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A CENSORED REGRESSION MODEL FOR THE EDUCATIONAL ATTAINMENT OF BOYS AND GIRLS IN TURKEY

by

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Abstract

This study aims to analyse the reasons behind the gender-based differences in educational attainment in Turkey. It focuses on the effects of family background and household characteristics on the demand for education. Using 1988 Household Survey Data, final educational achievement regressions for boys and girls are estimated by ordered probit modelling incorporating both the random family effects and censoring in the data. The results suggest that family background characteristics, particularly parents' education level, have a significant effect on the education of individuals and that some of these effects are different for boys and girls.

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1. Introduction

According to neo-classical theory, the human capital characteristics of individuals determine their productivity and hence the differences in the human capital characteristics of the individuals are the main determinant of the differences in labour market outcomes; women are paid less or they are recruited into certain types of occupations because they fail to invest enough on their human capital both before and after entering the labour market (Becker, 1993). Therefore studies of labour market discrimination control for human capital characteristics as a first step, and then try to attribute the remaining part to discrimination. But it is important to realise that even the differences in the human capital characteristics of the individuals might themselves be a result of a discriminatory process in society.

In many parts of the world girls receive less education than boys on the average; social structure, culture, religion, institutions and the level of economic development jointly constitute barriers to the education of the girls (Gertler and Glewwe, 1992; Hill and King, 1995; Sudha, 1997). In most societies, men are seen as the "breadwinner" and it is a common belief that men are responsible for finding the money to fulfil the needs of their families and women are responsible for doing the housework and taking care of the children. Families, in this respect, give more importance to the education of their sons than to the education of their daughters. Even the theory of sexual division of labour in the family is based on this social structure. According to this theory, since the labour market outcomes of individuals are strongly related to their education level, it is rational to invest more in the human capital of boys as the return to education is higher in most of the occupations for males (Becker, 1993; Becker, 1998; Polachek and Siebert 1999). It should also be considered however that apart from increasing labour productivity, and hence employment opportunities and earnings, education has other non-market benefits to society such as economic growth, increased knowledge of health, nutrition, and hygiene. Increased education is also associated with greater use of contraceptive methods and accompanies the decrease in fertility, increases in family health and child survival (Binder, 1998; Hill and King, 1995). Educating girls has a particular importance in terms of these aspects.

As in many other parts of the world, girls in Turkey have less schooling than boys on average. In 1990, 23.3% of the male population were middle school or higher education graduates, whereas the figure for girls was 13.2%. There is also a wide disparity across regions, dependant on the social structure and development level. In West Turkey, 26.6% of the males and 18.3% of the females were middle school or higher education graduates whereas in East Turkey, the corresponding numbers were 17.8% and 6.5%. In line with the change in social structure and development level, the gender difference in education is decreasing, but it still has not reached complete equality. In 1997, the enrolment rates for male and females were, respectively, 74.3% and 53.93% for middle school education, 59.02% and 42.21% for high school education and 23.08% and 15.46% for university education[1].

This study aims to examine these issues in greater depth and investigate the reasons for these continuing disparities. It seeks to analyse the effects of family background and household characteristics on the educational achievement of boys and girls in Turkey. Using 1988 Household Survey Data, an ordered probit modelling approach is used to estimate final grade attainment regressions for boys and girls incorporating both the right censoring and the random family effects. The reason for the gender differential is then examined. Estimating four models with different econometric techniques, the effects of right censoring and the random family effects on the parameter estimates are also studied. The results suggest that family background characteristics have a significant effect on the education of individuals and that these effects are different for boys and girls.

The next section explains the theoretical model behind the analysis, section 3 discusses the possible determinants of the gender based differences in the educational attainment of children, section 4 gives some background information on the education of boys and girls in Turkey, and section 5 describes the data set used in this study. The econometric technique applied in estimating the models is explained in section 6. Section 7 explains the variables used included in the models, section 8 presents the model and the results, and finally section 9 is the conclusion.

[1] Enrolment rate is defined as "the ratio of the number of students by level of formal education to population enrolling age" (www.die.go.tr/okul/tanimo.html)

2. Theoretical Framework

The decision of how much to invest in education depends not only on the person who receives the education, but also on the parents who pay for it. Thus the educational investment decision is generally modelled within an intrahousehold allocation framework (Becker, 1979, 1998). An extension of the basic model allowing for the gender based differentials in the educational investment decisions of the parents forms the basis for the discussion in this study (Alderman and King, 1998).

The model assumes a two-period world, where parents work in the first period and retire in the second period. It is assumed that parents consume less than their income and invest in their children's human capital in the first period and their own consumption in the second period depends on the financial transfers coming from the children, which depends on the future wealth of the children, thus on the children's human capital. For the purposes of the model and for simplicity, the family is assumed to have two children, one of each sex. Thus the parents' lifetime utility function can be written as:

$$U = F(C_1) + G(C_2, W_b, W_g) \tag{1}$$

where C_1 is consumption in period 1, C_2 is consumption in period 2, W_b and W_g are the future wealth of the male and female child, respectively. Market incentives are introduced by allowing both the returns to children's human capital and children's remittance rates to differ by gender. The utility function then takes the form:

$$U = F(C_1) + G(\beta bH_b + \tau gH_g, bH_b, gH_g) \tag{2}$$

where H_b and H_g denote the human capital, and b and g denote the rates of return to human capital for the boys and girls, respectively. β and τ are the rate of transfers per unit of wealth from the male and female child. Preference differences between children can also be introduced by allowing the marginal utility of children's human capital to

differ by gender[2]. The budget of the family is assumed to be allocated between the consumption in the first period and the human capital investments for the children and is thus given by,

$$P_b H_b + P_g H_g + C_1 = Y \tag{3}$$

where P_b and P_g are the prices of investment in human capital of boys and girls and Y is the family income. Parents choose the level of investment in the human capital of their son and daughter by maximising their utility (Eq.2) subject to their budget constraint (Eq.3). Assuming that the direct costs of education are the same for boys and girls and after some calculation, the expression below is obtained[3]:

$$\frac{\partial G}{\partial C_2}\beta b + \frac{\partial G}{\partial W_b} b = \frac{\partial G}{\partial C_2}\tau g + \frac{\partial G}{\partial W_g} g \tag{4}$$

This expression indicates that parents invest in their son's and daughter's human capital up to the point where the marginal benefit of boy's human capital equals the marginal benefit from girl's human capital. Assuming equal remittance rates for boys and girls, if the market return to boy's human capital is greater than the return to girl's human capital ($b>g$), Eq.4 is satisfied at a point when the investments in the boy's human capital are higher than the investments in the girl's human capital ($H_b>H_g$), since the marginal utility functions are decreasing in the level of human capital (H). When boy's remittance rate is higher than the girl's ($\beta > \tau$), or if parents are concerned more with son's wealth than with daughter's wealth $\left(\partial G/\partial W_b > \partial G/\partial W_g\right)$, ceteris paribus, the marginal utility obtained from boy's human capital will also be greater than the marginal utility obtained from girl's human capital at the same level of human capital, H. Thus, by a similar argument, investment in boy's human capital will exceed that in girl's.

[2] If parents do not explicitly prefer one gender to the other, the marginal utility of each child's wealth will be equal.

[3] Different direct costs for girls' and boys' schooling might also be included in the model, but it is unlikely to observe direct costs differing by gender.

3. Determinants of Gender Based Differences in Educational Attainment

According to the intrahousehold allocation theory, parents might consider their children's education both as a consumption and an investment good. Parents' tastes towards education and their preferences for having educated children regardless of the financial benefits form the consumption part and the returns they receive from investing in their children's human capital form the investment part of the educational expenditures (Al-Samarrai and Peasgood, 1998; Gertler and Glewwe, 1992). Therefore the differences in the educational attainment of boys and girls in the family might be due to differences in parents' preferences for having educated sons and daughters, and/or to the differences in the net returns to boys' and girls' education. Hence parents might invest less in their daughter's education because the returns to girls' education are less and/or the costs for girls' education are higher than those for boys. The costs for education might be direct or indirect. The direct costs include expenditures on uniforms, necessary school materials like books, transportation costs and school fees whereas the indirect costs include the opportunity cost of child's time foregone whilst at school and travelling to school, and other non-monetary costs. The direct costs of schooling for children are more or less the same regardless of their gender, but there might be big differences in the opportunity costs.

Girls' opportunity cost of schooling is considered to be very high in some societies since they might spend the time at school taking care of their smaller siblings, helping the mother in the housework, or working in farmfields. These activities will indirectly but significantly contribute to the budget of the family (Binder, 1998; Chernichovsky, 1985; Glick and Sahn, 2000; Hill and King, 1995). Moreover, girls in some societies, are expected to learn and become familiar with the household activities before they get married. Parents, in this respect, might have the impression that girls miss an important part of the "home training" when they spend more time in formal education (Hill and King, 1995). Hence they might be reluctant to invest in their daughters' education or even send their daughters to school. Girls, because of their responsibilities in the family, may lack continuity of education and may spend less time doing homework or reading, which will in turn influence their success both in school and in the job market.

Besides the costs for education, parents also consider the returns they will receive from investing in their children's education. Return to boys' and girls' education in the labour market is one of the most important factors that affects the educational investment decisions of the parents in this respect. Gender based wage discrimination or occupational segregation in the labour market might discourage parents from investing in their daughter's education. The effect is stronger in the societies where parents expect their children to provide financial support when they get old. Traditions generally give this responsibility of taking care of parents to boys. Hence parents in these societies might value their sons' education more even if the returns to education for boys and girls were the same (Al-Samarrai and Peasgood, 1998; Binder, 1998; Sudha, 1997).

Another possible determinant of investment in children's education is the parental education level, which might affect the child's educational attainment in a number of different ways: By influencing the parents' tastes towards education; determining the quality and quantity of time spent with the child; parents acting as role models and indirectly via household income, genetic inheritance, and bargaining power of the mother. Moreover, it can be argued that educated parents are less influenced by tradition and are less likely to discriminate between their children (Al-Samarrai and Peasgood, 1998; Binder, 1998; Blau and Grossberg, 1992; Hill and King, 1995; Kalmijn, 1994; Leibowitz, 1974).

Gender based differentials in educational attainment in Turkey are likely to depend on most of the factors outlined above. Although the social structure is changing with development, men and women are still carrying on their traditional roles in most households. Families living in rural areas are largely engaged in agricultural activities and hence girls are mostly considered to have a higher opportunity cost of schooling than boys in such families. Also in many parts of Turkey, girls are considered to belong to their husbands' family after marriage and boys are expected to look after their parents and provide financial support when they get old. Moreover, some girls stop working after they get married or have a child as their husbands ask them to do so. Consequently, investing in their daughter's education may have limited financial returns to the parents.

4. Education of Boys and Girls In Turkey

Formal education in Turkey includes pre-school, basic, secondary, and higher education. Prior to 1997, basic education comprised five years of primary and three years of middle school, and since 1980, it had been compulsory to attend primary school and have at least five years of education. In 1997, as a part of an educational modernisation program, a new law combining the primary and middle schools was introduced and, with this change, compulsory education was extended from five to eight years. High schools provide a three year-educational programme. Primary and secondary education in public schools is free of charge.

Higher education consists of universities and non-university institutions of higher education with studies lasting at least two years. Each university consists of faculties and four-year schools that offer bachelor's level programs, and two-year vocational schools at a pre-bachelor's (associate's) level. Admission to undergraduate education is centralised and based on a nation-wide examination administrated by the Student Selection and Placement Centre (OSYM) .

5. Data

The sample used in this study belongs to 1988 Household Labour Force Survey conducted by the State Institute of Statistics of Turkey. The survey was conducted to 22,320 households –14,880 households from 59 urban locations and 7,440 households from 225 rural locations. The survey data has information about 102,062 individuals, 51,361 of whom are females and 50,701 are males.

Because this study analyses the effects of family background characteristics on the educational investment decisions of the parents, information on both the child and the parents are needed. Therefore, using the row survey data, a new data set where each observation has information on one child in the family and other family background characteristics was created. Only the households with children aged 6 or more were included in this new sample and in order to be able to analyse the effects of each parent separately, the sample was restricted to children in two-parent households. The final

sample created for the children includes 16,539 households and has information on 52,882 individuals.

Table 1 shows the enrolment rates by age and gender calculated using this data set[4]. Since the common starting age for primary schooling at the time of the survey was 8, the enrolment rates take their highest value at age group 8-9 for both boys and girls[5]. They then start to decrease suggesting some dropouts even at the primary school level. The highest decrease in enrolment rates for both boys and girls is observed for middle school, i.e. for age groups 12-13 and 14-15. The enrolment rate for girls is lower than the boys for all age levels, even in the primary schooling age which is supposedly compulsory. The gender gap increases for higher age groups, which correspond to higher education levels and the difference between the enrolment rates for boys and girls reaches to its highest level at ages 14-15.

Table1. Enrolment rates by age and gender in Turkey

Age	Males	Females
6-7	21.6	20.1
8-9	91.0	85.9
10-11	86.2	79.0
12-13	69.7	54.7
14-15	53.0	33.9
16-17	37.2	23.8
18-19	21.9	10.4
20-21	19.9	6.2

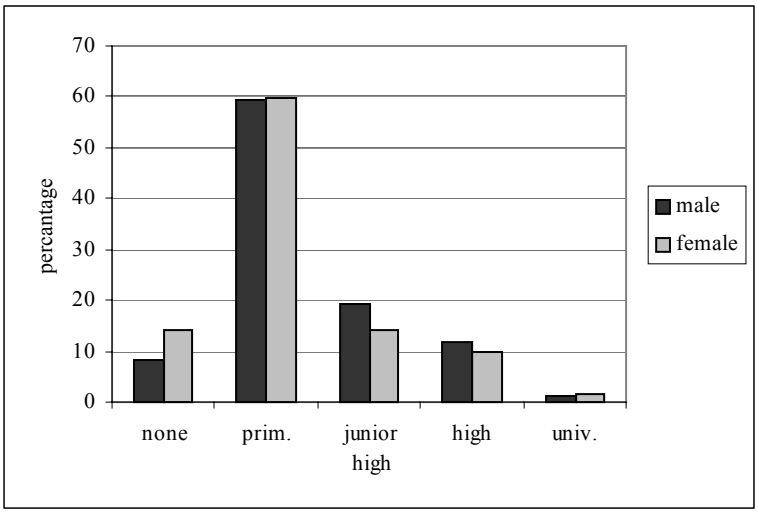
Calculated from 1988 Household LFS Data

Further information is presented in Graphs 1a and 1b, comparing the last grade attained by boys and girls. Considering that the average education level of the society is decreasing over time, the sample is divided into two cohorts: individuals aged between 12-25 and the ones older than 25. Note that some of the individuals in Graph 1a are still continuing with their education. The percentages for middle school and higher education graduates, thus, would be higher than what the graph represents. The graphs suggest that the younger generation attain more schooling than the older generation and even though it still exists, the gap between boys and girls have decreased. It is

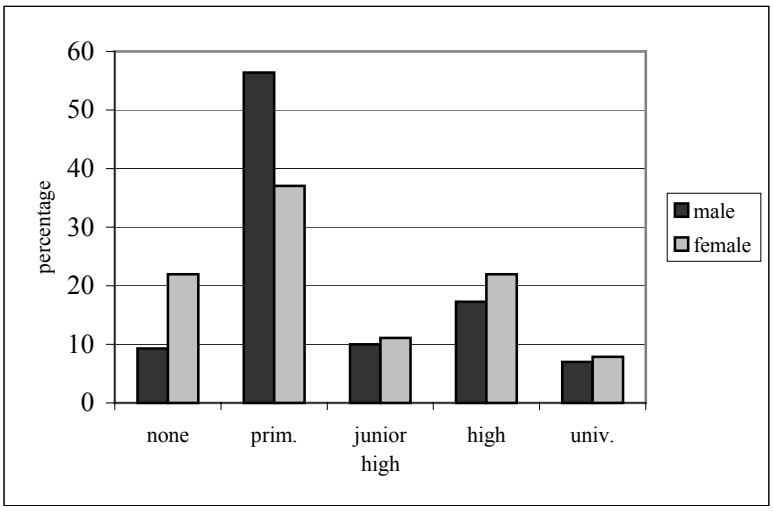
[4] The net enrolment rates are calculated by dividing the number of students by the total number of individuals in a certain age group.
[5] Note that primary schooling was compulsory at the time of the survey.

interesting to observe the difference in the distributions across regions, shown in Graph 2.

Graph 1a. Last school graduated, individuals aged 12-25

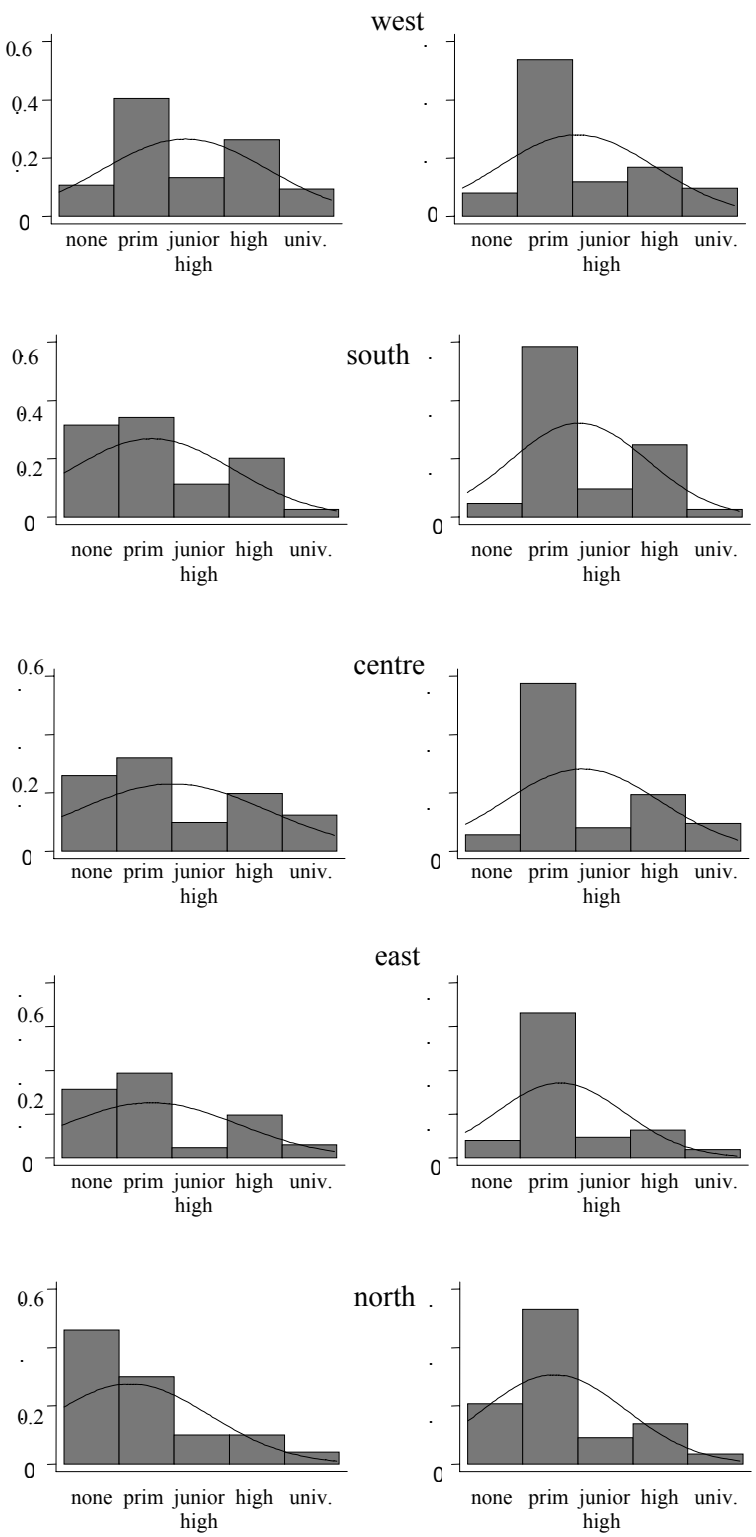


Graph 1b. Last school graduated, individuals aged 26 or older



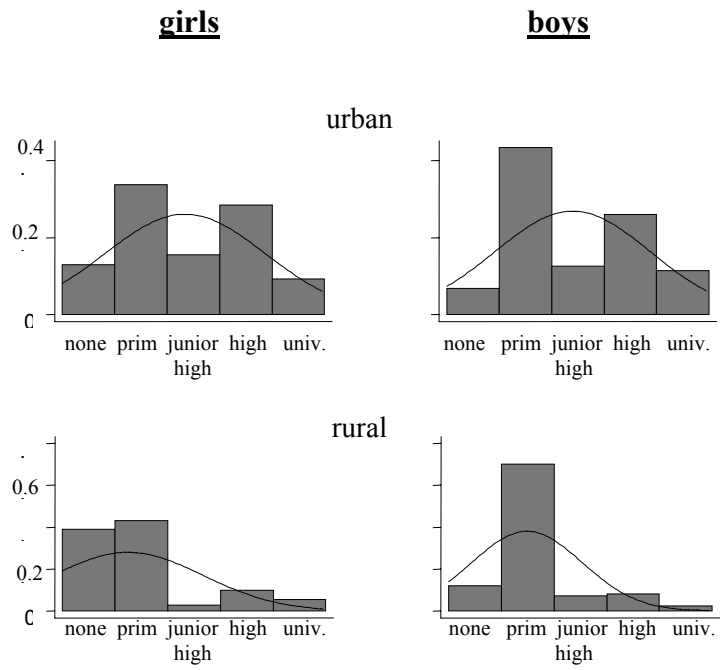
Data Source: 1988 Household Labour Force Survey Data

Graph 2. Histograms for last educational level achieved, individuals aged 12-25



Data Source: 1988 Household Labour Force Survey Data

Graph 3 Histograms for last school graduated by place of residence, individuals aged 12-25



Data Source: 1988 Household Labour Force Survey Data

The greatest difference in the educational achievement for both boys and girls is observed between the east and the west, which are the two regions with the highest gap in terms of the economic development level. The west has the highest educational achievement rates whereas east has the least. In all the regions, girls have less schooling than boys[6], but as expected, the difference between girls' and boys' education is much higher in the east than in all other regions.

Graph 3 presents the histograms for the highest grade attainment of individuals aged between 12-25 by place of residence. Individuals living in a rural area, on average, receive less education than the individuals living in an urban area and girls have less education than boys both in urban and rural areas, though the gender differential is higher in rural areas than the urban areas.

[6] The exceptions to this are observed in the west and the centre, where there are more university graduate girls than boys.

6. Econometric Technique

Following the theoretical model explained in section 2, factors influencing the educational investment decisions of the parents is analysed by estimating a reduced form demand equation for education, which is obtained by maximising the parental utility function subject to a family budget constraint.

A simple way of analysing the effects of household characteristics on educational investment decisions is to apply Ordinary Least Squares (OLS) to estimate years of schooling (Chernichovsky, 1985; Leibowitz, 1974). But OLS is not an appropriate technique to apply in such models since it assumes a continuous and normal distribution for the dependent variable, whereas the educational outcomes of the individuals are more likely to be discrete, and have a non-normal distribution with peaks for specific schooling levels[7] (Glick and Sahn, 2000; Greene, 2002). Hence, it is more convenient to apply discrete choice models because of the advantages they have compared to OLS.

The simplest way of estimating an educational attainment model with a discrete dependent variable is to apply logit or probit modelling to estimate the decision of whether or not to enrol in any level of school (Broaded and Chongshun, 1996). But instead of focusing on one educational transition, applying a multiple discrete choice model makes it possible to estimate a model where different levels of schooling could be analysed and hence the effects of household characteristics for each educational transition could be compared. Considering that the educational investment decisions follow a sequence of binary choices, that is the decision of investing to higher level of education is taken after the child completes the current grade they are in, some studies apply sequential logit/probit modelling to estimate the demand for education (Al-Samarrai and Peasgood, 1998; Butcher and Case, 1994; Hisarciklilar, 2001; Kalmijn, 1994; Lillard and Willis, 1994; Sudha, 1997). Enrolment models estimate the demand for education for one point at a time. They analyse the factors affecting the decision of whether or not to send the child to school at the time of the survey, but they do not give much information on the final grade attainment. Enrolment regressions, for example,

[7] See Graphs 1a and 1b for the distribution in Turkey.

do not consider the drop-outs or the absenteeism. Parents might enrol both their sons and daughters to school, but they might give priority to the quality of their sons' education, like supporting their sons more, allocating more resources to them, or providing a better environment for them to work while girls are helping the mother in the housework. Models for completed education on the other hand, allows one to analyse the cumulative decision making process.

Applying ordered probit modelling, Lillard and King (1984) estimate completed years of schooling for the Philippines, Glick and Sahn (2000) for the US, whereas Binder (1998) apply tobit modelling for Mexico. Tansel (1998) analyses the effects of individual, household, and local characteristics on the demand for schooling of boys and girls in Turkey, where she estimates ordered probit models of primary, middle and high school attainments. This study also applies ordered probit modelling to estimate the effects of family background and household characteristics on the final educational achievement of boys and girls in Turkey, but differently from Tansel's (1998) study, it incorporates both the right censoring and the random family effects into the model.

Four educational outcomes for the children in the family are included in the model: No degree, primary school degree, middle school degree, and high school degree. It is quite apparent that holding all the other factors constant, these educational outcomes reveal an ordering in the preferences; Having a primary school degree, for example, is preferred to having no degree, or having a high school degree is preferred to having a middle school degree. Therefore, ordered probit modelling is applied to estimate the models.

Let y_j be the propensity of schooling for the j^{th} individual:

(5) $$y_j = \beta' x_j + u_j$$

where β is a kx1 parameter vector, x_j is a kx1 vector for the individual characteristics and u_j is the stochastic disturbance term.

The observability criterion for the 4 possible outcomes in the model are given by[8]:

(6) $S_j = s \quad if \quad \mu_s \le y_j \le \mu_{s+1} \quad for\ s = 0,1,2,3$

where $s = \begin{cases} 0 & \text{if the individual has no degree} \\ 1 & \text{if the individual has a primary school degree} \\ 2 & \text{if the individual has a middle school degree} \\ 3 & \text{if the individual has a high school degree} \end{cases}$

Note that μ's are the threshold values where $\mu_0 < \mu_1 < ... < \mu_4$, $\mu_0 = -\infty$ and $\mu_4 = +\infty$. The conditional probability of observing the s^{th} category is then:

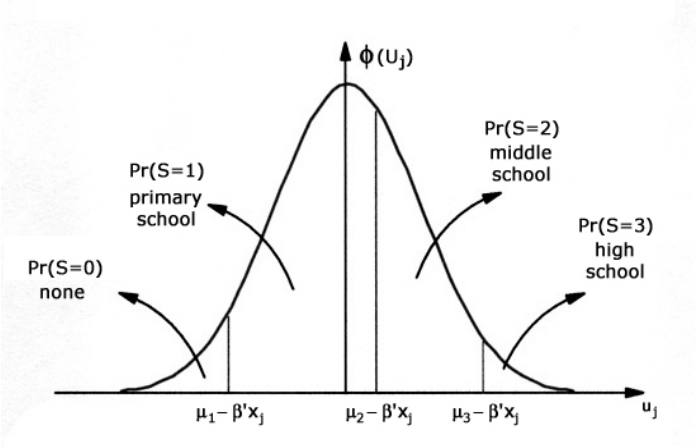
(7) $\Pr(S_j = s | x_j) = \Pr(\mu_s \le \beta' x_j + u_j \le \mu_{s+1})$.

Assuming a standard normal distribution for the stochastic disturbance term ($u_j \sim N(0,1)$), and arranging the terms above, the conditional probabilities could be re-written as[9]:

(8) $\Pr(S_j = s | x_j) = \Phi(\mu_{s+1} - \beta' x_j) - \Phi(\mu_s - \beta' x_j)$

where Φ is the normal probability density function with $\Phi(-\infty) = 0$ and $\Phi(+\infty) = 1$.

Graph 4. Graphical representation of the ordered probit model



[8] See Graph 4 for a better understanding.
[9] The model takes the form of ordered logit if we assume a logistic distribution for the disturbance term.

One of the two main issues arising in the estimation of the model is the right censoring in the data. Some of the individuals in the sample are still continuing with their education at the time of the survey. Including these individual in the estimation will lead to biased estimates for the coefficients since their grade level at the time of the survey doesn't represent their final grade attainment. Observations belonging to these individuals might be excluded from the sample so that the sample only includes individuals who have finished their schooling, though this is undesirable for two reasons. First, excluding some observations will reduce the sample size and will result in loss of information. This reduction in the sample size is particularly problematic in the case of girls as the number of female high school graduates is much lower than for boys. More importantly, excluding individuals attending school at the time of the survey will lead to a sample selection as the children of parents who value education less will be overrepresented in the sample because they will have ended their education after primary or middle school, whereas the children whose parents value education more will be continuing with their education in high school, for example, but will be excluded from the sample, causing a bias in the parameter estimates. Alternatively, the sample might be restricted to individuals who are older than a certain age, so that it only includes people who have completed their education. Tansel (1998), for example, estimates 3 regressions on selected samples of primary, middle and high schooling ages. This is also undesirable since it decreases the sample size, especially for some countries where late enrolment is commonly observed, increasing the lowest age limit chosen. Besides, people older than a certain age are likely to live separately from their parents, which might again create a problem if the sample only has information about individuals living in the same household.

One way of dealing with the problem of right censoring to model it explicitly (Glick and Sahn, 2000; Lillard and Willis, 1994). In the censored model, likelihood contributions for the individuals who are still continuing to their education at the time of the survey are included as well as the probability functions of those who have finished their schooling. If the individual is going to middle school, for example, we know that they have already finished primary school. If we assume that the individual will finish their current grade, then the final educational level they will achieve will either be middle school or a higher degree, in which case the likelihood contribution

will be $1-\Phi(\mu_2-\beta' x_j)$[10]. Likelihood contributions for other levels of education are written similarly. Hence the probability functions for the individuals who are continuing their education is:

(9) $\quad 1-\Phi(\mu_s-\beta' x_j)$

where *s* is the degree the individual is doing at the time of the survey.

A further consideration for estimation arises from having more than one individual from the same household in the data set (Glick and Sahn, 2000; Lillard and King, 1984; Lillard and Willis, 1994). Children coming from the same family might share the same unobserved family characteristics that can not be measured by the data. Ignoring these unobserved family characteristics results in correlated error terms across individuals within families, which causes underestimation of the standard errors. The model estimated in this study thus considers the unobserved family characteristics and includes a random error component which takes the same value for each individual belonging to the same household.

The propensity for schooling for the j^{th} individual in the i^{th} household then takes the form:

(10) $\quad y_{ij}=\beta' x_{ij}+\theta_i+u_{ij}$

where θ_i represents the unobserved family characteristics and is assumed to be common to all children in the household. It is assumed to be normally distributed with a variance of $\sigma^2_{\theta_i}$. ($\theta_j \sim N(0,\sigma^2_{\theta_i})$ and $u_{ij} \sim N(0,1)$). The correlation between the two disturbance terms is:

(11) $\quad \rho=\sigma^2_\theta/(\sigma^2_\theta+\sigma^2_u)=\sigma^2_\theta/(\sigma^2_\theta+1)$

[10] One can argue that the individual might drop out before finishing the current grade. We can drop our assumption and write the probability functions based on the last grade observed in the data, in which case the likelihood contribution will be $1-\Phi(\mu_1-\beta' x_j)$.

The conditional probabilities for the schooling outcomes of the individuals can be re-written as:

$$(12) \qquad \Pr(S_{ij}) = \Phi(\mu_{s+1} - \beta' x_{ij} - \theta_i) - \Phi(\mu_s - \beta' x_{ij} - \theta_i)$$

for the non-censored observations, and

$$(13) \qquad \Pr(S_{ij}) = 1 - \Phi(\mu_s - \beta' x_{ij} - \theta_i)$$

for the censored observations.

The conditional likelihood for the i^{th} household with n children is the product of all the conditional probabilities for the children in this household:

$$(14) \qquad L_i(\theta_i) = \prod_{j=1}^{n} P(S_{ij})$$

The probability functions in the conditional likelihood above include the random family component θ_i. The unconditional likelihood is thus written by integrating the marginal likelihood over all possible values of θ_i. Defining $\tilde{\theta}_i = \theta_i / \sigma_\theta$,

$$(15) \qquad L_i = \int_{\tilde{\theta}} \phi(\tilde{\theta}_i) \prod_{j=1}^{n} P(S_{ij}) d\tilde{\theta}_i$$

where

$$(16) \qquad P(S_{ij}) = \Phi(\mu_{s+1} - \beta' x_{ij} - \tilde{\theta}_i (\rho/1-\rho)^{1/2}) - \Phi(\mu_s - \beta' x_{ij} - \tilde{\theta}_i (\rho/1-\rho)^{1/2})$$

for the non-censored observations, and

$$(17) \qquad P(S_{ij}) = 1 - \Phi(\mu_s - \beta' x_{ij} - \tilde{\theta}_i (\rho/1-\rho)^{1/2})$$

for the censored observations.

The log-likelihood function for the total sample is obtained by taking the natural logarithm of the product of the unconditional likelihood functions for all the households in the sample:

$$(18) \qquad \ln L = \sum_{i=1}^{m} \int_{\tilde{\theta}} \left[\ln \phi(\tilde{\theta}_i) \sum_{j=1}^{n} \ln P(S_{ij}) \right] d\tilde{\theta}_i$$

where *m* is the number of households.

The estimates for $\beta, \mu,$ and ρ are obtained by maximising this function by a program written in Stata6. The first derivatives for the integral are calculated making use of the hermite integration suggested by Butler and Moffit (1982) (Frechette, 2001).

7. Variables

This study explores the educational achievement of boys and girls within an intrahousehold allocation framework. Hence it focuses on the effects of family background and some other household characteristics. The explanatory variables included in the models aim to measure the 3 factors which are discussed to cause the differences in educational investment decisions in the household, namely the opportunity cost of schooling, the net returns to education, and parental preferences towards having educated sons and daughters. Most of the explanatory variables included in the regressions are proxies for more than one of these factors. Parents who value education less and have a higher preference for their sons' education are more traditional and thus the effect of opportunity cost of schooling are stronger in these families. Besides, these parents are also the ones who consider the return to education, namely the financial support they will receive from their sons when they get older. Therefore, although the aim of including each explanatory variable is explained below, it is impossible to precisely group these variables according to the effects they have.

Parental Education:

Parental education is considered to be one of the most important factors affecting the educational attainment of the individuals in the family. It affects the educational attainment of the child in various ways. Mother and father's education are likely to have different effects for different levels of educational attainment and each gender. To observe the effects of each, 3 education dummies are included: Parent not having any educational degree; parent being a primary school graduate; and parent being a secondary or higher education graduate. These are included separately for mothers and fathers in the models estimated[11]. Parents without any educational degree are chosen to be the reference category.

Agricultural Dummies:

As discussed in section 3, opportunity cost of schooling is likely to be another important determinant of the child's schooling and the differences for the boys' and girls' education in the family. The opportunity cost of schooling is very high for children whose parents are engaged in agricultural activities, since the help that children in these families can give to other family members in the fields might be considered to be more important than attending school. The percentage of women working in farm fields in Turkey is higher than the percentage for men signalling that the opportunity cost of schooling for girls is much higher than the opportunity cost for boys. Families engaged in agricultural activities are also likely to be more traditional, upholding the belief that boys are the breadwinners of their families while girls should be taking care of the household, in which case girls' education may be valued less. Therefore dummy variables controlling for mother and father working in agricultural activities are included in the models.

Existence of a female relative, existence of an elderly person in the household:

Other factors measuring the opportunity cost of girls' schooling in the model also relate to a woman's traditional role in the family. In traditional families, girls are expected to help their mothers in taking care of the smaller siblings or helping the

[11] While estimating the models, parental education was first included with 5 dummies in the model: parent not having any educational degree, parent being a primary school graduate, parent being a middle school graduate, parent being a high school graduate and parent being a university graduate. The dummies for middle school, high school and university degree were combined in the last estimations because of insufficient number of observations for the dummies representing each education level.

mother in the housework. The existence of a grandmother, or any other female relative, who can help the mother in the housework is expected to decrease the opportunity cost of girls' schooling. The existence of an old person who needs to be taken care of is, on the other hand, expected to increase the opportunity cost as the workload of the mother increases. Three variables are included in the models to capture these effects. One of the variables is a dummy indicating whether there is a female relative aged 12 or older living in the household[12]. The other 2 variables are a dummy for the existence of an elderly person who is aged 60 or older in the household and an interaction variable of their age with this dummy.

Mother's participation:

Another variable included in the regressions is the mother's participation in the labour market[13]. In some households, girls in the family might be responsible for doing the housework or taking care of the younger siblings when their mothers are at work, increasing the opportunity cost of schooling for the girls. However this variable may have two differing effects depending on the mother's education and thus occupation. In families where the mother is less educated and working in a low paid occupation, the parents are likely to value girls education less, whereas in some other families where the mother is highly educated and working in a better occupation, the mother's participation may be an indicator of a strong preference towards having an educated daughter[14]. Mothers in these families are also a good role model for the girl. The mother's participation in the labour market is also serves as a proxy for the bargaining power of the mother in the household, which is again likely to increase girls' schooling.

Number of individuals in the household:

There are quite a number of studies investigating the effects of the number and composition of the siblings in the family. The number of siblings has a big effect on the educational attainment of the children, especially the girls in the family. Even if

[12] Instead of this variable, the number of female relatives in the household could be included in the model, but it is likely to be correlated with family size, which is another variable included in the regressions.

[13] Mother's hours of work instead of participation was also included in the regressions but the estimation results more significant with a participation dummy.

parents do not discriminate between their children, the financial resources allocated to each child and the amount of parents' time spent on each child will decrease as the quantity of the children in the family increases[15]. The situation is worse for girls if parents' have a preference for having educated sons. Instead of the number of siblings in the family, this study uses the family size, i.e. the number of individuals in the household. One reason of doing so is that the sample includes some very large families where the couples are living with the husband's parents or brothers after marriage. The educational investment decisions in these families are probably taken jointly, where the total number of children in the household becomes more important. This variable is also likely to be a good proxy for how traditional the family is and the value given to education.

Family income per capita:

Financial limitations for the family are considered to be very important on the educational investment decisions. Families with less financial resources will invest less in their children's education and, the effect may be stronger for girls because poorer parents are likely to give priority to boy's education considering the breadwinner role of the males and the financial support they will receive from their sons when they get older. Considering the large families in the sample, total family income per capita, instead of the total income is included in the regressions[16].

Urban versus rural residence and region dummies:

The last set of explanatory variables included in the regressions are, a dummy variable for living in an urban versus rural area and 5 region dummies for West, East, South, North and Centre, Centre being the reference category. These dummy variables for the place of residence capture many different effects, from the socio-economic status of the family to the supply factors. Families living in a rural area are generally involved in agricultural activities or husbandry, and the access to high quality schools is more limited. Similar arguments also hold for different regions. There is a big difference

[14] At first, 8 parental occupation dummies were included in the models instead of only controlling for agriculture, but these dummies were excluded from the final estimations because of the insufficient number of observations for each occupational category.

[15] See Becker (1998) for a detailed discussion on the quality-quantity trade-off for the children.

[16] Including the father and mother's earnings separately into the model would allow us to compare the effects of each, but families engaged in agricultural activities tend to report a total income for the head

between the regions in terms of the structure of the society, values and traditions, the level of economic development and industrialisation, etc. Schools in the west generally provide higher quality education, whereas there is an insufficient supply of schools in the east because of its geographic situation or fewer investments in that region. Families in the east are also mostly engaged in agricultural activities or husbandry and are less open to change.

8. The Model:

8.1. Comparison of Different Approaches

This study estimates the final educational achievement of boys and girls using random effects ordered probit modelling which allows for possible censoring in the data. In order to assess the impact of unobserved family characteristics and right censoring, four models are estimated. The first model is estimated by an ordered probit modelling without considering the right censoring or the unobserved family characteristics; the second model applies a censored ordered probit modelling without the random family effects; the third model includes the random family effects, but not censoring; and the final one incorporates both the right censoring and the random family effects. The models which do not incorporate censoring are estimated on a subsample of individuals who have completed their education[17]. The sample used in estimating the models in this study is restricted to individuals who are aged between 10 and 25.

Table 2 presents the results of the four different approaches. In all four models, the parameter estimates are generally highly significant and have the expected signs, supporting the discussion in section 3. The effect of bias is clear with, in general, the parameter estimates increasing as we move along from the simplest to the most complicated model. The change in the parameter estimates is most obvious for gender and parental education dummies, which are considered to be among the most important factors in demand for education. Even the measured effects of maternal and paternal

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of the household. Hence even though the mother is working in the family farm fields, she reports a zero income, which makes it difficult to include separate earnings for the parents.

[17] As discussed above, we might as well estimate these models on a restricted sample of individuals who fall in a chosen age interval, but for the purposes of this exercise, it is preferred to exclude students.

education differ for the four approaches, with mother's and father's education being close to each other in the first two approaches, but father's education appearing to be more important in the 3rd and the 4th approaches. This indicates a bias in the parameter estimates for the models that do not include censoring or random effects in the model, causing overestimation in the predicted probabilities. The coefficients for the 3rd and the 4th models are relatively close to each other hinting that the effect of unobserved family characteristics on the model is bigger than the right censoring.

When we examine the results of the 4th model, the importance of parental educational level can be observed. The higher the level of parental education the greater the impact, suggesting that children of parents with a primary school degree are more likely to receive education than the children of parents without any degree, and children of parents with secondary or higher education are more likely to receive education than children of parents with a primary school degree.

All the explanatory variables included in the model as indicators of the opportunity cost of schooling are significant and have the expected signs. If the mother and father are engaged in agricultural activities, this has a diminishing effect on educational attainment, with the results of the two being very similar. Children belonging to families living in an urban area attain more schooling compared to those living in rural areas. The existence of a female relative who can help the mother in the housework or taking care of the children increases the likelihood of children receiving education. Finally, the existence of an elderly relative aged 60 or older, has a negative effect on the education of the children.

Consistent with our expectations, children belonging to large families are less likely to receive education than the ones in smaller households. Family income per capita, measuring the financial limitations of the family (and hence a good indicator for the quality of education the parents can provide), is found to have a positive effect on the educational attainment. Children of families with higher income are thus more likely to have education than the children of poorer parents.

Controlling for age would make us concentrate on an older cohort where the parameter estimates would already be different even if there were no bias.

Table 2. Comparison of different approaches

Econometric Technique / Variables	Ordered probit modelling	Censored ordered probit modelling	Random effects ordered probit modelling	Random effects ordered probit modelling with censoring
Gender	0.3299***	0.3771***	0.6439***	0.6250***
	(17.010)	(22.043)	(21.056)	(28.850)
Mother primary school education	0.2354***	0.3064***	0.3499***	0.4963***
	(9.538)	(14.347)	(7.021)	(13.881)
Mother middle school education or higher	0.9252***	1.0749***	1.3784***	1.4903***
	(10.448)	(15.626)	(8.241)	(14.078)
Father primary school education	0.3312***	0.3870***	0.5380***	0.6025***
	(14.780)	(19.263)	(11.492)	(17.276)
Father middle school education or higher	0.9241***	1.1401***	1.5259***	1.6496***
	(20.675)	(30.872)	(17.029)	(26.591)
Family income per capita	0.3665***	0.2808***	0.5483***	0.1786*
	(5.611)	(4.823)	(4.001)	(1.751)
Mother engaged in agriculture	-0.1575***	-0.2053***	-0.2715***	-0.2385***
	(-4.279)	(-6.115)	(-3.514)	(-4.091)
Father engaged in agriculture	-0.1288***	-0.1706***	-0.1716***	-0.2724***
	(-4.345)	(-6.366)	(-2.773)	(-5.865)
Living in an urban area	0.0885***	0.1647***	0.1686***	0.2948***
	(3.348)	(7.064)	(3.091)	(7.395)
Mother's participation	0.0648*	0.0657**	0.0660	0.0407
	(1.782)	(1.981)	(0.871)	(0.712)
Family size	-0.0711***	-0.0758***	-0.1260***	-0.1017***
	(-17.480)	(-20.649)	(-14.069)	(-15.411)
Existence of an elderly	-0.9346***	-0.7627***	-1.3765***	-0.9729***
	(-4.191)	(-3.775)	(-2.806)	(-2.659)
Age of the oldest	0.0148***	0.1240***	0.2280***	0.1514***
	(4.754)	(4.379)	(3.283)	(2.925)
Existence of a female relative	-0.0028	0.1275**	0.0567	0.2341**
	(-0.046)	(2.240)	(0.443)	(2.434)
West	-0.1016***	-0.0990***	-0.1831***	-0.1398***
	(-3.625)	(-4.065)	(-3.242)	(-3.432)
South	-0.1505***	-0.1772***	-0.2938***	-0.2215***
	(-4.703)	(-6.248)	(-4.398)	(-4.563)
North	-0.4192***	-0.3314***	-0.6916***	-0.3137***
	(-13.881)	(-12.405)	(-11.018)	(-6.848)
East	0.0838**	0.1193***	0.1393	0.2224***
	(1.982)	(3.205)	(1.604)	(3.535)
Threshold1	-1.3284	-1.297***	-2.0950***	-1.7427***
		(-15.165)	(-13.653)	(-15.165)
Threshold2	0.8399	0.6775***	1.3940***	0.7428***
		(6.518)	(9.127)	(6.518)
Threshold3	1.2360	1.0769***	2.0646***	1.1918***
		(10.414)	(13.399)	(10.414)
Rho	-	-	0.6386***	0.5337***
			(62.923)	(57.169)
Sample size	15062	26992	15062	26992

*** Significant at the 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level
Note: The numbers in parenthesis are the t-ratios.

Holding other factors constant, living in the west, south, or north of Turkey has a detrimental impact on children's educational attainment compared to the central and especially eastern regions[18]. The results for the west and the east are quite surprising, as living in the west is expected to have positive effect on the education of the children whereas the effect is expected to be negative for living in the east[19]. Tansel (1998) however also found similar effects for the regions in her model when she examined the schooling attainment of boys and girls in Turkey. A possible explanation for these results is that all the variables included in the model are capturing the effects that region dummies are anticipated to capture, such as how traditional the family is, the girl's opportunity cost for her family engaged in agriculture or other socio-economic factors.

8.2. Gender Regressions

In order to compare the effects of each factor on the final grade attainment of boys and girls, the model was re-estimated separately for each using random effects ordered probit modelling incorporating the right censoring. The gender differential on the effects of the variables is then investigated by applying an F-test, where the model is run on a pooled sample with the interaction variables of the child's sex and testing the significance of the interaction terms.

The results of the two models are presented in Table 3[20]. The threshold values for the primary school degree are very close to each other for boys and girls, but the ones for the middle school and high school degrees are higher for girls than the boys indicating that it is easier for boys to attain middle or high school degree than for the girls. As before, the children of highly educated parents are more likely to receive education. Further, the results are consistent with the idea that mother's education level is more important for girls' schooling than the boys' schooling. Family income per capita is also found to have significant positive effects on the education of the girls, whereas it

[18] Central Turkey is taken as the base group.
[19] Families living in the east are more traditional, many married couples are living in the same household as the husband's parents and other married brothers, most of the population is engaged in agriculture or husbandry, the income level is lower compared to other regions, and women generally do not participate in the labour market. Families in the west generally have the opposite characteristics and the other regions are somewhere in between.

Table 3. Regressions by gender

Variables	Males	Females	Gender Difference
Mother primary school education	0.4326***	0.6875***	***
	(8.748)	(12.072)	
Mother middle school education or higher	1.2939***	2.1418***	***
	(8.835)	(11.524)	
Father primary school education	0.6106***	0.7523***	
	(12.932)	(13.381)	
Father middle school education or higher	1.7089***	1.9675***	
	(19.265)	(19.594)	
Family income per capita	0.0821	0.6187***	**
	(0.685)	(3.084)	
Mother engaged in agriculture	-0.2245***	-0.2413***	
	(-3.544)	(-3.134)	
Father engaged in agriculture	-0.3093***	-0.3140***	
	(-4.995)	(-4.203)	
Living in an urban area	0.2446***	0.3905***	
	(4.535)	(6.099)	
Family size	-0.0832***	-0.1626***	***
	(-9.067)	(-14.805)	
Existence of an elderly	-0.6776	-1.2996**	
	(-1.388)	(-2.176)	
Age of the oldest	0.1094	0.2037**	
	(1.586)	(2.415)	
Existence of female relative	0.3536***	0.1871	
	(2.741)	(1.114)	
West	-0.2337***	-0.0699	***
	(-4.214)	(-1.074)	
South	-0.2416***	-0.2873***	
	(-3.667)	(-3.762)	
North	-0.0914	-0.7212	***
	(-1.490)	(-9.894)	
East	0.2623***	0.2205**	
	(3.079)	(2.279)	
Threshold1	-2.3060***	-2.4881***	
	(-14.795)	(-12.388)	
Threshold2	0.3232**	0.5990***	
	(2.134)	(3.071)	
Threshold3	0.8624***	1.0542***	
	(5.671)	(5.379)	
Rho	0.5952***	0.6654***	
	(45.975)	(50.998)	
Sample size	14534	12458	

*** Significant at the 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level

Note: 1. The numbers in parenthesis are the t-ratios.
2. The last column shows if there is a significant gender difference in the coefficients. The significance levels are reported as follows: *** 1 percent, ** 5 percent, *** 10 percent. The empty cells suggest that there is no evidence for a gender difference for that variable.

[20] The dummy variable for mother's participation is excluded from the regressions since the coefficients for this variable were insignificant for both boys and girls.

is insignificant for the boys, hinting that financial limitations of the family might be more important for girls' schooling than the boys' schooling. Family size is another factor causing the gender differentials in educational attainment. Children in larger families are less likely to receive education but the effect is significantly higher for girls than for the boys.

Although the parameter estimates of an ordered probit modelling indicate the significance and the direction of the effects for the explanatory variables in the model, it doesn't give much information about the effects of the variables on different levels of educational achievement. According to the regression results in Table 3 for example, mother's education has positive effects on children's education. It is quite apparent that it decreases the likelihood of the child having no degree and increases the likelihood of them attaining high school education, but it is difficult to comment on the direction and magnitude of its effects on the child attaining a primary or middle school education[21]. Calculating the marginal effects allows us to observe the effects of a change in the explanatory variable on each educational outcome. Calculation of the marginal effects of a continuous variable is straightforward: The 1st derivatives of the probability functions with respect to the explanatory variable are evaluated at the sample means of the variables. The marginal effects for a dummy variable is calculated by comparing the probabilities in the cases of dummy taking the values 1 and 0, while holding the other variables at their sample means. The marginal effects of a variable for all of the grade attainments sum to 0, that is the calculated numbers show the change in the predicted probabilities for each outcome as a result of a change in the explanatory variable examined[22].

Turning to the results in Table 4, if the parent has a primary school education, then this decreases the probability of the child having no degree or having primary or middle school education, while it is increases the likelihood of high school attainment both for boys and girls. If a mother has primary school education, it increases the boys' high school attainment probability by 14.31 percentage points (Note that this number shows

[21] See Greene (2002) for a detailed discussion.
[22] See Greene (2002) for the details of the calculation.

Table 4. Marginal effects for the gender regressions

	BOYS				GIRLS			
Variables	No degree	Primary school education	Middle school education	High school education	No degree	Primary school education	Middle school education	High school education
Mother primary school education	-0.0003	-0.1110	-0.0318	0.1431	-0.0001	-0.1875	-0.0604	0.2481
Mother middle sch. educ. or higher	-0.0003	-0.1942	-0.2859	0.4804	-0.0001	-0.2550	-0.1578	0.4129
Father primary school education	-0.0007	-0.1681	-0.0220	0.1907	-0.0003	-0.2266	-0.0557	0.2826
Father middle sch. educ. or higher	-0.0006	-0.2551	-0.3507	0.6063	-0.0002	-0.3118	-0.1586	0.4706
Family income per capita	-0.0023	-0.0289	0.0253	0.0058	-0.0102	-0.2007	0.0636	0.1472
Mother engaged in agriculture	0.0003	0.0646	0.0034	-0.0682	0.0001	0.0752	0.0179	-0.0932
Father engaged in agriculture	0.0004	0.0893	0.0038	-0.0935	0.0001	0.0981	0.0230	-0.1213
Living in an urban area	-0.0002	-0.0683	-0.0077	0.0763	-0.0001	-0.1195	-0.0298	0.1494
Family size	0.0068	0.0163	-0.0212	-0.0019	0.0224	-0.0053	-0.0098	-0.0074
Existence of an elderly	0.0018	0.2627	-0.0922	-0.1723	0.0037	0.4687	0.0020	-0.4744
Age of the oldest	-0.0004	-0.0389	0.0149	0.0244	0.0000	-0.0608	-0.0167	0.0776
Existence of female relative	-0.0006	-0.1099	0.0120	0.0986	-0.0001	-0.0593	-0.0134	0.0728
West	0.0003	0.0665	0.0049	-0.0717	0.0000	0.0210	0.0057	-0.0267
South	0.0003	0.0709	0.0008	-0.0720	0.0001	0.0916	0.0200	-0.1117
North	0.0001	0.0255	0.0029	-0.0285	0.0005	0.2407	0.0387	-0.2798
East	-0.0002	-0.0650	-0.0238	0.0890	0.0000	-0.0609	-0.0201	0.0810

the absolute change in the predicted probability, not the percentage change), whereas the impact on girls is 24.81 percentage points. If the mother has secondary or higher education, it has a similar effect on both boys' and girls' high school attainment. A one-unit increase in family income per capita increases girls' middle and high school attainment, respectively by 6.36 and 14.72 percentage points, whereas its effect is very small for the boys[23]. If the parents work in agriculture, this has a positive effect on primary school attainment, whereas it is decreases the high school attainment probability for both boys and girls. The effect of the father working in agriculture is higher than that for the mother with a higher effect for girls. Children living in an urban area are more likely to have high school attainment than the ones living in a rural area and the effect of this variable is nearly twice as high for girls than for boys. Although its effect on the predicted probabilities is small, an increase in family size decreases the likelihood of girls attaining any level of schooling. This result indicates that girls in large families tend to receive no education, whereas boys in these families are more likely to attain primary school education. As mentioned above, it is surprising to observe that living in the east has positive effects on the education of the children, whereas the coefficients for all the other regions are negative. Another surprising result we observe in Table 4 is that the effects of this variable on the predicted probabilities for all levels of schooling are nearly the same for boys and girl though a significant gender difference is expected in this region.

A possible problem with the models estimated in this study is that, girls in some traditional families get married at very young ages (14-15 for example), and then leave the parental home. The sample used in this study doesn't have information on such individuals. This may give rise to a sample selection, with gender differential in educational achievement being underestimated, especially for higher levels of educational transitions, i.e. for high school[24].

[23] Recall that the parameter estimates for this variable was insignificant for the boys.
[24] The same problem might exist for boys if those not doing schooling get married early. However this group will correspond to a higher age level since they need to be mature enough to earn money and take care of their families. Besides, boys in more traditional families tend to stay with their parents after marriage.

9. Conclusion

This study has examined the determinants of gender based differentials in educational attainment in Turkey. It has focused on how family background and household characteristics influence the final grade attainment of boys and girls in the family. The results suggest that these have significant effects on the educational investment decisions, and some of the factors considered have different impacts on boys and girls, in general favouring boys.

Consistent with the previous research, parental education, the opportunity cost of schooling and the financial limitations of the family are found to have significant impacts on the educational attainment of the children in the family. In agreement with the other studies, the results suggest that parental education is the most important factor for the educational achievement, with father's education being slightly more important than the mother's. The results also support the notion that mother's education is more important for girls than for the boys.

Children living in rural areas and those whose parents work in agricultural activities are less likely to receive schooling, suggesting that the opportunity cost of schooling may be an important factor affecting the educational investment decisions of the parents. Such impacts may also reflect the supply side factors, which impact education negativelly. An insufficient supply of education may make it more difficult for the parents to invest in their children's education.

Children belonging to large families are also less likely to receive education than the ones in smaller households, with the impact of this factor being higher for girls than for the boys. Family size may reflect parents' taste and preferences towards education, as well as the financial resources available for education. Parents with fewer children may also be able to help the child with reading, schoolwork, and other activities. The traditional roles of the girls in the society makes the effect of this variable stronger for the girls, since they are expected to help the mother in the housework or taking care of the siblings.

Finally, whilst family income per capita is found to have an insignificant effect on boys' education, it has a highly significant effect on girls. This result suggests that families with financial limitations give priority to their sons' education.

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