Educational Choice, Wage Determination, and Rates of Return to Education in Taiwan

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This paper estimates educational choice, wage determination, and the rate of return to education in Taiwan using Taiwan's Manpower Utilization Survey data of 1996. As education investment is a self-selection process, this paper adopts a two-stage estimation method. First, a polychotomous ordered probit model is used to estimate the education decision. Second, the wage equations of different educational attainments are estimated by incorporating the possible selection bias obtained in the probit model. Finally, rates of return on each education level are calculated from the estimation results. (JEL I21, J24, J31)

Introduction

For the past fifty years since World War II, the proportion of educated people in Taiwan has been increasing tremendously. The number of students increased from 1.19 million in 1953 (18.6 percent of the population over six years of age) to 5.18 million in 1997 (26.2 percent of the population over six years of age). The enrollment rates of all education levels also surge over time: from 56.96 percent in 1953 to 90.7 percent in 1997 for senior high school and from 26.27 percent in 1953 to 56.88 percent in 1997 for college and university.1 The average years of education increased from 5.5 in 1976 to 10.55 in 1997. According to the human capital theory [Becker, 1975], people forego their possible earnings (including all costs of schooling), accumulate skill and knowledge in school, and expect in return to receive higher lifetime earnings. If education is a type of investment, what are the rates of returns for different education levels? Moreover, schooling is not only an individual's decision but it is also a family decision.2 That is, people self-select into appropriate educational attainment according to their talent and family resource constraints. In this regard, the observed market wages for different educational attainment are the result of self-selection. Therefore, any direct calculation of rates of educational returns, even after considering individual and job attributes, may still be subject to bias. In this paper, a two-stage selection-corrected method was adopted using Taiwan's Manpower Utilization Survey data of 1996.3 The individual's educational decision is examined first by a polychotomous ordered probit model. The wage equations of different educational attainments were then estimated by incorporating the possible selection bias term obtained in the ordered probit estimation. Finally, returns on each education level are calculated from the estimation results.

The rest of the paper is organized as follows. The second section provides the theoretical background for the optimal education decision and self-selection process, and the third

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The fourth section summarizes the estimation results and calculates the rates of returns for each education level, and concluding remarks are made in the fifth section.

The Theoretical Model

This section provides a theoretical model that emphasizes the self-selection process of educational choice and the need to correct the selection bias for the estimation of wage equations of different education levels. Suppose each individual maximizes the present value of his lifetime earnings, defined as:

$$ V(s) = \int_s^N y(s) e^{g(t-s)} e^{-r t} dt $$ \hspace{1cm} (1)

where $y(s)$ is the income for $s$ years of education, $N$ is the year of retirement, $g$ is the growth rate of income, and $r$ is the discount rate. Integrating (1) yields:

$$ V(s) = \frac{y(s)}{r - g} \left[ e^{-r s} - e^{(N-s)g} e^{-r N} \right] . $$ \hspace{1cm} (2)

Let $N$ approach infinity. Then (2) will reduce to $V(s) = \frac{y(s)}{(r - g)} e^{-rs}$. Thus, the first-order condition for optimal education is:

$$ \frac{\partial V(s)}{\partial s} = \frac{y'(r - g) + g' y}{(r - g)^2} e^{-rs} - \frac{y}{r - g} e^{-rs} = 0 , $$ \hspace{1cm} (3)

where:

$$ y' = \frac{\partial y}{\partial s} > 0 , \quad g' = \frac{\partial g}{\partial s} \leq 0 , \quad \text{and} \quad V_{ss} = \frac{\partial^2 y}{\partial s^2} \leq 0 . $$

The growth rate of income has the property that $g : \mathbb{R} \rightarrow \mathbb{R}$ is a strictly quasi-concave function, which satisfies $\lim_{s \to \infty} g(s) < r$. From (3), optimal education can be expressed as:

$$ S = S(y', r, g, g') . $$ \hspace{1cm} (4)

Let income at time $t$ with $s$ years of education be:

$$ y(t) = ye^{g(t-s)} e^0 $$ \hspace{1cm} (5)