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Estimating the Impact of Education on Income with Econometric Approach: A Case Study in Universities

Javad Mirmohammad Sadeghi
Department of Economics, Khomeinishahr Branch, Islamic Azad University, Isfahan, Iran
Email: J.sadeghi@iaukhsh.ac.ir

Leila Shirouyehzad
Department of Economics, Khomeinishahr Branch, Islamic Azad University, Isfahan, Iran
Email: Leila.shirouyehzad@iaukhsh.ac.ir

Saeed Samadi
Department of Economics, University of Isfahan, Isfahan, Iran
Email: samady@ase.ac.ir

Abstract:

Nowadays, education is one of the most important issues in individual development of people in the society. Therefore, the attention on the development of education is increasing. During the past years, a number of economical theorists have studied on the education and training concepts. Econometrics has been identified as the most common technique in previous studies. In this research, the income values in different level of education are examined. The case study includes two groups of staffs and faculty members in a university. Regression equations are estimated in both groups according to Mincer's equations in a way that staffs are evaluated in three levels of diploma, associate and bachelor degrees. And faculty members are evaluated in two levels of master and PhD degrees. Moreover, in this study, the meaningfulness of coefficient and regression equations is examined. Finally, the reformed equations of income are developed in different level of education.

Keywords: Education, Regression, Econometrics, Training, Mincer model

1. Introduction

Econometrics is the application of economical mathematical theories and statistical techniques for testing, proposing and estimating economical phenomena. Econometrics methods can address and estimate multivariate models. This method can help researcher to develop cause and effect deductions in which experimental conditions are under control (Salvatore and Reagle, 2002).

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Adam Smith stated the importance of the training economically. He believes training the individuals is kind of investment. Training the individuals can improve their ability and grow up them. These trainings cause individuals get more income and society use their productive ability in a better condition. According to the Smith's point of view, knowledge acquisition requires the cost which is regarded as an investment in nature. On the other hand, people who receive can improve production process and society's income. Alfred Marshal stated that education as a kind of investment. He believes that education can create basic changes in people. Also, he emphasized on the training work forces as the main fundamental factor in the society (Emadzadeh, 2005).

According to the Schultz's point of view, acquisition abilities of individuals are the main source of growing productivity and economic improvement during the last years. These abilities are considered as a pre-produced capital and targeted production factor. He stated that training costs are a kind of investment which has noticeable economic efficiency (Schultz, 1961).

Mincer emphasize that it is possible to get a more equitable distribution income in society by more training to people. Moreover, Mincer pointed the importance of service training and its efficiency in specific jobs, and tried to measure the efficiency of investment in terms of training employees at work (Mincer, 1962).

Becker believes education and professional training of individuals is a kind of investment. The economical value of this training is included monetary costs and time to get skill (Becker, 1975). When the value of income obtained from training is more than costs of workforce productivity, the social efficiency would happen. A number of researches for measuring the effect of education on income and calculation of the education rate have been implemented. Some of these studies are mentioned in Table 1.

In this paper, equations of income-education are developed. In this study, Mincer's equations and least squares method are exploited. This study is performed in some universities in Iran. Estimation of equations for increasing education and income of staffs and faculty members are calculated separately.

2. Regression analysis

Regression analysis is the main part of econometric studies. One of the main issues in regression is estimation parameters of the model. Assume that the regression function of society is:

$$Y_t = \beta_0 + \beta_1 x_{1,t} + \cdots + \beta_k x_{k,t} + \varepsilon_t$$

And estimation of $\beta_i$and y_t with $\hat{\beta}_i$, $\hat{y}_t$ regression model will be :

$$Y_t = \hat{\beta}_0 + \hat{\beta}_1 x_{1,t} + \cdots + \hat{\beta}_k x_{k,t} + e_t$$

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$$\hat{Y}_t = \hat{\beta}_0 + \hat{\beta}_1 x_{1,t} + \cdots + \hat{\beta}_k x_{k,t}$$

Difference between (y_t) observation and ($\hat{y}_t$) estimation is called error term and is shown by e_t. Since $\hat{\beta}_i$ is estimable, it is possible to estimate regression model of sampling. In contrary, population parameters are not measurable and visible. However, ε_t is not basically visible. There are different ways for estimating regression models. These methods depend on the kind of the model, like ordinary least square (OLS) (Salvatore & Reagle, 2002).

Table 1. The abstract of previous studies about the yield of education on income

row	writer	Year	Type of information	model	Findings
1	Knight & Sabott	1987	Cross-section	Mincer	Final rate of efficiency have been normal for high school level. In east Africa the level of skill have the main role to determine the income structure.
2	Goldfarb & Chang	1995	time series	Mincer	Efficiency of domestic private level of training for men is higher than woman. Efficiency of domestic private rate for university education is higher than other level of education.
3	Sadeghi	1998	Cross-section	Cost-benefit analysis	Efficiency rate for PhD is 10%, for BA 6.7% and for high school 2%. Low rate of efficiency for high school by high rate of unemployed for these graduates is realistic
4	Wolter & Weber	1999	Cross-section	Cost-benefit analysis	When the cost of education decrease, profit derived of income be meaningful for different group of training.
5	O'Donoghue	1999	Cross-section	Mincer	Efficiency rate decreases when education and efficiency rate of woman is more than men.
6	Arai	2001	Panel	Algabric	Internal rate of return of high education for individual that have job is high. This rate for women is higher than men.
7	Gomez & Mainar	2004	Panel	mincer	Education efficiency rate is high in Portugal and this capital is so valuable.

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8	Menon	2006	Cross-section	Cost-benefit analysis	Noticeable increase in efficiency rate was occurred between 1994-2004. One of the reasons of increase rate is the low unemployment rate among educated people.
9	Suaza, et.al	2009	time series	Cost-benefit analysis	Efficiency rate for high education in Colombia in some cases is between 0.0123-0.074. Findings reveal that there are significant differences based on the genders in Colombia market.

In ordinary least squares (OLS), coefficient must be determined in a way that the sum of squares $\sum_{t=1}^{T} e_t^2$ has the minimum value.

In order that estimated coefficient being unbiased and possible to examine the significant of the test, classic statistical assumptions should be proved.

3. Mincer Income Model

The income function was introduced by Mincer in 1974 in order to describe individuals' income ways in USA. Different factors may influence individuals' income. These factors are not only include cases such as age, education, training during work, work hours in a week, rural or urban living, but also involves some other individual characteristic such as gender, race, social level or family background, language and motivation. Mincer has used an income function to analyze relation between formal training (school training) and experience (including training during the work) among American men employees. In this analysis, it was considered that income of employees is a function of education (s) and their tenure / experience (ex). Using a multiple regression equation which is semi-logarithmic, the equation is as follows:

$$LnY = a + bs + cex$$

In this equation, 'Lny' is normal logarithm of income, 's' number of education years, 'ex' the number of experience years and, b and c are regression coefficients. This model is a simple function that assumes income is only determined by education and experience. However, it is possible to determine more different functions that include more variables.

4. Methodology

The methodology of this paper includes five steps.
Step 1.Determining the variables and gathering the data

In this step, by analyzing previous studies on the effective factors on income and environmental conditions related to the case study, the important variables are determined. Then, data of variables are gathered. In the following, categorizing on the basis of different level of education is implemented and the required analysis is performed in each category.

Step 2.Creating the Mincer Model

In this step, Mincer model is developed by using the independent and dependent variables for all level of education. In this step, all the effective factors are considered.

Step 3. Estimating model coefficients

In this step, age coefficients of all variables in per group is estimating the coefficient to be meaningful the coefficient and total of regression equation is testing. In this stage if one of the coefficients in meaningful level was not expected, this variable is delivered and coefficient is estimated with remain variables.

Step 4. Testing OLS assumptions

In this step, cross-section data both co linearity and heteroscedasticity are tested. If one of these were happened, the problem should be resolved.

Step 5.Determining the final model of estimating income in each group.

In this step, according to the Mincer Model, the final regression model of estimating income in each group is calculated.

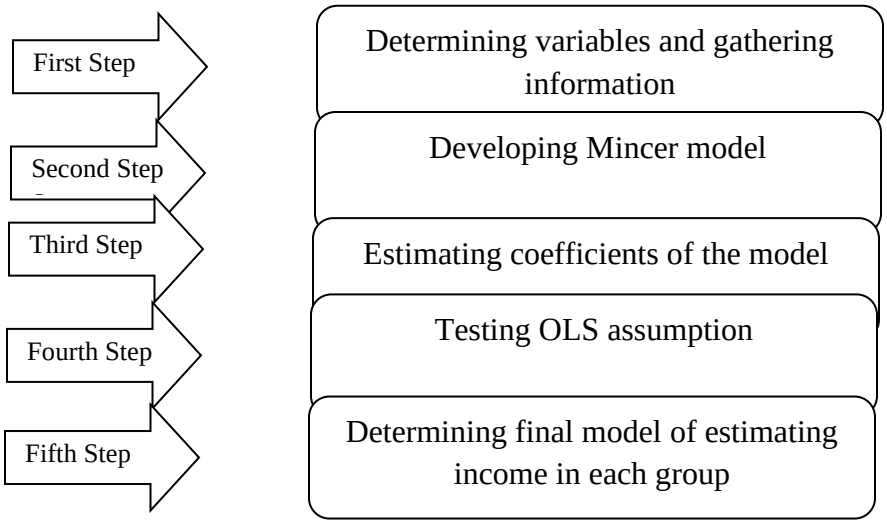

Figure 1 – The method of estimating the income model

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5. Case study and findings

The case study of this paper includes four similar universities in Iran. In this case, people are divided into two main groups. The first group includes staffs and the second group refers to the faculty members. In the first group (staffs) there are three levels of educations, Diploma, Associate degree and Bachelor. In the second group (faculty members),there are two levels of education including Master degree and PhD degree. According to the Figure 1, the steps in the case study are as follows:

First step: In this step, the required data for study has been gathered. Totally 239 persons as staffs and 105 persons as faculty members were considered. Demographic characteristics of staffs and faculty members are summarized in Table 2.

Second step: Regression equations are calculated separately for each group. The equation 1 is related to staffs and equation 2 refers to the faculty members.

Table 2. Gender information of staff and faculty members in case study model

Staffs			Faculty members		
Description	Percent %	Number	Description	Percent %	Number
Education					
Diploma	13	32	MA	51	54
Associated Degree	13	32	PhD	49	51
BA	74	174			
Gender					
Female	25	59	Female	26	27
Male	75	180	Male	74	78
Work experience					
Less than 3 years	23	55	Less than 3 years	17	18
4-7 years	22	52	4-7 years	18	19
8-10 years	15	35	8-10 years	19	20
11-14 years	19	46	11-14 years	15	16
More than 15 years	21	51	More than 15 years	35	36
Number of dependent persons					
0	5	13	0	3	3
2	18	44	2	24	25
3	25	60	3	30	32
4	38	90	4	28	29
More than 5	14	34	More than 5	16	17
Age					

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Less than 25 years	3	7	Less than 30 years	9	9
26-30 years	14	34	31-35 years	28	30
31-35 years	22	53	36-40 years	27	29
36-40 years	36	87	40-45 years	20	21
40-45 years	17	43	46050 years	7	8
More than 46 years	7	16	More than 51 years	9	10
Nature of the job					
Staff & Expert	91	218	Personnel	37	39
Supervisor	7	15	Faculty member	63	66
Manager	2	6			

In equation 1 variable related to occupation type and gender has considered virtually.

$$Lny = C_1 + C_2EXP + C_3 (EXP)^2 + C_4FS + C_5GENDER + C_6OT_1 + C_7OT_2 + e_i \quad (1)$$

y = income of persons per year
EXP = Experience
FS = Family size
GENDER = the virtual variable of sex (If it be female it is equal 1, otherwise it is zero.)
OT = Occupation type, the virtual variables of type of job (It is equal 1 for considered occupation and otherwise is zero.)
e_i = Sentence of error
Equation 2 is for faculty member that variables related to occupation type and gender is virtual.

$$Lny = C_1 + C_2EXP + C_3 (EXP)^2 + C_4OT_i + C_5GENDER + C_6FS + e_i \quad (2)$$

Third step: In this step, using OLS method, coefficients of variables in different group has been estimated. The coefficients in Diploma level have been insignificant as presented in Table 3. Results of estimating coefficients for faculty members are represented in Table 4.

Table 3. Regression model results for staffs.

Variables	Estimate coefficients		Coefficients for estimate again meaningless coefficients for calculating income average	
	Associate Degree	BA	Associate Degree	BA
Experience	0.034 (6.66)	0.031 (14.07)	0.32 (6.84)	0.031 (14.21)
Square of Experience	-0.0005 (-2.98)	-0.0007 (-6.82)	-0.0005 (-3.02)	-0.0008 (-7.015)
Size of family	-0.008 (-0.983)	-0.0033 (-1.21)	----	----

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Virtual variables of occupation type of group 1	-0.008 (-0.206)	-0.0061 (-0.63)	----	----
Virtual variables of occupation type of group 2	-0.023 (-0.621)	0.008 (1.02)	----	----
Virtual variables of gender	0.048 (1.32)	0.0063 (0.743)	----	----
R^2	0.82	0.81	0.82	0.81
Adjusted – R^2	0.79	0.80	0.80	0.80
Circumstantial evidence F	25.54	143.72	67.16	375.45
Intercept	15.537	15.67	15.51	15.67
No of observation	33	174	33	174

According to the Table 3,in Associate and Bachelor levels of education, coefficients related to size of family, occupation type and gender has been identified insignificant. The modified coefficients have been estimated again by deleting insignificant variables. These variables are presented in Table 3. Considering the value of R^2 in regression equation in staffs group for associated degree and BA levels, it is clear that more than 80% of changes of dependent variables are predictable by independents variables.

Table 4. Results derived from regression for faculty members

Variables	Estimate coefficients		Coefficients for estimate again meaningless coefficients for calculating income average	
	MA	PhD	MA	PhD
Experience	0.013 (3.62)	0.016 (3.101)	0.014 (3.78)	0.015 (3.04)
Square of Experience	-0.0002 (-2.80)	-0.00018 (-1.215)	-0.0002 (-1.99)	-0.0002 (-1.12)
Size of family	-0.0035 (-1.28)	-0.0124 (-0.81)	----	----
Virtual variables of occupation type	0.185 (10.95)	0.1 (3.502)	0.18 (11.04)	0.102 (3.83)
Virtual variables of gender	-0.0087 (-0.505)	-0.0092 (-0.283)	----	----
R^2	0.81	0.62	0.81	0.62

Adjusted – R^2	0.79	0.58	0.79	0.59
Circumstantial evidence F	41.69	15.102	69.13	25.61
Intercept	16.39	16.84	16.40	16.80
No of observation	54	51	54	51

According to Table 4 the coefficients related to size of family and gender are estimated insignificant for MA and PhD levels. The modified coefficients have been estimated by removing those variables as represented in Table 4.

Fourth step: In this step, both co-linear and difference between variances tests have been done for the final models. Considering the values in Tables 3 and 4, and the above regressions, there is not co-linear in the model. Moreover, Gold fold Quant Test is performed for identifying heteroscedasticity the models. The results are represented in Table 5. According to Table 5, calculated statistics value is lower than the considered value in the table of F-distribution. None of the presented models in the 5% level of meaningfulness have None of the presented models in the 5% level of meaningfulness have heteroscedasticity.

Table 5. Results of heteroscedasticity test in meaningful 5% level

Level of education		Test static	Degree of freedom	F distribution amount
Staffs	A D	1.605	7,7	3.787
	B A	1.369	62,62	1.524
Faculty members	M A	1.688	15,15	2.403
	PhD	0.924	14,14	2.484

Fifth step: Considering the results of regression, the equation of education levels in staffs group and faculty members are as follows:

A D) $Lny = 15.51 + 0.032\ EXP - 0.0005\ (EXP)^2 + e_i$

B A) $Lny = 15.67 + 0.031\ EXP - 0.0008\ (EXP)^2 + e_i$

M A) $Lny = 16.40 + 0.014\ EXP - 0.0002\ (EXP)^2 + 0.18\ OT_i + e_i$

PhD) $Lny = 16.80 + 0.015\ EXP - 0.0002\ (EXP)^2 + 0.102\ OT_i + e_i$

6. Conclusion

In this study, the income regression equations in universities were estimated. Therefore, Mincer Equation and for estimating coefficients, OLS method were utilized. In this study, two groups and two levels of education were considered.

According to the obtained results, variables related to the experience and square of experience were just identified significant. Also, the Results revealed that people with Associate degree receive less salary in comparison with people with Bachelor degree at the beginning of their employment. In associate level of education, slope of regression equation in terms of experience variable is more than bachelor level of education.

On the other hand, increasing income in associate level of education is more sensitive in comparison with in terms of experience is more sensitive toward experience vertical in AD is higher than BA, that is, income increasing is more sensitive than experience in AD than BA.

On the other hand, for faculty member group, variables related to experience, experience square, occupation type were just significant and others were addressed insignificant. Results show that intercept in MA level is lower than PhD level, that is, at the beginning of employment, a person who has PhD, get higher salary. Slope of regression equation in MA is lower than PhD, that is, PhD people get more salary. In Master level of education, slope of regression equation in terms of experience variable, is lower than bachelor level.

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