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Does Human Capital Investment Increase Inequality of Earnings in Korea?*

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The empirical human capital model of personal distribution of earnings hypothesizes that there is positive relationship between human capital investment and inequality of earnings. Some empirical evidence supports this hypothesis, but some does not. Thus, the effect of investment in human capital on inequality of earnings remains controversial.

By using the same human capital framework, I find that human capital investment per se does not ensure a more equal or a more unequal distribution of earnings, and it can be used as a tool to solve not only absolute poverty but also inequality of earnings by implementing relevant policy measures.

I. Introduction

With the advent of the human capital theory in the 1960s, the role of investment in human capital in reducing inequality of earnings distribution has attracted considerable attention. The human capital theory predicts a positive relationship between investment in human capital and earnings inequality even though investment in human capital improves the level of earnings.[1] However, some economists such as Tinbergen (1972) and Winegarden (1979) have advocated investment in human capital as a major set of policies directed toward the important goal of improving the level of earnings and of reducing inequality of earnings. Therefore, the effects of investment in human capital on the personal distribution of earnings still remain controversial.

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[1] See Chiswick (1974), Hirsch (1978), Shah (1986), etc.

The basic idea of the human capital theory starts from the analysis of the earnings function. Suppose the earnings function is:

$$(1)\quad \ln Y = a + r\,HK + u$$

where ln Y = natural logarithm of earnings,
HK = amount of human capital investment,
r = rate of return to human capital investment,
u = stochastic error term.

If r and HK are independent random variables, then taking the variance of both sides of equation (1) would result in:

$$(2)\quad \mathrm{Var}(\ln Y) = (\bar{r})^2\,\mathrm{Var}(HK) + (\overline{HK})^2\,\mathrm{Var}(r) + \mathrm{Var}(r)\mathrm{Var}(HK)$$

where the bar(–) on the top of a variable represents the mean value of the variable.[2] Since each term in the right hand side of equation (2) is positive, the human capital theory argues that an increase in human capital investment leads to a more unequal distribution of earnings.[3] However, I find that interpretation of the equation (2) by the human capitalists has been too strict, and that the human capital investment does not always increase inequality of earnings even within the human capital framework. So, in this paper, I will show in which case human capital investment can increase or decrease inequality of earnings.

Usually a large proportion of female workers drop out of the labor force during their childbearing period and the labor force participation rate of females is much lower than that of males. Thus, human capital variables are relatively weak in explaining the relationship between earnings and human capital investment. Since household income is largely determined by earnings of a household head, who is usually male, the personal distribution of earnings of male workers is more important. Therefore, I will examine the relationship between the distribution of earnings and human capital investment only for male workers in this study.

[2] Var (ln Y)/(ln Y) may be more appropriate than Var (ln Y) for the independent variable in equation (2), because the former represents relative inequality, while the latter shows absolute inequality. In this paper, however, I want to show the human capital model can explain the phenomenon that human capital investment does not always increase inequality of earnings. Therefore, I will use the same independent variable with the traditional human capital model.

[3] When r and HK are dependent, the net effect of human capital investment is indeterminate (see Marin and Psacharopoulos (1976), Yoo (1988)).

II. The Human Capital Model

Human capital is defined as any productive power embodied in a person produced at a cost and providing useful services over a lifetime in either production or consumption (Chiswick (1974)). Human capital is acquired by formal education or schooling, vocational training, on-the-job training, learning by doing through job market experience, medical care, getting information, migration, and so on. However, it is impossible to deal with all kinds of human capital because we cannot get information on kinds of human capital accumulated by each individual. Therefore, I will consider only two forms of human capital in this paper: education and job market experience. Job market experience is considered as post-school investment in human capital.

People with the same level of human capital actually have different experience-earnings profiles, because of differences in abilities, attitudes toward work, family and cultural backgrounds, and so on. Therefore, the personal distribution of earnings can be measured as a distribution of experience-earnings profiles, that is, as the variance of the natural logarithm of earnings of each individual.

In the human capital theory, it is assumed that investment in human leads to higher productivity of workers, which causes higher earnings. The relationship between the level of earnings and the level of human capital investment is generally represented as following Mincer's earnings function (Mincer (1974)).

$$(3)\quad \ln Y = a + r\,ED + b_1 EXP + b_2 EXPSQ + u$$

or

$$(4)\quad \ln Y = a + r\,ED + b_1 EXP + b_2 EXPSQ + c \ln WEEK + u$$

where $\ln Y$ = natural logarithm of earnings,
ED = years of education,
EXP = years of job market experience,
$EXPSQ = (EXP)^2$,
$\ln WEEK$ = natural logarithm of the number of weeks worked,
u = stochastic error term.

Since earnings increase with educational level, the coefficient of years of education(r) is positive and it is interpreted as an estimate of the average rate of return to education (Conlisk (1987)). Years of job market

experience (EXP) is interpreted as postschool investment in human capital, so the coefficient of experience(b_1) is also positive. Usually older workers have less incentive to invest in human capital because benefits from investment decline as the payoff period shortens and the human capital stock depreciates. Therefore, the typical experience-earnings profile is concave and the coefficient of squared experience(b_2) is negative. Usually as the number of weeks worked increases, earnings increase. So the coefficient of the natural logarithm of the number of weeks worked(c), which measures the elasticity of earnings with respect to weeks worked, is also positive. Mincer (1974) finds that r is very stable, so he assumes that r is constant.

Hirsch (1978) and Shah (1986) delete the variable EXPSQ from the earnings equation (4) for simplicity and get:

$$(5)\quad \ln Y = a + r\,ED + b\,EXP + c\,\ln WEEK + u$$

Assuming that r and b are random variables independent of ED and EXP respectively, and that r and b are uncorrelated, they take the variance of both sides of equation (5) and get:

$$\begin{aligned}(6)\quad \text{Var}(\ln Y) &= (\bar{r})^2\,\text{Var}(ED) + \text{Var}(r)(\overline{ED})^2 + \text{Var}(r)\text{Var}(ED)\\ &+ (\bar{b})^2\,\text{Var}(EXP) + \text{Var}(b)(\overline{EXP})^2 + \text{Var}(b)\text{Var}(EXP)\\ &+ c^2\text{Var}(\ln WEEK) + 2\bar{r}\bar{b}\,\text{Cov}(ED, EXP)\\ &+ 2\bar{r}c\,\text{Cov}(ED, \ln WEEK)\\ &+ 2\bar{b}c\,\text{Cov}(EXP, \ln WEEK) + \text{Var}(u)\end{aligned}$$

Relative earnings inequality is now expressed as a function of variances and covariances in education, experience, and employment, the distribution of the rate of return to education, and the distribution of the slope of the experience-earnings profiles. Since each term in the right hand side of equation (6) is positive, based on equation (6), the human capital model predicts that earnings inequality is positively related to the level of investment in human capital.

In the traditional human capital model, usually the variable "EXPSQ" is deleted for simplicity from the earnings function. The deletion of EXPSQ, however, will bias the slope coefficients of experience-earnings profiles downward. So if we use Mincer's full log earnings function, as in equation (3), and if we assume that the rate of return to education(r) is a random variable independent of years of education(ED), that the slope coefficients of earnings profile (b_1 and b_2) are random variables independent of experience (EXP and EXPSQ), and that r, b_1, and b_2 are

uncorrelated, and if we permit interdependency only among ED, EXP, and EXPSQ, then taking the variance of both sides of equation (3) would result in:

$$
\begin{aligned}
(7)\ \text{Var (ln Y)} \quad &= (\bar{r})^2\ \text{Var(ED)} + \text{Var}(r)\ (\overline{ED})^2 + \text{Var}(r)\text{Var(ED)} \\
&+ (\bar{b}_1)^2\ \text{Var(EXP)} + \text{Var}(b_1)(\overline{EXP})^2 + \text{Var}(b_1)\text{Var(EXP)} \\
&+ (\bar{b}_2)^2\ \text{Var(EXPSQ)} + \text{Var}(b_2)(\overline{EXPSQ})^2 \\
&+ \text{Var}(b_2)\text{Var(EXPSQ)} + 2\bar{r}\bar{b}_1\ \text{Cov(ED, EXP)} \\
&+ 2\bar{r}\bar{b}_2\text{Cov(ED, EXPSQ)} + 2\bar{b}_1\bar{b}_2\text{Cov(EXP, EXPSQ)} \\
&+ \text{Var(u)}
\end{aligned}
$$

In equation (7), most of terms are readily obtainable from the available data. The only unknowns are Var(r), Var(b_1), and Var(b_2). However, if the underlying model is equation (7), then the equation to be estimated is:

$$
\begin{aligned}
(8)\ \text{Var (ln Y)} \quad &= e_0 + e_1((\bar{r})^2\ \text{Var(ED)}) + e_2(\overline{ED})^2 + e_3\text{Var(ED)} \\
&+ e_4((\bar{b}_1)^2\ \text{Var(EXP)}) + e_5(\overline{EXP})^2 + e_6\ \text{Var(EXP)} \\
&+ e_7((\bar{b}_2)^2\ \text{Var(EXPSQ)}) + e_8(\overline{EXPSQ})^2 \\
&+ e_9\ \text{Var(EXPSQ)} + e_{10}(2\bar{r}\bar{b}_1\text{Cov(ED, EXP)}) \\
&+ e_{11}(2\bar{r}\bar{b}_2\ \text{Cov(ED, EXPSQ)}) \\
&+ e_{12}(2\bar{b}_1\bar{b}_2\ \text{Cov(EXP, EXPSQ)}) + u'
\end{aligned}
$$

where Var(u) is captured in e_0, and u′ is a random disturbance term. The value of unknowns is roughly measured by estimated coefficients, that is, $\text{Var}(r) = e_2 = e_3$, $\text{Var}(b_1) = e_5 = e_6$, and $\text{Var}(b_2) = e_8 = e_9$.

III. Data

The data for this study are raw data of the Occupational Wage Survey of Korea for the years 1976 and 1986 conducted by the Ministry of Labor of the Republic of Korea. The purpose of this survey is to provide basic wage statistics for the study of labor earnings and wage structure in the Korean labor market. The survey collects various information on workers, such as age, sex, level of education, occupation, industry, skill level, years of experience in the current occupation, years of employment in the current firm, number of days worked in a month, number of hours worked in a month, regular monthly payment, overtime payment, other sources of payment, bonus in a year, total monthly payment, location of the firm,

firm size, and so on, as of March of each year.

The survey of each year has a sample size of approximately 300 to 500 thousand workers from about three thousand sampled firms employing ten or more workers. The survey covers workers of 50 industries in 1976 and 49 industries in 1986. The reason why the number of industry is smaller in 1986 is that the agriculture, forestry, hunting and fishing industries are excluded from the 1986 survey.

The survey reports the level of education completed, not the years of education. A dropout of high school, for example, is reported as a middle school graduate. So I convert the level of education completed to the actual years of education by considering years of education in each level of schooling. For example, if a person graduates from primary school, his years of education is 6, and if he graduates from middle school, his years of education is 9, and so on. This poorly represents years of education of dropouts, but it will not change estimators of earnings equation a lot because the percentage of dropouts is very small in Korea.[4] Years of job market experience are categorized into five groups: less than one year, 1-2 years, 3-4 years, 5-9 years and 10 or more years. Although the data report years of employment in current job, the average level of experience at current job is very short: 3.6 years in 1976 and 4.7 years in 1986. So experience in "current" job is inappropriate as an explanatory variable of earnings. Therefore, I use "age — years of education (ED) — 6" as a proxy of years of total job market experience. It is generally accepted that this proxy is good for male workers if there is no chronic unemployment, but it is inappropriate for females because large proportion of females dropout of the labor force during their childbearing period (Blinder (1976)). Since there has been no significant unemployment during last 25 years in Korea and I estimate just for male workers, the proxy of "age — years of education — 6" does not represent a big problem.

The Occupational Wage Survey Data provides a lot of very useful information on Korean labor market behavior, but a weakness of this data set is that it does not cover firms employing fewer than ten workers and it excludes workers employed in national and local government, the military and the police, and national and public educational institutions.

4 Dropout rates of students in Korea are 6.9 percent for primary school, 5.7 percent for middle school, and 5.5 percent for high school in 1976. In 1986, they are 3.7 percent for primary school, 3.0 percent for middle school, and 7.3 percent for high school (*Social Indicators in Korea,* Economic Planning Board, 1987).

IV. Estimation and Empirical Results

A. The Unit of Analysis

Usually workers in the same occupation group are relatively homogenous with respect to the amount of human capital accumulated. As a result, if occupation is selected as the unit of observation, human capital variables may have relatively weak explanatory power. This seems to be the reason why Shah (1986) finds that education has no significant effect on the distribution of earnings when occupation is selected as the unit of observation, while education has a significant effect on the distribution of earnings when region is chosen as the unit of observation. Region may be thought of as an appropriate unit of observation in Korea, but since Korea is a small country and most firms are concentrated in certain regions, if we choose region as the unit of observation, we have too small a number of firms in many regions. So region seems to be inappropriate as the unit of observation in Korea. Usually the variance of human capital by industry group will be relatively large. Therefore, industry seems to be the most appropriate unit of analysis. So I use industry as the unit of observation in this study.

B. The Determinants of the Personal Distribution of Earnings

The regression results are presented in Table 1, and a detailed explanation on the personal distribution of earnings follows.

1. The Rate of Return to Education and the Variance of Education

For both years, the product of the rate of return to education and the variance of education $((r)^2\text{Var}(ED))$ has a significant positive sign, and this is consistent with the findings of Hirsch (1978) and Shah (1986). This result means that there is a positive relationship between inequality of earnings and $(\bar{r})^2\text{Var}(ED)$. Therefore, we can draw two policy implications from this result, which Hirsch (1978) and Shah (1986) neglected.

First, if the rate of return to education is stable, as the variance of education becomes smaller, earnings inequality will decrease. Thus, policies that would help to equalize educational opportunities would reduce inequality of earnings distribution in the future by reducing the variance of education.

When the average level of education of the labor force is zero, the variance of education will also be zero. As some people begin to go to primary schools, middle schools, high schools and colleges, however, the

variance of education (Var(ED)) will gradually increase as the average level of education increases. If all people graduate from colleges, Var(ED) will become very small. Therefore, we can hypothesize that the relationship between Var(ED) and the level of education will depict the inverted U-shaped curve. Thus, if other things remain constant, when the average level of education is very low, investment in education may initially lead to a more unequal distribution of earnings because an increase in the level of education leads to an increase in Var(ED), which will also increase the interaction effect between the rate of return to education and Var(ED). A continuous increase in the level of education, however, is likely to lead to a more equal distribution of earnings in the long run because when the average level of education is very high, an increase in the level of education will reduce Var(ED) and so the interaction effect between the rate of return to education and Var(ED) becomes smaller. This may be a part of the reason for the inverted U-shaped relationship between economic growth and inequality of earnings as hypothesized by Kuznets (1955).

Table 1

REGRESSION RESULTS

Variable	1976		1986	
Intercept	−0.10963	(−0.93)	0.16673	(2.77)
$(\bar{r})^2$Var(ED)	1.30495	(7.54)*	1.28582	(6.14)*
$(\overline{ED})^2$	0.00065	(1.98)	−0.00017	(−0.80)
Var(ED)	−0.00093	(−0.11)	0.00097	(0.17)
$(\bar{b}_1)^2$Var(EXP)	1.22247	(1.85)	1.74916	(3.61)*
$(\overline{EXP})^2$	0.00047	(1.00)	0.00014	(0.57)
Var(EXP)	0.00240	(1.19)	−0.00312	(−2.47)*
$(\bar{b}_2)^2$Var(EXPSQ)	1.81103	(1.61)	2.34889	(2.38)*
$(\overline{EXPSQ})^2$	−0.00001	(−0.80)	−0.0001	(−1.55)
Var(EXPSQ)	−0.00001	(−0.62)	0.00001	(2.85)*
$2\bar{r}\bar{b}_1$Cov(ED, EXP)	1.36063	(3.20)*	1.13358	(2.60)*
$2\bar{r}\bar{b}_2$Cov(ED, EXPSQ)	1.53740	(2.09)*	0.79453	(1.07)
$2\bar{b}_1\bar{b}_2$Cov(EXP, EXPSQ)	1.41871	(1.58)	2.00723	(2.81)*
$\bar{R}^2$	0.7981		0.7932	
F	17.140		16.340	

Notes: Dependent variable = Var(ln Y)
t-ratios in parentheses
* represents significant coefficient at 5% level.
n = 50 industries for 1976 and 49 industries for 1986

Thus, even if investment in education can, in some circumstances, lead to a greater inequality of the personal distribution of earnings in the short run, policies designed to reduce inequality of educational opportunities are likely to contribute to a more equal distribution of earnings in the long run. Examples of such policies include subsidies for educational expenditures, exemption of a part of educational expenditures for students in the households of low income level, bank loans for educational expenditures at more favorable conditions, tax reduction on educational expenditures, an increase in the compulsory education period, providing more evening school education and correspondence education, and an increase in the vocational training opportunity.

Second, if the variance of education is stable, as the average rate of return to education decreases, earnings inequality will become small. Therefore, policies that would reduce the wage differential by educational level will reduce inequality of earnings by reducing the average rate of return to education.

However, the regression results show that the effect of the variance of education on inequality of earnings is not significant in either year. This is consistent with the regression result of Hirsch (1978) and Shah (1986). According to this result, the variance of education per se is not important in determining inequality of earnings, even if the interaction effect between the rate of return to education and the variance of education has a significant positive effect on inequality of earnings.

2. The Level of Education

The coefficient of $(\overline{ED})^2$ is insignificant in both years. Therefore, as in Hirsch (1978) and Shah (1986) the level of education per se has no significant effect on inequality of earnings. Thus, an increase in the average level of education itself does not guarantee the decrease of inequality of earnings.

3. The Level of Experience and the Variance of Experience

The coefficients of $(\overline{EXP})^2$ and $(\overline{EXPSQ})^2$ are insignificant in both years, and this is consistent with the findings of Hirsch (1978) and Shah (1986). This result means that the years of experience per se is not important in determining the distribution of earnings.

The products of the slope coefficient of the earnings profile and the variance of experience (more precisely $(\overline{b}_1)^2$Var(EXP) and $(\overline{b}_2)^2$ Var(EXPSQ)) are insignificant in 1976 as in Hirsch (1978) and Shah (1986), but they are significant in 1986. Also the coefficient of Var(EXP)

is insignificant in 1976, but it is significant in 1986. Thus, the effect of the variance of experience is not clear in this model.

4. The Interaction between Education and Experience

There are several interactive variables in the model. In both years, the coefficients of $2\bar{r}\bar{b}_1$Cov(ED, EXP), $2\bar{r}\bar{b}_2$Cov(ED, EXPSQ) and $2\bar{b}_1\bar{b}_2$Cov (EXP, EXPSQ) have positive sign. Since the covariance between education and experience is negative, a larger negative covariance between education and experience is associated with greater equality of the distribution of earnings. As the educational level increases, it becomes more difficult and, on average, takes more time to enter the higher educational level in Korea. Thus, the negative covariance between education becomes larger with the educational level, and this will reduce inequality of earnings.

V. Conclusion

Until now, the human capital model argues that an increase in human capital investment will lead to an increase in inequality of earnings. Some empirical evidence supports this hypothesis, but some does not.

I find that the interpretation of the human capital model has been too strict and it has neglected the interaction effects between human capital investment and the rate of return to human capital investment. The important aspects of education in the determination of the personal distribution of earnings are the "interaction effects" between the rate of return to education and the variance of education, and between the rate of return to education and the level of education. If the rate of return to education is stable, increases in the level of education and the variance of education lead to a more unequal distribution of earnings, while decreases in the level of education and the variance of education lead to a more equal distribution of earnings. If the level of education and the variance of education are stable, an increase in the rate of return to education leads to a more unequal distribution of earnings, and a decrease in the rate of return to education leads to a more equal distribution of earnings. If both the rate of return to education and the variance of education decrease at the same time, the interaction effect between them leads to a more equal distribution of earnings. And if both the rate of return to education and the variance of education increase at the same time, the interaction effect between them leads to a more unequal distribution of earnings. From these results, we can conclude that the effect of education on the personal distribution of earnings depends on situations of each country. Therefore, policies that reduce the rate of return to education and the

variance of education will reduce inequality of earnings in the future.

It is found that the relationship between the variance of education and the level of education depicts an inverted U-shaped curve. Thus, if other things remain constant, it can be hypothesized that, when the average level of education is very low, investment in education will initially increase inequality of earnings in the short run, but its effects on inequality of earnings gradually decline, and investment in education will reduce inequality of earnings in the long run.

From these regression results, we can see that the absolute amount of human capital investment is not important in the personal distribution of earnings. Investment in human capital itself will not ensure a more equal or a more unequal distribution of earnings, and it could be used as one of the tools for equalizing the distribution of earnings if the government implements appropriate policy measures.

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