

Estimation of the Marginal Rate of Return and Supply Functions for Schooling: The Case of Egypt

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Abstract

Education is one of the most important types of investment in human capital that creates benefits eventually. Private returns to education include financial option return, non-financial options and non-market returns. On the other hand, the social returns to education include economic growth and non-market social effects. Education has many development goals i.e. it is considered as a tool of social empowerment and global competitiveness. Moreover, education is the most significant asset that explains income disparities among individuals. Accordingly, equity in education leads to equity in income distribution. The main objective of this paper is to estimate the demand and supply functions for schooling in Egypt using the data of Egypt Labor Market Panel Survey 2012. It is concluded that, the number of years of schooling and the family characteristics are the main variables that affect the demand and supply functions of education in Egypt.

Keywords

Education- Marginal rate of return- Supply functions for schooling- Egypt.

1. Introduction

Education affects the life of individuals, their participation in economic activities, and overall economic development in various ways. This paper, however, will focus on the economic returns to education and its opportunity cost. Human capital investment in the form of education has an important economic value. The returns to investment in education are generally estimated by micro and macro levels. Investment in education has many benefits on both individual and social levels as well (Lucas, 1988). This means that, there are two types of returns to investment in education; namely, social and private rate of return to education. On the individual level, each additional year of schooling will increase the individual's earnings (Mincer, 1974).

There is a kind of spillover from the individual investment in human capital (i.e. education) into the social level. Externalities of investment in schooling include, for example, low levels of crime, high levels of democracy and high levels of political participation. These kinds of externalities are too difficult to be measured; accordingly, the returns to investment in education are underestimated.

Alternatively, Becker (1994) assumes that, there are two kinds of schooling costs; namely, direct and indirect costs. The direct costs consist of costs of teachers, administration staff, books, and

other fees. The foregone earnings while in school represent the indirect costs of schooling. He assumes that, the direct costs of schooling can be estimated easily. However, the foregone earnings are too difficult to be estimated.

The main objective of this paper is to estimate the demand and supply functions for schooling in Egypt using the data of Egypt Labor Market Panel Survey 2012. This paper consists of five main sections, including introduction and conclusion. The second section surveys the related literature review. The third section presents the data description and the theoretical framework of marginal rate of return and supply functions for schooling. The fourth part proposes the empirical model, estimation and the results.

2. Literature Review

The issue of rate of return to education has dominated the research in the area of economics of education for the last several decades depending on work of Schultz (1961) and Becker (1962). The concept of human capital is first introduced by Mincer (1958) and then elaborated by two of the Nobel Prize winners, Schultz (1961) and Becker (1962). It means that, individuals acquire skills and knowledge in order to increase their future earnings stream. Individuals acquire these skills through education, training and experience (Biltagy, 2010).

The private rate of return to education can be estimated by two methods; either by the internal rate of return to education or by the Mincerian earnings function, originally introduced by Mincer (1974). The internal rate of return is called the full or elaborate method of estimating the demand functions of schooling. It can be defined as the discount rate that equates the net present value of benefits of schooling for an individual to the net present value of costs of education at a given point of time.

Psacharopoulos (1994) presents a survey, which includes the results related to estimating rate of return to education for about 70 countries. The rate of return to education is particularly high when the supply of educated labor is rather scarce. The main conclusions of Psacharopoulos (1994) are that primary education yields a higher rate of return than other advanced stages of schooling. Moreover, in general, private rates of return are higher than social rates of return and the rate of return for females is higher than that for males.

Ashenfelter and Rouse (1998) estimate a model of schooling investment using data on 700 identical twins. The empirical results indicate that higher ability individuals reach more schooling levels because of the advantage of lower marginal costs. The estimated model implies that genetically identical individuals have the same levels of schooling investments. The results suggest that the rate of return to schooling is about 9%. Moreover, it is concluded that, the marginal benefits of schooling decreases with attaining higher levels of education and there is a negative relationship between the ability level and the marginal costs of schooling.

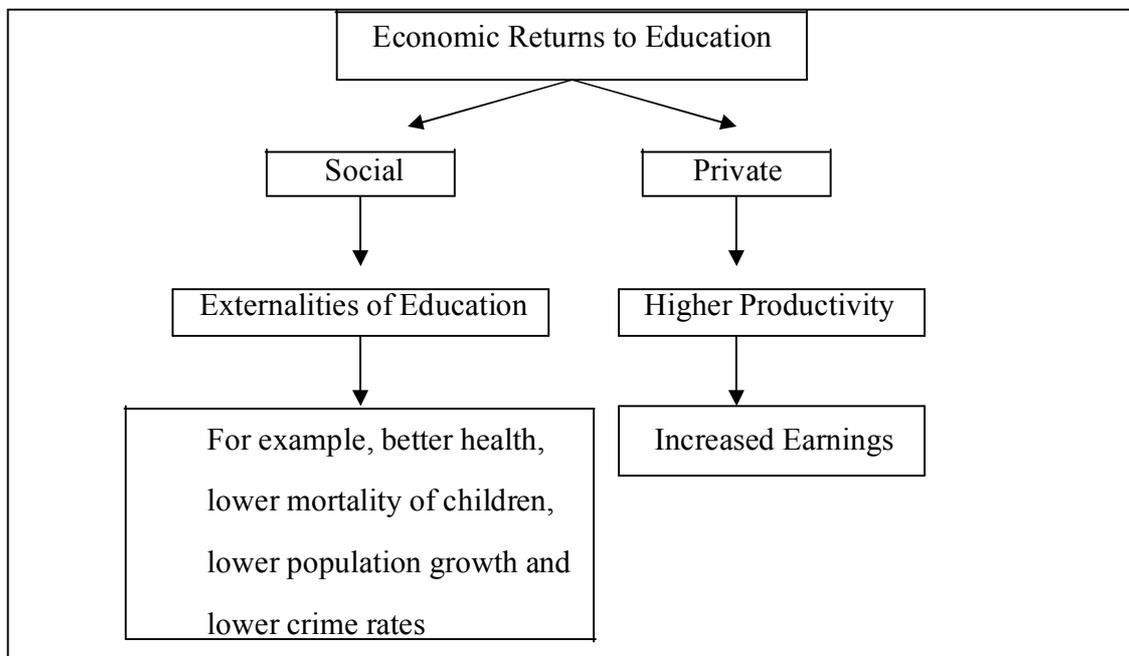
Regan et al. (2006) derive the demand and supply functions of schooling using the data from the National Longitudinal Survey of Youth 1979 (NLSY79). The authors estimate the demand and supply functions for schooling depending on the earnings-schooling relationship. According to the analysis of Regan et al. (2006), individuals invest in schooling until the marginal rate of return to schooling equals the discounting rate of interest. The results of estimating these equations

imply that the discounting rates of interest are lower for individuals from wealthier families. Moreover, the results show that individuals with higher ability get through school faster. The estimation of the model indicates that the marginal rate of return to schooling is 9.6 %.

3. Marginal Rate of Return and Supply Functions for Schooling: Theoretical Framework and Data Description

As mentioned above, there are two kinds of economic rate of return to schooling i.e. social and private. It is more difficult to estimate the social rate of return to education because of complexity of capturing and calculating the externalities of education¹. However, the relation between education and increased earnings is explained in the literature depending on the Mincerian earnings function. Figure one provides a general overview of the economic returns to education.

Figure One: Economic Rate of Return to Education



Source: Done by the author based on Becker (1962). Carry out

The social rate of return to schooling includes public expenditure on education in addition to the private cost considered for the calculation of the private rate of return. Accordingly, the social rate of return is taking into consideration the total cost of education, in turn, this decreases its estimates. In general, social rate of return is higher in primary education if compared to secondary and higher education because public expenditure per student tends to increase significantly with the level of education.

¹ Foster and Rosenzweig (1995) ascertain that there are positive externalities of education on other people in the neighborhood in addition to the externalities on the educated individual's own family.

The data used in the analysis is Egypt Labor Market Panel Survey 2012 (ELMPS 2012). The ELMPS 2012 is the third round of the longitudinal survey, which was also done in 1998 and 2006. The ELMPS, was presented by the Economic Research Forum (ERF) in cooperation with Central Agency for Public Mobilization and Statistics (CAPMAS) in Egypt. The ELMPS 2012 intends to analyze the characteristics of the Egyptian labor market. It is considered as a follow-up survey to the same households that have interviewed in 2006, in addition to a new sample, which was selected within a random sample to participate in the survey to be able to analyze the evolution of the labor market in Egypt over time. The questionnaire of the ELMPS 2012 consists of three chapters. The first chapter introduces the household questionnaire that contains information on basic characteristics, housing services and facilities, and durable goods. The second chapter presents the individual questionnaire that includes information on father's and mother's characteristics, siblings and health, in addition to detailed education histories and earnings. The third chapter proposes information about migration, remittances, non-agricultural and agricultural enterprises (Biltagy, 2014_a).

For the purpose of this study, the size of the total sample is 7573 observations. The sample contains waged workers whose ages range from 15 to 64 years. Those individuals answer all the questions needed for the estimation of basic earnings function and the supply functions for schooling. This section includes the descriptive statistics of all variables used in the model together with a brief description of each variable.

Table (1): Descriptive Statistics of the Variables

Variable	No. of Observations	Mean	Std. Dev.	Min	Max
<i>Age</i>	7573	36.7	10.87	15	64
<i>Gender</i>	7573	0.772	0.419	0	1
<i>W</i>	7573	3545.3	3675.5	240	54000
<i>lnW</i>	7573	7.91	0.687	5.48	10.89
<i>S</i>	7573	11.79	4.47	0	16
<i>SS</i>	7573	159.2	81.44	0	256
<i>Experience</i>	7573	16.24	11.17	0	58

<i>ExpExp</i>	7573	388.6	464.5	0	3364
<i>Urban/Rural</i>	7573	0.56	0.49	0	1
<i>Marital Status</i>	7573	0.78	0.42	0	1
<i>Sector of emp.</i>	7573	0.57	0.49	0	1
<i>N. of days/w</i>	7573	5.70	0.84	1	7
<i>N. of hours/day</i>	7573	8.35	2.28	1	24
<i>N</i>	7573	4.45	1.82	1	21
<i>FSL</i>	7573	5.58	5.63	0	20
<i>MSL</i>	7573	2.91	4.84	0	20

Source: Author's calculations based on ELMPS 2012.

Table (1) presents the variables, which are used in estimating the demand and supply functions for schooling as follows,

- *Age*: The age ranges from 15 to 64 years old; the mean value of age is 36.7 years.
- *W*: This variable refers to the total wage of the individual. The minimum and maximum values of the total wage in this sample are 240 and 54000 Egyptian pounds per month, respectively and the mean value is L.E. 3545 per month.
- *S*: The variable *S* represents the number of years of schooling of an individual. The mean value of this variable is 11.8 years. The variable *S* takes values between 0 and 16, where the value 0 refers to illiterates and the value 16 refers to the university education².
- Experience (*T*): This variable stands for the number of years of experience. The mean value of this variable is 16.24 years.
- *FSL*: This variable symbolizes the father's schooling level. The mean value of this variable is roughly 6 years; similarly, *MSL* corresponds to the mother's schooling level. The mean value of this variable is around 3 years.

² This paper follows the study of Bratsberg and Terrell (2002) in defining the variable of the number of years of schooling.

- N : This variable represents the family size. The variable N is used in estimating the supply function for schooling. The mean value of this variable is approximately 5 persons.

It is concluded from table (1) that, the percentage of males in the sample is 77.2% while the percentage of females is 22.8%. In addition, the table ascertains that, 78% of the individuals in the sample used are married and 56% of those individuals live in urban areas. Furthermore, 57% of the individuals in the sample used are employed in government and public enterprises. Moreover, the average number of working days is roughly 6 days per week and the average number of working hours is 8.35 hours per day.

4. Empirical Model, Estimation and Results

This paper derives the demand and supply functions for schooling depending on the earnings-schooling relationship³. It can be said that, individuals invest in schooling until the marginal rate of return to schooling equals the discounting rate of interest. The study considers individuals who earned approximately 300 Egyptian pounds per month. The dependent variable in the log earnings function is the log of an individual's total wage.

The marginal rate of return to schooling is,

$$\delta = \frac{\partial \ln W}{\partial S} . \quad (1)$$

In which,

$$\delta_j = f(S_j). \quad (2)$$

Where S is the number of years of schooling for an individual.

This implies that, the first derivative of the log earnings function with respect to schooling yields an individual's demand function for schooling i.e. the rate of return to education (the demand function for schooling) is a function in the number of years of schooling.

The previous studies, such as, Schultz (1989), Ashenfelter and Krueger (1994) and Glewwe (1996) ascertain that the earnings of an individual depend on many other factors, for example, whether an individual lives in urban or rural areas, whether he/ she works in government sector or in private sector. In addition, the earnings differ depending on gender differences.

Moreover, the previous studies show that, the earnings differ from one person to another depending on the number of working days per week and the number of working hours per day. The earnings depend also on the marital status of an individual; that is, marriage makes individuals more productive.

³ The empirical framework follows Mincer's estimation of the simple schooling model.

The following earnings function takes all these factors into consideration.

$$\ln W_j = \theta_0 + \theta_1 S_j + \theta_2 T_j + \theta_3 T_j^2 + \theta_4 X' + u_{1j}. \quad (3)$$

Where T signifies the number of years of experience, X represents a vector of variables that affects the earnings of an individual and u_1 is \sim iid $N(0, \sigma_1^2)$. The results of estimation of this function are illustrated in table (2).

Any individual seeks to maximize the present value of his/ her lifetime earnings over time, thus,

$$\ln P = \ln W - iS - \ln i. \quad (4)$$

Where P is the present value of lifetime earnings and i is the discounting rate of interest.

This indicates that,

$$\delta = i. \quad (5)$$

An individual's supply function for schooling investment can be derived by using the present value function as defined in (4). The discounting rate of interest can be defined as a function of an individual's family characteristics (i.e. family income levels and family size). The individual's supply function for schooling can be written as,

$$i_j = \beta_0 + \beta_1 S_{ff} + \beta_2 S_{mj} + \beta_3 N_j + u_{2j}. \quad (6)$$

Where S_f and S_m are the levels of father's and mother's schooling, N denotes the family size and u_2 is \sim iid $N(0, \sigma_2^2)$. In equation (6) the family income levels can be represented by the schooling levels of an individual's parents.

Table (2): The Results of Estimation of Earnings Function

<i>lnW</i>	Coefficient	Std. Err.	t	P> t
<i>S</i>	0.0442086	0.0018834	23.47	0.000
<i>Experience</i>	0.0262104	0.0023612	11.10	0.000
<i>ExpExp</i>	-0.0002842	0.0000549	-5.18	0.000

<i>Gender</i>	0.2554301	0.0189975	13.45	0.000
<i>Marital status</i>	0.1105411	0.0196645	5.62	0.000
<i>Urban/Rural</i>	0.1927933	0.0149652	12.88	0.000
<i>Sector of emp.</i>	0.0099666	0.0175634	0.57	0.570
<i>N. of days/week</i>	-0.0104486	0.0088547	-1.18	0.238
<i>N. of hours/day</i>	0.0270247	0.0034664	7.80	0.000
<i>cons</i>	6.513099	0.0708414	91.94	0.000

Source: Author's calculations based on ELMPS 2012.

Depending on table (2), it is estimated that, the private rate of return to education is 4.5%. Moreover, the rate of return to the number of years of experience is 2.6% i.e. each additional year of experience will increase the earnings of an individual by 2.6% on average. Since θ_3 is negative, the earnings will increase overtime by decreasing rate.

Gender has a significant effect on the earnings of an individual. This means that, males get more monthly earnings than females by 29.1% on average. Furthermore, keeping other factors constant, the individual who lives in urban areas gains more earnings than the one who lives in rural areas by 21.3%. The marital status of an individual plays a significant role in determining his/ her earnings. The married individual gets more earnings than the single by 11.7%. In addition, the results show that, at 5% significance level, the variable of sector of employment is insignificant while working for long hours per day is associated with higher levels of earnings for an individual.

As mentioned above, the supply function for schooling (the discounting rate of interest for individual j , i_j) is a function in an individual's family characteristics. The results of estimation of the supply function for schooling are demonstrated in table (3).

Table (3): The Results of Estimation of Supply Functions for Schooling

<i>i</i>	Coefficient	Std. Err.	t	P> t
<i>FSL</i>	0.0112895	0.0017748	6.36	0.000

<i>MSL</i>	0.0106348	0.0020655	5.15	0.000
<i>N</i>	-0.0213314	0.0042941	-4.97	0.000

Source: Author's calculations based on ELMPS 2012.

It is clear from table (3) that, the variables that represent the family income (*FSL* and *MSL*) and the family size, *N* are significant at a 5% significance level. Individuals from poor families have an increased likelihood of receiving financial aid, which decreases their discounting rate of interest.

5. Conclusion

It is concluded that, there is a positive relationship between the number of years of schooling and the private rate of return to schooling. It is estimated that, the private rate of return to education is 4.5%. The results ascertain that, working in urban areas is associated with more earnings for an individual. Moreover, married individuals get more earnings because they are more productive.

The model proved that, the main independent variable that is contained in the individual's demand function for schooling is the number of years of schooling, *S*. On the other hand, the main independent variables that are included in the individual's supply function for schooling in Egypt are; the father's schooling level (*FSL*), the mother's schooling level (*MSL*) and the family size (*N*). The best possible schooling level is determined when the demand and supply functions for schooling are equal.

The policy implications of these estimates are crucial since the rate of return to education is considered one of the most important determinants in the decision making process of investment in education. Egypt should reallocate its public resources in favor of education, especially the primary stage. Government expenditure on education has grown remarkably during the past few years. The amount of the government's budget directed to education increases from L.E. 40 billion in 2009/10 to L.E. 64.5 billion in 2012/13. Moreover, the new budget in 2014/15 assigned L.E. 94 billion and 355 million to the education sector with an increase of L.E. 11 billion compared to the amount devoted to education in 2013/14 (MOF, 2014). As a percentage of GDP, government spending on education reached 4.4% in 2006, decreased to 3.7% in 2009/10 and amounted to 4% in 2014/15 (Biltagy, 2014_b).

The participation of private sector and civil society is also important in developing the education sector in Egypt. Depending on the argument that private rates of return are higher than social returns, individuals should pay the largest part of the educational fees and the free education presented by the government should be restricted especially in higher education. Moreover, it is essential to put controls on the huge population increase in Egypt because of the direct relationship between the family size and the discounting rate of interest. This study demonstrates

that family background factors are fundamental in determining the education decisions⁴. Accordingly, it is important to increase the level of schooling of an individual's parents and to increase the real income of the family because there is a positive relationship between the family income levels and the schooling level. Finally, in order to increase the role of education in achieving economic prosperity, it would be necessary to restructure the political and economic framework.

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⁴ This coincides with Coleman (1966). He showed that family background factors are very crucial in explaining different levels of academic achievement among individuals.

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