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Optimal Level of Schooling and its Determinants in Egypt Using a Human Capital Model

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Abstract. This paper focuses on specifying the determinants of optimal level of schooling in Egypt, identifying the supply and demand functions for optimal schooling level and estimating the optimal level of schooling in Egypt using a human capital model. 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. The models of investment in human capital ascertain that, the optimal schooling level occurs when the marginal benefits of schooling equal its marginal costs. The main objective of this paper is to provide an economic analysis of a human capital model in order to specify the optimal schooling level and its determinants in Egypt. The methodology of this paper is based on studying and analyzing the topic of optimal level of schooling by clarifying the concept, identifying its determinants and formulating and estimating a model that help in determining the optimal schooling level in Egypt by using data of Egypt Labor Market Panel Survey 2006 (ELMPS 06), which was presented by Central Agency for Public Mobilization and Statistics (CAPMAS) in cooperation with Economic Research Forum. The results imply 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 optimal level of schooling for the sample is 12.6 years on average. Moreover, the main determinants of optimal level of schooling in Egypt are: the father's and mother's level of schooling, which represents the income of the family, the ability differences and the quality of education. Actually, there are two main policy implications of this paper; the first policy is to decrease the number of years of schooling from 16 to 13 years in order to apply the empirical results of this paper. The alternative policy that should be adopted is to pay more attention to the variables that are included in the model so as to increase the optimal level of schooling in Egypt.

Keywords: Human capital theory- Human capital investment models- Optimal level of schooling- Egypt.

1. Introduction

The importance of this paper stems from the significance of the education issue itself. Investment in education improves the quality of life for millions of people. In other words, education is the most powerful tool of achieving economic growth, reducing poverty and improving living standards. Education is considered a social endowment and it represents the real wealth of nations. Barro and Lee (2000) ascertain that, an increase in the number of well-educated individuals implies a higher level of labor productivity and a greater ability to absorb advanced technology from other countries.

The education system in Egypt suffers from many problems, for example, high illiteracy rate, low levels of quality of education, high rates of dropping out of school and the misallocation of resources between pre-university and university education. In 2007, about 30% of the population aged 15 years and over was illiterate, which poses a serious challenge that requires new strategic directions (EHDR, 2010). The quality of education in Egypt continues to be a big problem; it is unequally distributed among regions and areas, leading to inequality of educational outcomes.

Consequently, this paper helps in solving some of these problems by adopting new policies that enhance the education system in Egypt, depending on the model that determines the optimal level of schooling in Egypt. The issue of determining optimal schooling level has gained a lot of importance and attention in the

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field of economics. It has attracted several economists including Becker (1980), Ashenfelter and Rouse (1998) and Regan et al. (2006). However, there is a scarcity of the literature that handles the topic of optimal schooling level in Egypt. The major research questions that this paper aims to answer are: What is the optimal schooling level in Egypt? What are the determinants of optimal level of schooling in Egypt? What are the main independent variables included in the supply and demand functions for schooling in Egypt?

The main objective of this paper is to provide an economic analysis of a human capital model in order to specify the optimal schooling level and its determinants in Egypt. In order to achieve the objective mentioned above, a model is formulated in order to identify the determinants of optimal schooling level and estimate the optimal level of schooling in Egypt using the data of ELMPS 06.

2. Determination of Optimal Schooling Level: Theoretical and Empirical Models

In economics, there are two ways to conceptualize optimal educational attainment; the first way presents the literature of human capital models, for example, Southwick and Zionts (1974), Ramcharan (2004) and Regan et al. (2006). In these models, individuals accumulate their human capital through acquiring high levels of schooling depending on the future income streams (returns to education) and the discounting rates of interest. These models regard education as an investment good. The second way formulates optimal schooling levels through education production function in which the output (education) is a function in the inputs (family and school characteristics). These models include, for instance, Edwards (1975) and Lang and Ruud (1986). The main difference between these two ways is that, educational attainment in the first method is determined by the choice of an individual while in the second one, optimal schooling levels are determined by the different inputs (independent variables) that exist in the production function of education (Wilson, 2001).

Edwards (1975) presents a model for teenage schooling decisions using 1960 census data. He analyzes schooling decisions by using production function of education where the number of years of schooling is one of the important inputs for the production function of child quality. The results of the model ascertain that there is a positive relationship between the income of the family and the enrolment rate of schooling for their child. In addition, there is a positive relationship between the school expenditure and the schooling enrolment rates. This means that, the differences in school expenditure lead to differences in the schooling quality and in the optimal level of schooling as well.

Similarly, Lang and Ruud (1986) present an education production function in order to determine optimal schooling level. The main assumption of this model is that each individual wants to maximize the present value of his/ her lifetime earnings. The results imply that, family background is the main factor that affects the optimal level of schooling. Furthermore, the discount rate and the rate of return to education affect the optimal educational attainment of an individual.

Southwick and Zionts (1974) present a human capital model, which determines the optimal path of education by using a certain function. This function illustrates whether there is a full time schooling, part-time schooling or full time work by determining the proportion of time spent on education. The authors didn't determine the optimal level of schooling in terms of years as others did. Instead, the form of optimal path of education takes three stages, full time schooling at the initial period followed by part time schooling followed by zero schooling.

Moreover, Ramcharan (2004) assumes that, there is a positive relationship between the enrolment rates and costs of schooling and this is consistent with Edwards (1975). The increase in the schooling enrolment rates requires high levels of expenditure on the inputs of education. To determine the optimal level of schooling (secondary or tertiary education), it is important to compare between the premium induced by tertiary education relative to secondary schooling. This means that, there will be new investment in education if the returns to education are more than the costs.

The analysis of Regan et al. (2006) is similar to the analysis of Lang and Ruud (1986) in determining optimal level of schooling, but they differ in their methodology. Regan et al. (2006) introduce a human capital model to specify the optimal schooling level depending on two main variables; family background

variables and the ability differences. The results imply that individuals from wealthier families are more likely to have high optimal schooling level. Moreover, more able individuals get through school faster than others with less ability.

3. Specifying the Determinants of Optimal Schooling Level in Egypt: An Application

After introducing the theoretical human capital models that determine the optimal level of schooling, it is important now to specify the determinants of optimal level of schooling in Egypt. This section identifies the supply and demand functions for optimal schooling level and estimates the optimal level of schooling in Egypt using a human capital model.

3.1. Data Description

The data used in this analysis is obtained from Egypt Labor Market Panel Survey 2006 (ELMPS 06), which was presented by CAPMAS in cooperation with Economic Research Forum. For the purpose of this paper, the size of the sample used is 6572 observations. It contains waged workers whose ages range from 15 to 64 years. Those individuals answer all the questions needed for the estimation of Mincerian equation, demand and supply functions for schooling investment and the equation that determines the optimal level of schooling.

The main characteristics of the sample are that, the average earnings of an individual in the sample used are 671 pounds per month. Moreover, the average number of years of schooling is 11.5 years, the average age is 36 years old, the average number of years of experience is 19 years and the average family size is 6 individuals. In general, the schooling levels of the parents are very low. In addition, it is obvious that 71% of the individuals in the sample used are married and 68.8% of those individuals live in Lower Egypt. Furthermore, 61.4% of the individuals in the sample used are employed in government and public enterprises. Additionally, the average number of working days is 6 days per week and the average number of working hours is 8.35 hours per day.

3.2. The Model

The log form of the earnings function can be written as,

$$\ln Y_j = B_0 + B_1 S_j + u_j . \quad (1)$$

Where Y represents the monthly earnings of an individual and S reflects his/ her years of schooling.

The log earnings function as defined in (1) can be written as,

$$\ln Y_j = B_0 + B_1 S_j + B_2 A_j + B_3 S_j^2 + B_4 A_j S_j + B_5 T_j + B_6 T_j^2 + B_7 Q_j S_j + u_{1j} . \quad (2)$$

Where u_1 is ~ iid $N(0, \sigma_1^2)$. This equation assumes that the relation between the number of years of schooling and the earnings is not linear in order to avoid the criticism of the Mincerian equation. This formula of the log earnings function stems from Card and Krueger (1992) and Regan et al. (2006).

In equation (2), A_j refer to the ability differences for individual j. This variable is calculated by using several questions listed in ELMPS 06. These questions inquire if an individual repeats any grade at school; takes any private lessons or participates in after school help groups. It must be said that, there is no indicator for ability differences in Egypt, for example, *IQ* scores or *AFQT*. Accordingly, the variable used in this paper is just a proxy for ability differences that helps in estimating the log earnings function.

Furthermore, T_j represent the number of years of experience for individual j. It is assumed that this function exhibits positive but diminishing marginal returns to experience. The number of years of experience (T_j) is calculated by using a simple rule, that is, T_j = Age - S_j- 6, where S is the number of years of schooling.

Moreover, Q_j capture the quality of education for individual j. This variable takes values 0 or 1 depending on whether there are computers available for students in their primary/ preparatory schools or not (an indicator of school budget per student). Again, there are no explicit questions listed in ELMPS 06 that help in measuring quality of education, for example, there is no information about the ratio of students to teacher in the class, the average term length, the average annual salaries of the teachers and the types of assessment of the students.

Accordingly, the demand function for schooling of an individual can be obtained by differentiating equation (2) with respect to *S*,

$$\gamma_j = B_1 + 2B_3 S_j + B_4 A_j + B_7 Q_j . \quad (3)$$

Equation (3) indicates that, the rate of return to education (the demand function for schooling) is a function in years of schooling, ability differences and quality of education.

The discounting rate of interest of an individual can be defined as a function of an individual's family characteristics i.e.

$$i = i(X). \quad (4)$$

Where *X* denotes a vector of family background variables. These variables include the family income levels and the family size.

Hence, the individual's supply function for schooling can be written as,

$$i_j = \alpha_0 + \alpha_1 S_{fj} + \alpha_2 S_{mj} + \alpha_3 N_j + u_{2j} . \quad (5)$$

Where S_f and S_m are the level of father's and mother's schooling, *N* denotes the family size and u_2 is ~ iid $N(0, \sigma_2^2)$. In equation (5) the family income levels can be represented by the schooling levels of an individual's parents.

Then, the optimal level of schooling, S^*, can be represented as a function of family background variables, ability differences and quality of education i.e.

$$S^* = f(X, A, Q). \quad (6)$$

Furthermore, the equation of optimal level of schooling of an individual can be written by using equations (3) and (5), i.e.

$$\gamma_j = i_j . \quad (7)$$

Solving for *S*,

$$S_j = \frac{\alpha_0 - B_1}{2B_3} + \frac{\alpha_1}{2B_3} S_{fj} + \frac{\alpha_2}{2B_3} S_{mj} + \frac{\alpha_3}{2B_3} N_j - \frac{B_4}{2B_3} A_j - \frac{B_7}{2B_3} Q_j + \frac{u_{2j}}{2B_3} \quad (8)$$

$$\therefore S_j = r_0 + r_1 S_{fj} + r_2 S_{mj} + r_3 N_j + r_4 A_j + r_5 Q_j + u_{3j} . \quad (9)$$

Here, the dependent variable is the optimal level of schooling and the explanatory variables are mainly reflecting the schooling levels of an individual's parents (i.e. family income levels), the family size, the ability differences and the quality of education. Depending on the literature review, it is concluded that these selected variables are the main factors that should be included in the model as independent variables.

4. Estimation and Results

The demand function for schooling (the rate of return to education for individual *j*, γ_j) can be obtained easily by differentiating equation (2) with respect to *S*. The results imply 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 marginal rate of return to schooling for the whole sample is 6.1% on average. The estimation of the supply function for schooling of an individual (the discounting rate of interest for individual *j*, i_j) implies that, the family size, *N*, is not significant at a 95% confidence interval. Moreover, the variables that represent the family income are significant at a 5% significance level.

The optimal level of schooling, *S**, is obtained by combining the individual's demand function for schooling (the marginal rate of return to schooling) and the individual's schooling investment supply function (the discounting rate of interest), as shown in equation (9). By estimating equation (9), it is concluded that, the optimal level of schooling for the whole sample is 12.6 years on average.

Equation (9) illustrates the determinants of optimal schooling level in Egypt. By estimating this equation, it is concluded that, the optimal level of schooling of an individual will increase by 0.16 if the father's schooling levels increase by 1 unit. Similarly, if the mother's level of schooling increases by 1 unit, the optimal level of schooling will increase by 0.12.

Moreover, if the family size increases by one individual, the optimal schooling level will decrease by 0.011. Finally, the increase in the level of ability of an individual by 1 point will lead to increase his/ her optimal level of schooling by 3.4 years.

5. Conclusion

After presenting and estimating the demand functions for schooling and the schooling investment supply functions, it is concluded that, the main independent variables that are contained in the individual's demand function for schooling are: the number of years of schooling, S_j, the ability differences, A_j and the quality of education, Q_j. The estimation of the demand functions for schooling ascertains that, these variables are the main independent variables that affect the rate of return to schooling in Egypt (demand function for schooling).

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, the mother's schooling level and the family size. The estimation of the supply functions for schooling shows that, the father's and mother's schooling levels are the main independent variables that affect the discounting rate of interest (supply function for schooling). The family size is not significant and it has no effect in determining the discounting rate of interest in Egypt.

The results show that, the main determinants of optimal level of schooling in Egypt are: the father's and mother's level of schooling, which represents the income of the family, the ability differences and the quality of education, i.e. $S^* = f(X, A, Q)$. It is concluded that, the optimal level of schooling for the whole sample is 12.6 years on average.

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