9,575	18,435	26,081	39,340	61,944
46-50	11,003	21,183	29,851	46,119	61,759
51-55	12,695	24,440	32,016	52,260	86,422
56-60	15,444	29,732	35,101	52,982	103,259

Note: 1. Earnings reported is the estimated monthly earnings excluding overtime.
2. In estimating the internal rates, annual earnings is used.
3. Retirement age was assumed as 60.

of schooling at the jth period of one's working life, C_i is the costs associated with the ith level of schooling, and n is the length of working life after the ith level of schooling. Using the above equation, the private and social marginal internal rates of return to four different levels of schooling – elementary over none, junior-high over elementary school, high school over junior-high, and college over high school.

Total costs of education include direct educational expenditures borne by student and public, and opportunity costs incurred which are the foregone earnings for the students while attending school rather than working. The cost data used in this chapter is borrowed from the study of Y. Chang whose data was based on the Annual Educational Survey in Korea in 1971 by the Ministry of Education and the Manpower Development Survey in 1970 by the Manpower Development Research Institute.[13] Those figures were adjusted for the rate of inflation to make the cost data compatible with the 1973 level of earnings.

Table 2 shows the total direct costs of education per student for each level of education in 1973 which are the estimates of Chang inflated by the price index. The direct costs of education included two items: (1) in-school expenditures including such items as tuition, fees, capital expenditures including the depreciation of school facilities, etc.; and (2) outside expenditures which include expenses

13 Chang(1974).

for books, supplies, transportation, and for room and board. Portion fo in-school expenditures paid by the students are also reported in Table 2.

Estimates of opportunity costs are the adjusted earnings estimated through earnings function. In estimating the opportunity costs, it was assumed that there is no employment opportunities open to children of age up to 14 years and that employment beyond that age continues without interruption after the completion of one's formal education. Since it is not unusual for college students to take part-time jobs during their school years, possible error is suspected in estimating opportunity costs for college student when opportunity costs for college students are assumed to be full amount of foregone earnings.

Total private costs of education, therefore, include direct cost borne by the student and opportunity costs. Total social costs are obtained by adding direct educational expenditures not borne by the students to total private costs.

The private and social margnial rates of return to investment in four different levels of education are calculated using equation (3) with the age-earnings profiles obtained and above cost data – private costs for private rate of return and social costs for social return. The rates thus calculated are reported in Table 3. Both rates, social and private, decline through additional level of schooling; social rate of return diminishes from 15.5 percent for the elementary education to 8.8 percent for college; and private rate declines from 22.8 percent for elementary school to 9.9 percent for college. This seems to verify the conjecture that the margnial efficiency of investment in schooling is decreasing. Confronted with these estimates of private returns, individuals would thus tend to increase their amount of schooling if the supply of investment funds becomes greater, or if the marginal internal discount rate applicable to them were to decrease. The

Table 2

Total Direct Education Expenditure per student, 1973

Level of Schooling	In-school Expenditure	In-school Exp. paid student	Out-of school expediture	Direct Exp. paid by student	Total Exp. per student
Elementary School	18,499	2,669	9,461	12,130	27,960
Junior-High School	37,460	27,271	27,503	54,774	64,963
High School	45,675	35,317	37,715	73,032	83,390
College	192,168	114,480	83,489	197,969	275,657

* Figures above are estimated by inflating Chang's estimates of educational expenditures by 25 percent.

Table 3

Estimates of Cross Sectional Rates of Returns to Education in Korea 1973

	Social	Private
Elementary over None	15.5%	22.8%
Junior-High over Elementary	14.4%	15.3%
High School over Junior-High	12.2%	12.4%
College over High School	8.8%	9.9%

* Internal rates are calculated from the University of Minn. computer package, BAS/GIRRVP.

difference between social and private marginal rates to different levels of schooling are not significant except for elementary education. This is apparently because of the fact that only a small portion of the educational expenditures are financed by students at elementary education.

These estimates are based on cross-sectional relationship between the earnings and years of schooling received from the educational system of the past. It may not accurately reflect, therefore, the expected earnings stream for the generation currently enrolled in the present educational system in Korea. In absolute terms, future earnings differentials related to different schooling level will be greater than the measures currently observed, thus generating greater values of estimates of estimated rates. However, it is not a priori clear how the relative earnings differentials may change over time.

From the working sample adopted in this study, two major sectors of the economically active population are omitted: — those employed in the agricultural sector and the urban self-enplayed. Since the age-schooling-earnings association are not clearly documented for these sectors, it is not clear how the exclusion of these sectors will affect the relative earning differential among different schooling groups. Careful consideration should be given before any application of these estimated rates to actual policy concern seems necessary.

Since the measure of social costs and benefits accrued from each level of schooling may vary according the subjective definition. If the educational authority is determined that margnial changes in the resources devoted to educational investment must produce as high a return as marginal changes in the resources devoted on other investment projects, rates of return on educational investment are relevant. On the other hand, if the authority favor non-economic objectives and

non-pecuniary returns from education such as forstering national cohesion or boosting democratic system, etc., then the rates or return to education are simply irrelevant.[14]

3. Conclusion

In this paper, an attempt was made to utilize a particular set of earnings data which provides information on individual labor market history in estimating cross-sectional age earnings profiles. Because of the lack of succint economic theory on the rate of turn-over and sufficient data source, the method presented here seems to be ad hoc and heuristic. However, it was seen in this paper that one of the feature education provides in affecting individual earnings is job security and low turn-over rate besides inherent function of enhansing productivity potential of individual. At the same time, with the method presented here, it was possible to distinguish these features in estimating earnings profiles.

In view of this paper, future study in this field should be directed to formulating an earnings function which encompasses other factors as family background, individual ability, type of education as well as length of education, etc., as dependant variables which were omitted in this analysis for better understanding the formation of individual earnings and obtaining more confident estimates of rate of returns to educational investment.

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14 Problems in the application of rate of return analysis in educational policy can be found in Blaug (1965).

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