

Unlocking Effect of Education

VorapitchayaRabiablok¹ and Peerawich Thoviriyavej²⁺

¹Independent Researcher

²Assumption University, Bangkok, Thailand

Abstract. This paper illustrates the benefit of evaluating the effect of education on income using education level rather than years of schooling. The result indicates that an extra year of advance education is worth more than an extra year of basic education. Our findings contradict with past research articles that find evidence of diminishing return to education but are consistent with Becker's[2] and Schultz's[9] claim that the positive effect of education on income is not uniform. Ultimately, our findings offer guideline for nation's education financing policy.

Keywords: Effect of Education, Cumulative Logit Model, Education Financing.

1. Introduction

Human capital theory posits positive relationship between education and income. Thus, one attends school hoping to make more money afterward. However, Becker[2] and Schultz[9] insist that this positive effect of education on income is not uniform. Different levels of schooling may have different effects on wages. Using years of schooling as a predictor in the income model is incapable of capturing this heterogeneous effect of education on income because the estimate coefficient implies an extra year of education creates uniform effect on income. Hence, the model would suggest that an extra year in elementary school is no different than an extra year in college. To make matter worse, past research articles find evidence of diminishing return to education. (Becker[2])

In this paper, we illustrate the benefit of evaluating the effect of education on income using education level rather than years of schooling using national survey data administered by King Prajadhipok's Institute. Because the response variable of our data is categorical, instead of using the conventional regression model we employ a cumulative logit model to fit this data. Agresti[1] and Ramsey&Schafer[7] recommend using the cumulative logit model with an ordinal response variable as it allows the model to capture information embedded in the internal ordering of the income level and to give simpler interpretations with possibly more power than other logits model.

2. Data

The data contains 1,880 samples with 155 variables. This national survey was conducted in Thai by King Prajadhipok's Institute (KPI) using a stratified survey method. Because many variables were unrelated to the main interest of this article, we selected only 9 relevant variables for our study. Schultz[8] notes that many studies of returns to education include only wage earners in their sample, while the excluded group may be relatively small in high-income countries, it represents a significant portion in low-income countries such as Thailand. This set of data contains samples of both wage earners and non-wage earners thereby avoiding bias noted by Schultz.

The response variable is a multilevel categorical response of monthly income. Originally, the income level was classified into 8 levels ranging from less than 5,000 baht (160 USD) to over 100,000 baht (3,175 USD). But samples with income over 40,000 Baht account for less than 5% of the entire sample, we had to reclassify income level into 5 levels.

This KPI data contains two variables as a measure of education; 1) Years of Schooling and 2) Education Level. For years of schooling, the minimum, median, and maximum value is 0, 9.23, and 39 years,

⁺Corresponding author. Tel.: +662-723-5178; fax: +662-313-4673.
E-mail address: peerawicht@hotmail.com.

respectively. As for the education level, this variable categorized education into ten categories from 'no official schooling' to 'higher than a bachelor degree'. Although this categorical variable is nominal, it can be recategorized to an ordinal variable by combining vocational education with general education system. Table 1 shows the counts of Education Level pre and post classification.

Table 1: Classification of Monthly Income Level

Original Classification	Counts	Percentage	Reclassification	Counts	Percentage
No Schooling	52	2.77%	No Schooling	52	2.77%
Not Finish Primary	140	7.47%	Not Finish Primary	140	7.47%
Finish Primary	639	34.10%	Finish Primary	639	34.10%
Not Finish VS	32	1.71%	Not Finish HS/VS	63	3.36%
Finish VS	230	12.27%	Finish HS/VS	635	33.88%
Not Finish HS	31	1.65%			
Finish HS	405	21.61%			
Pursuing BA	103	5.50%	Pursuing BA	103	5.50%
Finish BA	219	11.69%	Finish BA	219	11.69%
Higher than BA	23	1.23%	Higher than BA	23	1.23%
Total	1874		Total	1874	

Note: there are six NA's. HS = High School, VS = Vocational School, and BA = Bachelor Degree

3. Methodology

Follow the Mincer Model, we model income level as a function of education, gender, and age and age-squared as proxy for experience as well as accounting for nonlinearity in experience. Because the response variable is ordinal, we opt to go with the cumulative logit model. According to Ramsey&Schafer[7], using this model may allow the model to capture information that is embedded in the internal ordering of the income level¹.

We ran two models. One using years of schooling while another using education level in order to capture for different effect of education. Using the cumulative logit, our income model can be expressed mathematically as;

$$P(Y \leq i) = \alpha_i + \beta_1 Female + \beta_2 Age + \beta_3 Age^2 + \beta_4 Yrs. School, \quad i = 1, \dots, 4$$

In this logit model, the coefficient of the covariates gives an estimate of the odd of being in the next income level and these coefficients are merely analogous to the slope in the Ordinary Least Square (OLS) regression. As illustrated earlier, this cumulative logit model yields one constant coefficient for each explanatory variable, therefore, each of the four logits will have the same set of coefficients - β_1 , β_2 , β_3 , and β_4 . Essentially, the model is suggesting that an extra year of education whether at a kindergarten or college level affects one's ability to make money equally. We pay special attention to β_4 as it estimates the effect of education. Thus, for education to pay off it must be positive to indicate that more education will increase the odd of being in the higher income level. Addition to the 4 coefficients, the model produces four intercepts which is indexed by i , where $i = 4$ represents the highest income level while $i = 0$ represents the baseline or lowest income level.

To address Becker's[2] and Schultz's[9] claim that the effect of education is non-monotonic, education level is used in place of years of schooling in the model. Then, converting polychotomous covariate into multiple dummy variables we have the following model:

$$P(Y \leq i) = \alpha_i + \beta_1 Female + \beta_2 Age + \beta_3 Age^2 + \beta_4 NF. Elementary + \beta_5 F. Elementary + \beta_6 NF. Secondary + \beta_7 F. Secondary + \beta_8 Pursue. BA + \beta_9 Finish. BA + \beta_{10} Higher Than. BA, \quad i = 1, \dots, 4$$

¹An Ordinary Least Square (OLS) regressions have been fit and it suggests that years of schooling and education is positively associated with income level (p-value = 0) but the residual plot and normal Q-Q plot suggest that the normal assumptions of the response and error terms were violated.

NF and F are short for 'not finish' and 'finish'. Becker[2], Buchmann&Brakewood[4], and Schultz[8][9], all suggest that we should expect different pattern of β_4 to β_{10} . According to Schultz[9], if Becker's view is correct, we will see a positive but decreasing trend in the coefficients of education level, that is $\beta_4 > \beta_5 > \beta_6 \dots > \beta_{10} > 0$, indicating returns to schooling would decline with more advanced schooling.² It would be interesting to see what this data set will reveal.

4. Result and Discussion

Table 2 presents the estimate coefficients of the two cumulative logit models. Positive coefficient indicates favorable odd whilst negative coefficient indicates unfavorable odd.³

Table 2: Estimated Coefficients from Cumulative Logit Model

	Model 1 (N=1,751)			Model 2 (N = 1,858)		
<u>Intercepts</u>						
Less than 5,000	baseline			baseline		
Over 5,000-10,000	1.7194	***	(0.4562)	-0.1845		(0.4493)
Over 10,000-20,000	3.1021	***	(0.4593)	1.1868	**	(0.4495)
Over 20,000-30,000	4.2779	***	(0.4646)	2.3846	***	(0.4517)
Over 30,000	5.3603	***	(0.4711)	3.5104	***	(0.4565)
<u>Coefficients</u>						
Female	0.008		(0.0868)	-0.0436		(0.0846)
Age	0.055	**	(0.0185)	0.054	**	(0.0185)
Age^2	-0.0004	*	(0.0002)	-0.0005	*	(0.0002)
Years of schooling	0.1699	***	(0.0112)			
NF Elementary				-0.8741	**	(0.2343)
Finish Elementary				-1.0245	***	(0.1871)
Finish Secondary				-0.0718		(0.185)
Pursuing BA				0.797	**	(0.2487)
Finish BA				1.3753	***	(0.2127)
Higher than BA				2.594	***	(0.4552)

Note: standard errors are in parentheses, *P < .05, **P < .01, ***P < 0 (Wald z-test). NF = Not Finish and BA = Bachelor Degree. For model 2, three Chi-square tests to remove either NF or Finish Secondary, and both yield p-value of .48, .19, and .40, respectively. However, only NF Secondary was removed because of interest in comparing coefficient at secondary level to other education level. Because the sample size was different, for comparison purpose, years of schooling was also used in place of education level and the coefficient was 0.1425 (p-value =0).

In general, both models suggest the effect of education observed is favorable and somewhat similar to those observed in Turkey.(Oksuzler[6]) In Thailand, the estimate effect of education is 0.17 (SE = .01). Given a fixed income level, an extra year education is expected to increase the odd of earning the next income level by $e^{0.17} = 1.19$ times or 19%, given that all of the other variables in the model are held constant. These results reassure that investment in education is rewarding because it increases the chance of earning a higher income level. In addition, age and experience also impact one's chance of earning in a positive way. Using the deviance test, we also test for nonlinearity of the experience term, Age-squared. A Chi-square with df = 1 and different in deviance = 4.43 yields p-value < .05. Thus, the nonlinearity effect of experience also helps explain for differences in income level.

Then, after substituting education level for years of schooling, the model was able to capture the non-constant effect of education as described by Becker[2] and Schultz[9]. Of course, the size and sign of the coefficients are the main interest because they measure the degree and direction of association between

²Becker suggests that return to education would be diminishing. This should be a direct result of using the log function to estimate return.

³ Interestingly, our analysis suggests no significant gender effect but the sign of gender coefficient change when education level is used in place of years of schooling. Unfortunately, the page limitation will not allow for the discussion of gender effect or gender inequality. Please see *Women's education in developing countries barriers, benefits, and policies* edited by King and Hill for further information on the topic.

education and income. But even more intrigue here is the pattern of the sign at each education level⁴. For postsecondary education and up, the odd favor one with advanced education to one without it. Conversely, the odd are against those with less than postsecondary education when compare with those without one. For instance, the odd for a person with a bachelor degree to earn higher income is $e^{1.37} = 3.9$ times greater than one with no education at all, while the odd is against one who finish elementary school by a factor of $e^{1.02} = 2.8$ times. The rising coefficient at higher education levels further supports other empirical studies that found evidences contradicting with Becker's view that returns to schooling would decline with more advanced schooling. Conversely, the negative coefficients at the primary and secondary education level are inconsistent with human capital theory that suggests positive association between income and education. According to Heckman *et.al.*[4] and Schultz[9],this varying effect of education on income should have substantial implication to the nation's education financing program.

5. Conclusion

Results in Table 2 suggest 1) education is positively associates with income and 2) the strength of the association is higher at higher level of education. Only after using education level for years of schooling that the model suggests that value of an extra year of schooling is worth more for advanced education than basic education. Hence, one disadvantage of using years of schooling as an explanatory variable is that it incorrectly treats all levels of education the same. One extra unit (years) of elementary school should not be the same as one extra unit of postsecondary education.

Interestingly, our result suggests that only postsecondary education and higher that has positive effect on one's income level while both primary and secondary education negatively affects one's income level. The positive effect of postsecondary education shed lights on the rise in number of students enrolled in university as well as the rise in number of postsecondary institutions in Thailand. Data from the Ministry of Education indicates that the percentage of first year students enrolled in university compared to school-aged population had surpassed 50% since year 2000 and this number continues to increase passing 80% in several occasions. While data from the Higher Education Commission indicates that the number of postsecondary institution in Thailand, ignoring all the teacher's colleges, has gone from a total of 44 institutions in 1991 to a staggering total of 80 institutions in 2012⁵.

On the other hand, the negative effect on income at the primary and education level put forward a legitimate question on the quality of mandatory education in Thailand. This empirical result would certainly raise concern regarding the quality of primary and secondary education in Thailand should these students were to attend university only because they realized that they will never survive on their high school diploma. In order to make a decent living, going to university is their only option. Therefore, the negative coefficients at the primary and secondary education in the model may explain why greater percentage of students decides to pursue university degree.

Most importantly, our findings offer guideline for education financing policy. From a public financing perspective, our findings suggest more monetary funding at a lower level education and less monetary funding at a higher level education since extra year of education in higher education has the potential to generate more return than extra year of lower level education.

6. Acknowledgements

We are grateful to Professor Frank Munger at New York Law School for his permission to use this dataset.

7. References

- [1] Agresti, Alan. *An Introduction to Categorical Data Analysis*. Hoboken: John Wiley & Sons, Inc. 2007.

⁴Initially, not all education levels are statistically significant, Hosmer&Lemeshow[5] suggest that such model can be simplified by collapsing the number of level and make decision to collapse the level based on the Chi-square test. The finished result is shown in Table 2.

⁵ The data were retrieved from www.info.mua.go.th on Dec. 19, 2012.

- [2] Becker, Gary Stanley. *Human capital: a theoretical and empirical analysis, with special reference to education*. Chicago: University of Chicago Press. 1993.
- [3] Buchmann, Claudia, and Dan Brakewood. Labor Structures and School Enrollments in Developing Societies: Thailand and Kenya Compared. *Comparative Education Review*. 44 (2): 175-204. 2000.
- [4] Heckman, James J., Lance Lochner, and Petra Todd. *Fifty years of Mincer Earnings Regressions*. Cambridge, MA: National Bureau of Economic Research. 2003.
- [5] Hosmer, David W. Jnr, and Stanley Lemeshow. *Applied Logistic Regression*. Hoboken: John Wiley & Sons, Inc. 2004.
- [6] Oksuzler, Oktay. Does Education Pay off in Turkey? An Ordered Logit Approach. *MPRA Paper 14375*, University Library of Munich, Germany. 2008.
- [7] Ramsey, Fred L., and Daniel W. Schafer. *The statistical sleuth: a course in methods of data analysis*. Australia: Duxbury/Thomson Learning. 2002.
- [8] Schultz, TP. Returns to women's education. In *Women's Education in Developing Countries: Barriers, Benefits and Policies*, ed. EM King, MA Hill, pp. 48-99. Baltimore: Johns Hopkins Univ. Press. 1993.
- [9] Schultz, TP. Investments in the schooling and health of women and men. *Journal of Human Resources*. 28:694-734. 1993.