The Optimal Schooling Level in Egypt

Marwa Biltagy

***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) [1] and then elaborated by two of the Nobel Prize winners, Schultz (1961) [2] and Becker (1962) [3]. 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.**

***Index Terms*—Human capital theory, human capital investment models, optimal level of schooling, Egypt.**

I. 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. Reference [4] ascertains 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.

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Marwa Mohamed Shibl Biltagy, Assistant Professor at Faculty of Economics and Political Science, Department of Economics, Cairo University, Egypt (e-mail: bilmarwa@hotmail.com).

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 [5]. 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 field of economics. It has attracted several economists including Becker (1980) [6], Ashenfelter and Rouse (1998) [7] and Regan, Burghardt and Oaxaca (2006) [8]. 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.

II. 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) [9], Ashenfelter and Rouse (1998) [7], Ramcharan (2004) [10] and Regan, Burghardt and Oaxaca (2006) [8]. 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) [11] and Lang and Ruud (1986) [12]. 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 [13].

Reference [11] presents a model for teenage schooling decisions using 1960 census data. The enrollment rates can be determined by specifying the desired educational attainment levels of any individual. Reference [14] presents a model that helps in explaining the desired years of schooling for each child in the family. He assumes that the desired years of schooling for each child can be regarded as one important factor of production because years of schooling are considered an input for the production function of child quality. Reference [11] adopts the demand function for child quality, *Q* presented by reference [14]. 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, reference [12] presents an education production function in order to determine optimal schooling level. They assume that, high wages of the family are associated with attaining high levels of schooling for an individual. In addition, they said that, the family background is the main factor that affects the optimal level of schooling i.e. the lower levels of schooling reflect the bad family background conditions (for example, poor families). Sociologists always explain the lower educational levels of poor children by the cultural environment in which those poor children live. In terms of economics, there is a negative relationship between the socioeconomic status of the parents and the rates of time preference. This means that, poor children always prefer leaving their schools in order to work and get early income instead of getting high levels of schooling and earn high income in the future. In other words, poor individuals always use higher discount rates compared to other individuals; accordingly, they get low educational attainment. 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, the discount rate and the rate of return to education affect the optimal educational attainment of an individual. It is estimated that, the increase in the index of socioeconomic status (SES) by one point raises the academic achievement per year by 2% and a one point increase in *IQ* scores is associated with about 1% increase in the speed of attaining high levels of schooling.

Reference [9] presents an optimal model of schooling for individuals who consider education as an investment tool in order to gain higher level of future earnings. There are two main assumptions; first, education is important for its own investment value. Second, individuals are rational and they act in an optimal way i.e. they invest in education as long as the marginal cost of education is less than its marginal benefit. The authors analyze the education decision in the framework of an optimal-control-theory model using data from the 1960 census. They 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.

Reference [7] develops a model of schooling investment using a sample of 700 identical twins. This model concentrates on the role of ability differences in the determination of optimal schooling levels. The goal of this model is to estimate the rate of return to education for identical twins and to identify the relation between ability differences and optimal levels of schooling. The authors assume that Individuals want to maximize their utility function, which is a function in log income and costs of schooling. The optimal schooling level occurs when the marginal benefits of schooling equal its marginal costs. This model implies that the optimal schooling level of genetically identical individuals should be the same. Furthermore, the empirical results indicate that higher ability individuals reach more schooling levels because of the advantage of lower marginal costs. As a result, the optimal level of schooling for more able individuals is higher than the one for people with lower ability. Alternatively, the OLS estimates imply that there is a positive and significant correlation between the ability of an individual and his/ her optimal level of schooling. Moreover, it is estimated that the marginal rate of return to schooling is about 9%.

Moreover, reference [10] assumes that there are three categories of labor: unskilled (has no education) *U*, low skilled (has basic education) *L* and high skilled (has tertiary education) *H*. In addition, there is one consumption good, which is produced in the economy by skilled and unskilled labor. He states that, there are two main characteristics of the optimal education policy; the first characteristic is that, investment in education increases with decreasing rate over time within an optimal path. Moreover, the cost of schooling increases as the enrollment level increases. The second characteristic is concerned with the type of schooling i.e. the investment in education should be increased on both levels: secondary and tertiary as well because the marginal productivity of skilled labor depends mainly on the level of secondary education. He assumes that, there is a positive relationship between the enrollment rates and costs of schooling and this is consistent with reference [11]. 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, Burghardt and Oaxaca (2006) [8] is similar to the analysis of Lang and Ruud (1986) [12] in

determining optimal level of schooling, but they differ in their methodology. Reference [8] introduces a human capital model to specify the optimal schooling level depending on two main variables; family background variables and the ability differences. They depend on the data collected from National Longitudinal Survey of Youth 1979 (NLSY79). The rule applied by individuals to invest in education is to equate between the discounting rate of interest of education and the marginal rate of return to schooling. This means that, the optimal schooling level is determined at a point where discounted lifetime earnings are maximized. The authors estimate the demand and supply functions for schooling depending on the earnings-schooling relationship; 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. In addition, the estimation of the model indicates that the marginal rate of return to education is 9.6 % and the optimal level of schooling based on the collected data is 11.4 years.

III. Specifying The Optimal Level Of Schooling And Its Determinants 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.

A. Data Description

The data used in this analysis are obtained from Egypt Labor Market Panel Survey 2006 (ELMPS 06), which was presented by CAPMAS in cooperation with Economic Research Forum. The questionnaire for the ELMPS 06 is composed of three major sections; the first section proposes the household questionnaire administered to the head of household that contains information on basic demographic characteristics of household members. The second section presents the individual questionnaire administered to the individual containing information on parental background, detailed education histories, detailed employment characteristics, job characteristics and earnings. The third section discusses the income sources of the household.

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. As mentioned in the literature, ability difference is one of the determinants of optimal schooling levels. There are no measures for ability differences in Egypt (for example, *IQ* scores), accordingly; the variable used in this study is calculated by using some questions listed in the questionnaire. If an individual repeats more than one grade and takes private lessons, this refers to individual with lower levels of ability and vise versa.

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.

B. 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. This paper follows the studies of Bratsberg and Terrell (2002) [15] and El-Araby and Ragan (2010) [16] in defining the variable S -the number of years of schooling- where S = 0 for illiterates, S = 6 for primary education, S = 9 for preparatory education, S = 12 for secondary education, S = 14 for above intermediate education, S = 16 for university education and S = 20 for post graduate studies.

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 Mincer (1974) [17], Card and Krueger (1992) [18] and Regan, Burghardt and Oaxaca (2006) [8].

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. These questions were converted to dummy variables which take values 0 or 1. The value 0 refers to the individual who neither repeats any grades nor takes any private lessons. In addition, the value of this variable is 1 if the individual repeats any grade at school and takes private lessons.

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*,

$$\gamma_j = B_1 + 2B_3S_j + B_4A_j + B_7Q_j. \quad (3)$$

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,

$$i_j = \alpha_0 + \alpha_1S_{fj} + \alpha_2S_{mj} + \alpha_3N_j + u_{2j}. \quad (5)$$

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^* (see figure one), 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*,

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

$$\therefore S_j = r_0 + r_1S_{fj} + r_2S_{mj} + r_3N_j + r_4A_j + r_5Q_j + u_{3j}. \quad (9)$$

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.

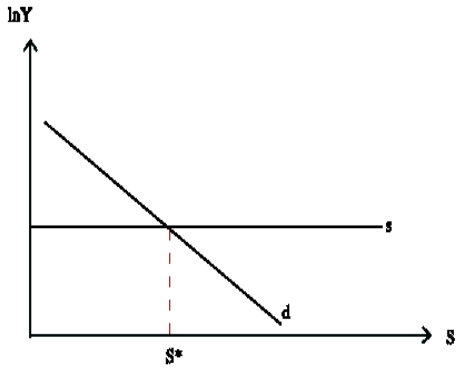

Fig.1. The Optimal Level of Schooling.

IV. Estimation and Results

TABLE I: The Results of Estimation of Mincerian Equation

LN Y	COEF.	STD. ERR.	T	P> |T|
S	.01868	.001893	9.87	0.000
cons	5.942129	.0236086	251.69	0.000

Table (1) ascertains that, there is a linear relationship between the number of years of schooling and *lnY*. The P-value of variable *S*- the number of years of schooling- is 0.000. This means that, at a significance level $\alpha = 0.05$, this variable has a significant effect on the dependent variable *lnY*, since the P-value is less than the significance level, α (i.e. 0.000 < 0.05). The private rate of return to schooling is equal to 1.89% on average[1]. Accordingly, each additional year of schooling for an individual will increase *Y* by 1.89% on average regardless of the educational level of that individual.

TABLE Ⅱ: The Results of Estimation of Equation (2)

LN Y	COEF.	STD. ERR.	T	**P> |T|**
S	-.0138444	.0062098	-2.23	0.026
Ability differences	.0579565	.1843789	0.31	0.753
SS	.0028733	.0003327	8.64	0.000
AS	-.0197561	.0161533	-1.22	0.221
experience	.0383965	.002421	15.86	0.000
expexp	-.0004202	.0000547	-7.69	0.000
QS	.0207025	.0064134	3.23	0.001
cons	5.368271	.0375285	143.05	0.000

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 (see table 2).

The supply function for schooling (the discounting rate of interest for individual *j*, i_j) is a function in an individual's family characteristics (family size and family income levels). There are some other factors that may affect the supply function for schooling of an individual, for example, the educational achievement of an individual's oldest sibling and

[1] Private rate of return to education = (exp coefficient – 1) * 100

the availability of reading material at home. These variables can not be included in the analysis since ELMPS 06 does not include any information about these variables.

TABLE Ⅲ: THE RESULTS OF ESTIMATION OF THE SUPPLY FUNCTION FOR SCHOOLING

I	COEF.	STD. ERR.	T	P> |T|
FS	.0009412	.0000674	13.97	0.000
MS	.0007143	.0000894	7.99	0.000
N	-.0000613	.0001287	-0.48	0.634
cons	.0545747	.0009841	55.56	0.000

Table (3) proposes the results of estimation of the supply function for schooling of an individual (the discounting rate of interest for individual j, i_j). It is clear from the table (3) 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. This result is consistent with the one mentioned in the literature, for instance, Regan, Burghardt and Oaxaca (2006) [8] who come to the result that the optimal level of schooling is 11.4 yeas.

These results ascertain that primary, preparatory and secondary education (pre-university education) should get the government support. This means that, more resources should be devoted to the sector of education. It is important to improve the quality of education in Egypt by giving more attention to the educational research because it represents the most important measure of the quality of education. Moreover, it is important to pay more attention to the infrastructure of schools (buildings, classes, libraries and so on). Furthermore, it is essential to increase the quality of teachers (their educational levels).

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.

V. CONCLUSION

It is concluded that, there are different models that analyze optimal schooling levels whether by human capital models or by production function of education. These models include, for example, the analysis of Southwick and Zionts (1974) [9], the analysis of Edwards (1975) [11], the analysis of Lang and Ruud (1986) [12], the analysis of Ramcharan (2004) [10] and the analysis of Regan, Burghardt and Oaxaca (2006) [8].

According to these models, the optimal schooling level is determined at a point where discounted lifetime earnings are maximized. There are two main variables which determine the optimal level of schooling; namely, family background variables (i.e. family size and family income levels) and the ability differences. In addition, there is a positive relationship between the school expenditure and the schooling enrollment rates.

This paper develops a human capital model in order to specify the optimal schooling level in Egypt and its determinants. The model is based on the maximization of the lifetime earnings of an individual taking into consideration ability differences among individuals and the effect of family income levels and family size. The data used in the analysis are collected from ELMPS 06. This data are used in estimating the simple earnings function and the demand and supply functions for schooling that help in determining the optimal level of schooling in Egypt. There is a considerable consistency between the results of this paper and the ones mentioned in the literature.

The individual's demand and supply functions for schooling are formulated in order to determine the optimal level of schooling. The optimal schooling level is determined when the marginal rate of return to an additional year of schooling equals the individual's discounting rate of interest.

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.
- The quality of education.

Alternatively, $S^* = f(X, A, Q)$. It is concluded that, the optimal level of schooling for the whole sample is 12.6 years on average.

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Marwa Mohamed Shibl Biltagy is an Assistant Professor at Faculty of Economics and Political Science, Department of Economics, Cairo University, Egypt. She was born in Cairo, Egypt, on Dem 24th, 1979. The registration date for her Ph.D. Degree was in 2007, she has finished the Preparatory year for Ph.D. with Excellent grade in 2006. She has got the Ph.D. Degree in Economics in 2010 with excellent grade from Cairo University. She has got the Master Degree in Economics in 2005 with excellent grade from Cairo University. Her Bachelor Degree was in Economics in the year 2000 with excellent grade from Cairo University and her ranking was the first among her colleagues, the major specialization is Economics and the Minor is Statistics.

She is an Assistant Professor at the Faculty of Economics and Political Science, Cairo University. Highly qualified in teaching Mathematical Economics, Micro Economics, Managerial Economics, Research Methods and Human Resources courses. She has worked as an Instructor in the Faculty of Economics and Political Science, Cairo University since 2000. Then, she became an Assistant Teacher since 2005 till 2010. The main publications are: 1- "The Egyptian Economy after the 25 January Revolution: Challenges and Opportunities". A paper presented to the Institute of Arab Planning, Kuwait, 2012, Forthcoming. "Higher Education for Sustainable Consumption: Challenges and Opportunities". A paper presented at the 4th International Conference on Higher Education for Sustainable Development, Lüneburg, Germany, 14 - 16 September, 2011.

Dr. Biltagy has got two awards of best theses; namely, M.Sc. and Ph.D. as they have been chosen as the best theses in Cairo University in 2005 and 2010. She has Fifteen years of experience in the field of Economics, human rights and education. She has a good experience in research, especially in education.