

**Returns on Investment in Education: Evidence from Turkey by
Education Levels and by Higher Education Programs**

Merve Kurt

Erdal Gumus

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MERVE KURT²

ERDAL GUMUS³

Eskisehir Osmangazi University

Abstract

This paper estimates private and social returns on investment in education in Turkey, by level of education and by higher education program, using the 2008–2016 Household Labor Force Survey and Income and Living Conditions Survey panel datasets. The paper uses panel econometrics with the Hausman-Taylor and instrumental variable methods dealing with the endogeneity and unobserved heterogeneity problems. The private returns on investment in higher education tend to be higher as compared to the private returns on investment in non-tertiary education. The results indicate that the private returns on investment from various higher education programs are significantly different across various higher education programs. Based on the empirical findings, a number of policy recommendations are developed.

Keywords: returns on education, investment in education, human capital, social return on higher education.

JEL: I21, I26, C33

1. Introduction

Gary Becker set the standard with regard to human capital theory, and many researchers have contributed to the theory by studying various aspects of investment in education and their effect on accumulating human capital and economic growth.

The human capital theory states that education, work experience, and individual abilities affect an individual's future income (Becker, 1992). Education, as an important element of human capital, refers to the process by which individuals acquire knowledge, skills, and abilities and contribute to society as well as themselves, and at the same time acquire positive attitudes, values, and behaviors. When considered within the human capital theory, contributions made through the educational process are accepted as an investment, and these investments benefit both individual and societies.

Education, especially higher education, is a significant contributor to the formation of a highly qualified workforce for an economy (Choi & Hur, 2020). At the same time, it is expected that higher education graduates will earn more in their lifetimes than graduates who have no higher

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² ORCID ID: 0000-0002-3903-5505

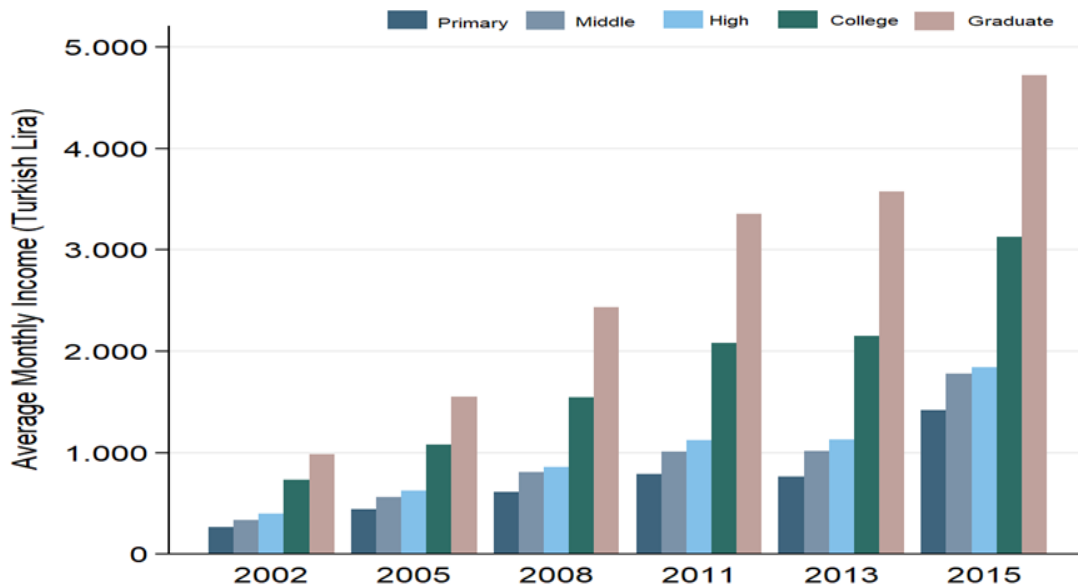
³ ORCID ID: 0000-0002-8593-9265

education. Due to this expectation of higher earnings, there is an ever-increasing demand for higher education. When considered from an economic perspective, more education can accelerate economic growth by providing individuals with new useful skills in various subjects and fields, and it contributes to higher productivity, which may increase the overall output level of the economy.

As a developing country, Turkey has recently invested in building educational capacity by establishing many privately funded, not-for-profit, and public higher education institutions since 1990. There were only 39 higher education institutions in 1990. Due mainly to market-based economic policies, investment in many areas, including higher education, became the main policy agenda in Turkey after the 1990s. There have been new higher education institutions established during the last three decades. Specifically, 11.65% of these new institutions were established in 1992, 7.77% in 2006, 10.19% in 2007, and 6.80% in 2008. The total number of higher education institutions has now increased to 206 in 2019.⁴

To get a rough idea concerning the linkage between education and earnings in Turkey, we share Figure 1, which shows the average monthly income by educational level from 2002 to 2015 for the case of Turkey. Each education level provides income that increases from year to year. While the differences in earning between primary, middle, and high school education are relatively small, they are very high between high school and tertiary education. Also, it is noteworthy to observe that graduate education has far higher earning.

Figure 1
AVERAGE MONTHLY INCOME



Source: Household Budget Survey, 2002–2015, Turkish Statistical Institute.

Table 1 shows the average monthly earnings by year and by higher education field in Turkey. The top three average monthly earners are graduates of law, health, and security (military)

⁴ These statistics are taken from the Council of Higher Education of Turkey's website (<https://istatistik.yok.gov.tr/>).

programs. Thus, higher education demand for these fields in Turkey is very high, and there is high competition for enrolment in these programs.

Table 1
AVERAGE MONTHLY EARNINGS BY YEAR AND BY HIGHER EDUCATION PROGRAM

Higher Education Programs	Average Monthly Earnings (Turkish Lira)			
	2010	2014	2016	2010-2016 Average
Law	2,787	3,216	3,949	3,298
Health	2,233	3,275	3,804	2,870
Security services	2,182	3,122	3,541	2,799
Social and behavioral science	1,914	2,644	3,118	2,536
Physical science	1,892	2,688	3,186	2,451
Life science	1,617	2,538	3,329	2,444
Mathematics and statistics	1,759	2,604	3,222	2,417
Veterinary	1,800	2,647	3,177	2,335
Journalism and information	1,614	2,063	3,191	2,239
Teacher training and education	1,601	2,444	2,920	2,218
Agriculture, forestry and fishery	1,655	2,407	2,903	2,198
Architecture	1,507	2,265	2,718	2,118
Transport services and environmental protection	1,418	2,829	2,306	2,094
Business and administration	1,385	2,032	2,555	1,928
Humanities	1,278	1,979	2,434	1,844
Engineering	1,268	1,923	2,415	1,810
Personal service	1,306	1,871	2,274	1,755
Arts	1,177	1,773	2,236	1,611
Computing	1,214	1,555	1,787	1,508
Manufacturing and processing	1,076	1,609	2,027	1,422
Social services	749	1,276	1,556	1,211

Source: Household Labor Force Survey 2010–2016, Turkish Statistical Institute.

Studies on returns on investment in education have been a hot subject in the literature since the 1960s (Schultz, 1961; Denison, 1962; Becker, 1964; Porath, 1967; Mincer, 1970; Heckman & Polachek, 1974; Psacharopoulos, 1985; Card, 2001). These studies mainly use developed countries' data to estimate the returns on investment in education. There are few studies that use Turkish data in estimating such returns. Even in these studies, panel data are rarely utilized. This paper tries to fill this gap. We use both panel and cross-section datasets to estimate the returns on education in Turkey. The purpose of this paper is to estimate the private and social returns on investment in Turkish education by level and by higher education program using estimation methods that are rather different from those of previous studies.⁵

⁵ There are relatively few studies specific to Turkey. Those studies on Turkey are mostly based on cross-sectional data. These studies have difficulties arising from the endogeneity of education. A panel data approach potentially presents an advantage to a cross-sectional analysis because observed variables are captured at several points for each individual. We also employed Hausman and Taylor's (1981) approach in this paper. If the instruments are chosen correctly, they can provide sufficient exogenous variation to identify the returns on education. This approach, therefore, both controls for endogeneity bias and allows for the identification of time-constant regressors such as education.

The rest of the study is organized as follows: Section 2 presents a brief review of the literature that is related to this study, Section 3 presents information about methodology and datasets, Section 4 shows the empirical results of the study, and Section 5 concludes the paper.

2. Literature Review

Education affects individuals, societies, and countries and has private and social returns. Although these returns vary according to the level of education, researchers in many countries have carried out studies to estimate the private and social returns on investment in education. The effects of education and health on human capital have been under intensive investigation since the conceptualization of human capital theory. The effect of investment in education at the macro-level has led to the development of endogenous growth theories (Solow, 1956; Uzawa, 1965; Lucas, 1988; Barro, 1997, 2013). Many empirical studies have found that investment in education has a positive contribution to economic growth and development in the long term (Topel, 1999; Kiraz & Gümüő, 2017; Gumus & Celikay, 2015).

Becker (1964) and Mincer (1974) are two prominent researchers who have empirically estimated the private returns on education. To estimate the returns on education, it is necessary to account for other variables that contribute to this return besides education itself. These variables include work experience, gender, and other individual factors, as mentioned in Mincer's earnings equation (Mincer, 1974; Psacharopoulos, 1973, 1985, 1994). Higher education provides individuals with specific knowledge and skills. It is an important tool that contributes to having highly educated manpower for an economy (Uysal & Aydemir, 2016).

The demand for higher education is increasing all over the world and specifically in Turkey (OECD, 2017; Gür et al., 2017). Due to the high demand for higher education in Turkey, it is important to determine the private and social returns on investment in higher education and whether they are significant.

There are many empirical studies that have estimated returns on education in Turkey. The estimated return on education generally varies between 3% and 14%, and the return on education is higher for women than for men in Turkey (Sarı, 2002; Tunaer & Gülcan, 2006; Tansel & Bircan, 2010; Tansel, 2011, 2016; Kırdar & Aydemir, 2017). When the individual returns on different levels of education are considered, it is evident that primary school graduates rank near the bottom of earnings and higher education graduates rank at the top, which is as expected (Sarı, 2002; Bakıs, 2012; Tansel, 1994; Tansel & Daoud, 2011; Tansel & Bodur, 2012). Polat (2017) has calculated the rates of return for all levels of education in 12 regions in Turkey and found returns of between 55.8% and 101% for 2002–2013. In a recent study, Patrinos, Psacharopoulos, and Tansel (2019) used the cost-benefit model and found that the rate of return on schooling is about 8.8% in the case of Turkey.

Recent studies also show that there are differences in returns on higher education from various higher education programs in developing and developed countries. In the case of one developed country, Ireland, Kelly et al. (2010) estimated the return on investment in higher education programs. These programs (and their respective returns) are medicine and veterinary (38%),

education (36%), engineering and architecture (13.4%), science (12.7%), and computers and IT (7.5%). Buchmueller (2019) estimated returns on higher education programs using non-cognitive skills in the UK. He found the return on higher education programs to be around 10%. Di Paolo and Tansel (2017) estimated the individual returns on education in different areas of higher education. They obtained the highest return for health graduates with a range of 41–64.4%. They obtained the lowest returns for graduates of manufacturing, personal services, and art departments.

Most recent studies confirm that higher education has the highest rate of returns in Turkey as well as in other countries (McMahon, 2018; Psacharopoulos & Patrinos, 2018). Higher education also has social benefits besides its private returns. Moretti (2004) pointed to higher education spillover effects that are higher than for other levels of education. Blagg and Blom (2018) studied the social benefits of higher education. They state that higher education may lead to reduced crime, increased average wages, and improved health outcomes. Çalışkan (2007) indicates that employment opportunities are more numerous for higher education graduates, which can also be seen as a social benefit of higher education.

3. Methodology and data sets

3.1. Data

We used two micro datasets provided by the Turkish Statistical Institute. The first dataset is the Income and Living Conditions Survey panel dataset covering from the years 2008–2011 and 2012–2015.⁶ The second dataset is the Household Labour Force Survey covering from the years 2010–2016.⁷ Descriptive statistics can be seen on Table 2.

Table 2
DESCRIPTIVE STATISTICS⁸

⁶ The Income and Living Conditions Survey contains 85,956 households and 209,601 individuals. TURKSAT explains on its website (http://www.tuik.gov.tr/MicroVeri/GYKA_Panel_2015/english/index.html) the details of the Income and Living Conditions Survey as follows: *[it] has been started to be carried out yearly using the panel survey technique for displaying the income distribution between individuals and households, measuring the living conditions of the people, social exclusion, and poverty, with the income dimension and determining the profile for 2006. The aim of the survey, which was started to apply in the frame of European Union Compliance Programme, is to produce data on income distribution comparable with the EU Countries, relative poverty by income, living conditions, and social exclusion. Respondents in the sample are monitored during four years in this survey where the panel survey technique is used and field application is carried out regularly in every year. Two kinds of data set, including cross-sectional and panel data, are taken from the survey each year.*

⁷ The Household Labor Force dataset is structured as cross-sectional and contains 499,116 individuals and covers the period 2010–2016. Both datasets contain education, marital status, health, employment status, and income type obtained from other sources.

⁸ Structure of datasets has been presented in Table A in the Appendix.

Dataset	Variable	Obs	Mean	Std. Dev.	Min	Max
Income and Living Conditions Survey 2008-2015	Log of annual earnings	43,251	9.56	1.17	4.31	23.00
	Number of years of education	43,251	10.38	4.72	0	16
	Number of years of spouse's education	1,482	1.90	3.10	0	16
	Number of years of parent's education	21,286	7.48	4.99	0	16
	If individual had social security	43,251	0.86	0.33	0	1
	Work experience	43,251	14.35	9.96	0	55
	Work Experience ²	43,251	305.39	364.20	0	3,025
	If Married	43,251	0.38	0.48	0	1
	If Female	43,251	0.25	0.43	0	1
	If Healthy	43,251	2.08	0.64	1	5
	If Primary	43,251	0.25	0.43	0	1
	If secondary	43,251	0.15	0.35	0	1
	If high school	43,251	0.12	0.32	0	1
	If vocational	43,251	0.13	0.34	0	1
If higher education	43,251	0.29	0.45	0	1	
Household Labour Force Survey 2010-2016	Log of monthly earnings	499,116	7.13	0.59	2.30	11.15
	If Female	499,116	0.24	0.43	0	1
	If Married	499,116	0.73	0.43	0	1
	Number of years of individual education	499,116	10.33	4.72	0	18
	Teaching	212,452	0.11	0.32	0	1
	Art	212,452	0.02	0.14	0	1
	Humanities	212,452	0.07	0.25	0	1
	Social and Behavioral Sciences	212,452	0.05	0.22	0	1
	Journalism	212,452	0.00	0.04	0	1
	Business	212,452	0.23	0.42	0	1
	Law	212,452	0.01	0.10	0	1
	Life Science	212,452	0.00	0.09	0	1
	Physics	212,452	0.01	0.13	0	1
	Mathematics	212,452	0.00	0.09	0	1
	Computing	212,452	0.01	0.13	0	1
	Engineering	212,452	0.19	0.39	0	1
	Architect	212,452	0.03	0.17	0	1
	Veterinary	212,452	0.00	0.08	0	1
	Health	212,452	0.06	0.25	0	1
	Social Services	212,452	0.01	0.10	0	1
	Personel Services	212,452	0.02	0.14	0	1
	Transport	212,452	0.00	0.05	0	1
	Security	212,452	0.02	0.15	0	1

In many empirical works, “education” is frequently represented by the number of schooling years. This data is not readily available in the case of Turkey. Instead, we consider the Turkish education system to obtain schooling years. Thus, graduation from school can give us the number of schooling years to represent education in this study. In the Turkish education system, there are 12 years of compulsory education from primary to high school. Higher education is left to the preference of individuals.⁹

3.2. The empirical setup

There are many studies in the literature that employ the Mincer earnings equation (Mincer, 1974) for estimating the returns on investment in education. We base our estimation model on the Mincerian earnings equation and use both the Hausman-Taylor (Hausman & Taylor, 1981) and the instrumental variable (IV) estimator to estimate the returns on Turkish education.

We have stated three Mincerian earnings equations to estimate different returns on education.

3.2.1. Private returns on investment in education

The classical Mincer equation is expressed in the form of:

$$\ln Y = b_0 + b_1 S + b_2 E + b_3 E^2 + \varepsilon \quad (1)$$

where Y is earnings, S is the number of schooling years, and E is work experience. The coefficients b_1 , b_2 , and b_3 represent the rates of return on education. This equation can be extended for panel data for estimating as follows:

$$\log_earnings_{it} = \beta_0 + \beta_1 education_{it} + \beta_2 experience_{it} + \beta_3 experience_{it}^2 + \beta_4 female_{it} + \beta_5 married_{it} + \beta_6 badhealth_{it} + \beta_7 social_secur_regist_{it} + u \quad (2)$$

$$i = 1, \dots, n \text{ and } t = 2008, \dots, 2015$$

In order to estimate each level of education, the model can be stated as:

$$\log_earnings_{it} = \beta_0 + \beta_1 experience_{it} + \beta_2 experience_{it}^2 + \beta_3 female_{it} + \beta_4 married_{it} + \beta_5 badhealth_{it} + \beta_6 social_secur_regist_{it} + \beta_7 primary_{it} + \beta_8 secondary_{it} + \beta_9 highschool_{it} + \beta_{10} vocational_{it} + \beta_{11} highereducation_{it} \quad (3)$$

$$i = 1, \dots, n \text{ and } t = 2008, \dots, 2015$$

In most studies that use panel data, fixed or random effects are generally preferred. However, there are unobserved heterogeneity and endogeneity issues that need to be taken into consideration in the estimations regarding the returns on education. In multiple regression estimation, there may be key variables such as ability, a family structure that affects income, and they may not be included in the dataset or may not be truly measured. This issue is known as unobserved heterogeneity and should be solved to obtain unbiased results. Another issue that

⁹ Compulsory education in Turkey consists of primary school (4 years), secondary school (4 years), and high school or vocational school (4 years). The duration of higher education is 2–6 years depending upon the level and type of higher education program.

also needs to be addressed is endogeneity. With regard to the relations between education and earnings, there is a correlation between non-observable variables and the education variable which is included in the error term but is not included in the regression. As an example, if there is a relationship between an individual's education and the educational level of the individual's family, this problem may occur when the educational levels of the individual's family are not included in the regression (Card, 2001).

There are arguments for and against spouses' education being used as an instrument in the literature. Studies that used a spouse's education as an instrument reported a strong relationship between individuals' education and their spouses' education. Lam and Schoeni (1993) suggest that for a developing country, a spouse's education does indeed control for an unobservable effect. They indicate that a spouse's education has a significant effect on wages.

Behrman, Rosenzweig, and Taubman (1994) used family background to estimate economic returns for schooling. Based on their results, they indicate that the family allocations of schooling play an important role for wages. They conclude that with regard to schooling, earnings and spousal schooling have a positive effect. Trostel, Walker, and Woolley (2002) estimated the economic returns on education with instrumental variables using spouses' and parents' schooling as determinants of schooling. They indicate that OLS estimates are biased. Further, Hoogerheide, Block, and Thurik (2012) used family background variables in their study, including parents' and spouses' education, to estimate the returns on education. They found that the family background variables are highly correlated with the individual's level of education.

Based on these studies, we used spouse's education as an instrument for observed education yields. We have exploited the very strong correlation between spouses' education levels and the lack of correlation between the wage of one spouse and the education of the other. Also, it is observed that in Turkey, one of the stronger determinants of marriage is education level of prospective partners.

There are various estimation methods to solve endogeneity and unobserved heterogeneity problems. In this study, we prefer using the Hausman-Taylor approach and instrumental variable methods. The basic model of the instrumental variable is as follows:

$$\text{Log_earnings}_i = X_i\beta + \gamma\text{Schooling}_i + E_i \quad (4)$$

$$\text{Schooling} = Z'_{ia} + v \quad (5)$$

Equation (5) shows the first-order regression model, and Equation (4) shows the basic instrumental variable model. In the study, an individual's parents' education and the individual's spouse's education were chosen as the instruments because both factors are considered to be external variables that affect the educational status of the individual.

Hausman and Taylor (1981) proposed an approach similar to the instrumental variable method in estimating the returns on education in panel data. The model is as follows:

$$y_{it} = x'_{1it}\beta_1 + x'_{2it}\beta_2 + z'_{1i}\alpha_1 + z'_{2i}\alpha_2 + \varepsilon_{it} + u_i \quad (6)$$

In Equation (6), x_{it} refers to time-varying variables, z_i refers to time-invariant variables, and u_{it} refers to the error term. In this study, similar to Hausman-Taylor's original study, bad health status was chosen as an external variable that changes over time.

3.2.2. Private returns to investment in higher education programs

The Mincer equation for different fields of higher education may be expressed as follows:

$$\log Y_i = b_0 + b_1 \text{female}_i + b_2 \text{experience}_i + b_3 \text{experience}_i^2 + b_4 \text{married}_i + \sum Z_i \quad (7)$$

In addition to the control variables (gender and marital status), Y refers to the log of earnings of the individual and Z refers to 21 higher education programs. Before we estimate the equation (7), we use the Breusch-Pagan/Cook-Weisberg test for heteroscedasticity and the Breusch-Godfrey LM test for the autocorrelation problems.

3.2.3. Social returns on investment in higher education

Moretti (2004) suggested that the correlation between aggregate human capital and wage income or earnings may not always be associated with human capital externalities. It can be caused by defective substitution between low-skilled and high-skilled workers. If there are substitutions between high- and low-skilled workers, an increase in the number of educated workers can increase productivity and therefore wages in the area.

We follow Moretti's (2004) approach and use both OLS and IV methods in estimating the social returns on investment in higher education by employing an equation in the form of

$$\log \text{earnings} = \beta_0 + \beta_1 \text{education} + \beta_2 \text{experience} + \beta_3 \text{experience}^2 + \beta_4 \text{average education (college ratio)} + \beta_5 \text{regional variables} + \beta_6 \text{control variables} + u \quad (8)^{10}$$

4. Results and discussions

There are three sections that report our estimation results.

4.1. Results of private returns on education

¹⁰ Moretti (2004) indicated that production externalities in education increase individuals' marginal product and thus wages. A brief empirical specification in Moretti's (2004) study assumes there is a Cobb-Douglas production function stated as $w_{li} = B s_{li}^a B^{m_i b}$ and its augmented form in equation: $w_{li} = x_{li} B + s_{li} B^m + \hat{s}_l B + \varepsilon_{li}$.

In this equation, w_{li} represents the log earnings of an individual i in state, city, or region l ; x_{li} is the vector of control variables; B^m is the Mincer micro-return on education; and \hat{s}_l is the average number of years of education in the state, city, or region. Since we want to estimate the social returns on higher education, \hat{s}_l is the tertiary-educated employee ratio. If this ratio is found to be positive, it indicates evidence of positive higher education spillovers. Therefore, the equation for estimating the social return on education can be stated as follows:

$$\log \text{earnings} = \beta_0 + \beta_1 \text{education} + \beta_2 \text{experience} + \beta_3 \text{experience}^2 + \beta_4 \text{average education (college ratio)} + \beta_5 \text{regional variables} + \beta_6 \text{control variables} + u$$

Our empirical results of private returns on education are shown in Table 3. In the table, there are four columns. The first three columns show the results of the instrumental variable (IV) methods, while the last column indicates the results of the Hausman-Taylor approach.¹¹

Table 3
PRIVATE RETURNS ON EDUCATION IN TURKEY, 2008–2015

Variables	IV₁	IV₂	IV₃	HT
<i>Education</i>	0.12*** (0.03)	0.12*** (0.00)	0.09*** (0.02)	0.08*** (0.00)
<i>Experience</i>	0.07*** (0.01)	0.04*** (0.00)	0.04*** (0.01)	0.05*** (0.00)
<i>Experience²</i>	-0.00*** (0.00)	-0.00*** (0.00)	-0.00** (0.00)	-0.00*** (0.00)
<i>Married</i>	-0.17*** (0.06)	-0.41*** (0.02)	-0.35*** (0.06)	-0.14*** (0.04)
<i>Female</i>	-0.35*** (0.12)	-0.29*** (0.05)	-0.34* (0.19)	-0.13*** (0.02)
<i>Bad Health</i>	-0.44** (0.18)	-0.12** (0.05)	-0.39** (0.18)	-0.04 (0.03)
<i>Registered Social Security</i>	0.15 (0.14)	0.29*** (0.03)	0.23** (0.11)	0.20*** (0.04)
<i>Constant</i>	7.59 (0.28)	7.91 (0.06)	8.17 (0.20)	8.07 (0.11)
<i>Sargan-Hansen Statistic</i>			0.36	6.40
<i>p-value</i>			0.54	0.01
<i>Anderson-Rubin Wald Statistic</i>	16.08	854.28	7.98	46.32
<i>p-value</i>	0.00	0.00	0.00	0.00
<i>Observation</i>	1,482	21,286	1,123	43,251
<i>R²</i>	0.17	0.15	0.19	0.38
<i>Parent's Education (schooling)</i>	0.33*** (0.04)		0.19*** (0.04)	
<i>F-value</i>	38.57*** (0.00)			
<i>Partner's Education (schooling)</i>		0.49*** (0.00)	0.32*** (0.03)	
<i>F-value</i>		20.94*** (0.00)	26.47*** (0.00)	

Standard errors in parentheses, *p < 0.10, **p < 0.5, ***p < 0.001. Estimation results in this table were obtained using Equation (2).

¹¹ We have also provided POLS regression results in Table B in the Appendix that may be compared with the Hausman-Taylor and IV results.

The positive returns on education in Turkey seem to be quite high when the results are discussed. Depending on the choice of instrument variable, the return on education in the first three columns ranges from 9% to 12.2%. The Hausman-Taylor approach shows 8.2%. In the first column, the IV approach uses an individual's parents' education which yields a return of 12.2%.¹² In the second column, the IV approach uses an individual's spouse's education which yields a return of 12%. Finally, in the third column the IV approach uses both an individual's parents' and spouse's education. In this case, the return is 9%.

The results in Table 3 show that women earn less income than men (13.4–35.1% less than men) and those who are married have less income. In addition, individuals with poor health status earn between 4% and 44% less than those with good health status. On the other hand, it can be said that individuals who have social insurance or are registered earn more than those who work without having social insurance.

Table 4 provides detailed results on the returns of different levels of education. We have estimated the returns of different levels of education in two separate samples of men and women, and the overall results of the education and the returns for each education level were collected in a single sample as reported in Table 4. The general return on education in Turkey varies from 9% to 13%. When we consider the levels of education, it is obvious that as the level of education increases from primary to higher education, so does the return. Specifically, the return on primary education through higher education for women ranges from 9% to 109% while it ranges from 14% to 107% percent for men.¹³

¹² The F-statistics are 38.57 for IV1 (we used parents' education as an instrument in this estimation), 20.94 for IV2 (we used spouse's education as an instrument in this estimation), and 26.47 for both instruments. If the F-statistic is lower than 10, then the model has weak instruments (based on Hausman, Stock, Wright, and Yogo, 2005) Also, we performed the Sargan-Hansen and Anderson-Rubin Wald test to determine whether our instruments are weak. Both test results show that the instruments are acceptable for analysis. The results of this test confirm the F-statistics.

¹³ The constraint of this study was limited data availability. We have limited values related to observations for instruments. Since the sample size for men is insufficient, the estimation obtained only for women is reported in Table 4.

Table 4
RETURNS ON EDUCATION IN TURKEY, OVERALL RESULTS, 2008-2011

Variables	IV _{1,1}	IV _{1,2}	IV _{1,3}	IV _{2,1}	IV _{2,2}	IV _{2,3}	IV _{3,1}	IV _{3,2}	IV _{3,3}	Female		Male	Female	Male	HT	HT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	IV ₁ (10)	IV ₂ (11)	IV ₁ (12)	RE (13)	RE(14)	(15)	(16)
Education	0.12*** (0.02)	0.13*** (0.02)	0.12*** (0.03)	0.13*** (0.00)	0.12*** (0.00)	0.12*** (0.00)	0.10*** (0.01)	0.10*** (0.01)	0.09*** (0.02)	0.07 (0.05)	0.14*** (0.02)	0.07*** (0.01)	-	-	0,082*** (0.00)	-
Experience	0.08*** (0.01)	0.08*** (0.01)	0.07*** (0.01)	0.06*** (0.00)	0.05*** (0.00)	0.04*** (0.00)	0.06*** (0.01)	0.05*** (0.01)	0.04*** (0.04)	0.11*** (0.03)	0.04*** (0.01)	0.05*** (0.00)	0.07*** (0.00)	0.06*** (0.00)	0.05*** (0.00)	0.05*** (0.00)
Experience ²	-0.00** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)
Female		-0.39*** (0.12)	-0.35*** (0.12)		-0.33*** (0.05)	-0.29*** (0.05)		-0.38* (0.19)	-0.34* (0.19)						-0.13*** (0.02)	-0.12*** (0.03)
Married		-0.16** (0.06)	-0.17*** (0.06)		-0.42*** (0.02)	-0.41*** (0.02)		-0.33*** (0.06)	-0.35*** (0.06)	-0.17 (0.23)	-0.27** (0.10)	-0.35*** (0.04)	-0.14*** (0.05)	-0.19*** (0.00)	-0.14*** (0.04)	-0.14*** (0.04)
Bad Health			-0.44** (0.18)			-0.12** (0.05)			-0.39** (0.18)						-0.04*** (0.03)	-0.04*** (0.03)
Social Security			0.15 (0.14)			0.29*** (0.03)			0.23** (0.11)						0.20** (0.04)	0.20*** (0.04)
Primary School													0.09* (0.05)	0.14*** (0.02)		0.54* (0.29)
Secondary School													0.14** (0.05)	0.23*** (0.02)		0.71*** (0.26)
High School													0.42 (0.04)	0.49*** (0.02)		1.14*** (0.25)
Vocational School													0.54 (0.05)	0.55*** (0.02)		1.23*** (0.25)
Higher Education													1.09 (0.04)	1.07*** (0.02)		1.41*** (0.24)
Constant	7.53	7.57	7.59	7.73	8.07	7.91	7.93	8.17	8.17	7.72	7.49	8.32	8.29	8.48	8.07	7.94
Parent's Education	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	No	Yes			-	-
Partner's Education	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes			-	-
Sargan-Hansen Statistic	-	-	-	-	-	-	0.24	0.40	0.36			1.11			6.40	5.49
p-value	-	-	-	-	-	-	0.62	0.52	0.54			0.29			0.01	0.01
Anderson-Rubin Wald Statistic	23.98	27.24	16.08	1181.5	1120.8	854.2	16.50	16.25	7.98	1.46	26.45	20.76			46.32	31.08
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00			0.00	0.00
R ²	0.14	0.15	0.17	0.11	0.14	0.15	0.14	0.17	0.19	0.26	0.25	0.32	0.27	0.33	0.38	0.37
N	43,251	43,251	43,251	43,251	43,251	43,251	1,123	1,123	1,123	108	442	1,103	10,992	32,253	43,251	43,251

Standard errors in parentheses, random effects estimates in clustered standard error in parentheses* p < .10; ** p < .05; *** p < .0. Results in columns 1–12 and 15 were obtained using Equation (2). Results in columns 13, 14, and 16 were obtained using Equation (3).

Return on investment in education is a general term. To interpret the return to a given year's education, we converted the returns to education levels as shown in Table 5.¹⁴

Table 5
BASED ON THE HAUSMAN-TAYLOR ESTIMATE, EARNINGS DIFFERENTIALS AT
VARIOUS LEVELS OF EDUCATION

Level of Education	Percentage Effect in Earnings (Percent)	Return to one year of education (Percent)
Primary School	71.60	10.80
Secondary School	103.40	8.80
High School	212.70	9.50
Vocational School	242.10	10.20
Higher Education	309.60	8.80

Estimation results in this table were obtained using Equation (3).

An individual with a secondary education degree earns about 45% more than an individual with a primary education degree. Based on Table 5, an individual who is a graduate of higher education earns:

- about 27% more than an individual who is a vocational high school graduate.
- about 45% more than an individual who is a general high school graduate.
- about 199% more than an individual who is a secondary education graduate.
- about 332% more than an individual with primary education.

One-year returns on education by education level are shown in the last column of Table 5. The one-year return on primary education was 10.8%, and the return of each year in higher education was estimated at 8.8% as shown in the table.

4.2. Results of private returns on higher education programs

One of the main aims of this study is to estimate the returns on investment for higher education programs that have relatively less research in the literature. Table 6 provides the variables and statistical summary of higher education programs. There are 212,452 observations in the dataset. The highest percentages of the sample are in the fields of business management and engineering (23.75%), while the lowest percentages are in the fields of journalism and information (0.18%) and transport services and environmental protection (0.29%).

¹⁴ We obtained the values of the first column of Table 5 by applying the semi-logarithmic equation used by Halvorsen and Palmquist (1980). The percentage effect of education level on income was calculated using the anti-log $((e^{\beta} - 1) \times 100)$ values of the coefficients, which are based on the Hausman-Taylor approach. The values in the second column also represent (return to one year of education) the coefficients of educational level that are based on the Hausman-Taylor approach and are calculated as $[100 * (\text{coefficient} / \text{years of education in Turkish educational system})]$.

Table 6
FIELDS OF STUDY STATISTICS, 2010–2016

Field of Study	Frequency	Percent
<i>Teacher training and education</i>	24,682	11.62
<i>Arts</i>	4,831	2.27
<i>Humanities</i>	14,918	7.02
<i>Social and behavioral science</i>	11,536	5.43
<i>Journalism and information</i>	392	0.18
<i>Business and administration</i>	50,449	23.75
<i>Law</i>	2,158	1.02
<i>Life science</i>	1,790	0.84
<i>Physical science</i>	4,053	1.91
<i>Mathematics and statistics</i>	2,057	0.97
<i>Computing</i>	4,017	1.89
<i>Engineering</i>	41,072	19.33
<i>Manufacturing and processing</i>	10,768	5.07
<i>Architecture</i>	7,029	3.31
<i>Agriculture, forestry and fishery</i>	3,874	1.82
<i>Veterinary</i>	1,732	0.82
<i>Health</i>	14,518	6.83
<i>Social services</i>	2,456	1.16
<i>Personal service</i>	4,541	2.14
<i>Transport services and environmental protection</i>	618	0.29
<i>Security Services</i>	4,961	2.34
<i>Total</i>	212,452	100

The estimates of returns on investment for various higher education programs are provided in Table 7. There are significant differences between the returns of the fields. The higher education programs of law (41%) and health (33%) have the highest estimated returns while the lowest returns are for computing (1%) and social services (-3%).

Table 7
RETURNS ON INVESTMENT IN HIGHER EDUCATION PROGRAMS: POOLED RESULTS

Variables	2010-2016
<i>Teacher training and education</i>	0.09*** (0.00)
<i>Arts</i>	0.01** (0.00)
<i>Humanities</i>	0.03*** (0.00)
<i>Social and behavioral sciences</i>	0.12*** (0.00)
<i>Journalism and information</i>	0.13*** (0.02)
<i>Business and administration</i>	0.01*** (0.00)
<i>Law</i>	0.41*** (0.01)
<i>Life science</i>	0.13*** (0.01)
<i>Physical science</i>	0.17*** (0.00)
<i>Mathematics and statistics</i>	0.16*** (0.01)
<i>Computing</i>	0.01 (0.00)
<i>Engineering</i>	0.08*** (0.00)
<i>Manufacturing and processing</i>	0.00 (0.00)
<i>Architecture</i>	0.12*** (0.00)
<i>Agriculture, forestry and fishery</i>	0.04*** (0.00)
<i>Veterinary</i>	0.08*** (0.01)
<i>Health</i>	0.33*** (0.00)
<i>Social services</i>	-0.03*** (0.00)
<i>Personal service</i>	Reference Group
<i>Transport services and environmental protection</i>	0.18*** (0.02)
<i>Security Services</i>	0.26*** (0.00)
<i>Constant</i>	5.19
<i>Education</i>	0.10*** (0.00)
<i>Experience</i>	0.04*** (0.00)
<i>Experience²</i>	-0.00*** (0.00)
<i>Female</i>	-0.12*** (0.02)
<i>Married</i>	0.16*** (0.00)
<i>R²</i>	0.51
<i>N</i>	212,452

Note: Details of each program can be found at (<https://biruni.tuik.gov.tr/DIESS/ChangeLocaleAction.do?dil=en>).
Estimation results for this table were obtained using Equation (7).

Since higher education program plays a major role in the future income of an individual, knowing a higher education program's rate of return can make a significant difference. This information is important in preferring or determining which higher education program to pursue.

Based on the returns on investment in higher education programs in Turkey, the top five higher education programs are law (41%), health (33%), security services (26%), transport services and environmental protection (18%), and physical sciences (17%).

4.3. Results of social returns on higher education

The last aim of this study is to estimate the social returns on higher education using 499,116 observations from the Households Labor Force Survey. We followed a methodology similar to Moretti's study (2004) in estimating the social returns on education. The summary statistics and variables are included in Table 8.

Table 8
SUMMARY OF BASIC VARIABLES¹⁵

Variables	Mean
Monthly earnings (Turkish Lira)	1,515
Education (Years)	10.34
Average Education (NUTS1) (Years)	10.34
Collage Share (Percent)	0.29
Experience (Years)	6.74
Unemployment Rate (Percent)	9.48
Numbers of College	13.36

In the study, gender, marital status, experience status, and spatial variables (NUTS1 and NUTS2)¹⁶ were used as control variables. We used year dummy variables which cover the years 2010–2016. As an instrument, we used numbers of college (university) and unemployment rate for IV analysis to estimate social returns on higher education. We also calculated average education with each educational level for the NUTS1 region. We report their results and provide detailed information about the datasets in Table C in the Appendix.

The social returns on education and of higher education are presented in Table 9.

¹⁵ Descriptive statistics provided in Table D in the Appendix.

¹⁶ NUTS1 covers seven statistical regions of Turkey, while NUTS2 covers 26 statistical regions of Turkey.

Table 9
SOCIAL RETURNS ON HIGHER EDUCATION

Variables	OLS	OLS	OLS	IV
<i>Education</i>	0.05*** (0.00)	0.05*** (0.00)	0.05*** (0.00)	0.05*** (0.00)
<i>Average Education</i>	0.01*** (0.00)	0.01*** (0.00)	0.05*** (0.00)	N/A
<i>Experience</i>	0.03*** (0.00)	0.02*** (0.00)	0.03*** (0.00)	0.03*** (0.00)
<i>Collage Share</i>	N/A	N/A	N/A	1.14*** (0.03)
<i>Constant</i>	6.24	6.09	5.58	5.61
<i>City Control Variables</i>	No	No	Yes	Yes
<i>Individual Control Variables</i>	No	Yes	Yes	Yes
<i>Instrument</i>	N/A	N/A	N/A	Yes
<i>N</i>	499,116	499,116	499,116	487,812
<i>R²</i>	0.35	0.37	0.53	0.53

Clustered standard error in parentheses* $p < .10$; ** $p < .05$; *** $p < .01$. Estimation results in this table were obtained using Equation (8).

The social rate of return on general education is found to be 5%. Social returns on average education are in the range of 1–5%. One important variable is college or university share. The social return on college share is 1.14%. This means that a 1% increase in the number of university graduates contributes to a 1.14% increase in earnings in a city or region. Thus, it may be argued that the social return on higher education in Turkey is estimated to be at least 1.14%. Therefore, higher education investment provides a net social benefit.

5. Conclusions

This study estimated the private and social returns on education and returns for different levels of education and higher education programs using Turkish micro-data sets. The Hausman-Taylor approach and instrumental variable method were used considering the endogeneity and unobserved heterogeneity problem. The results show that the returns for primary to higher education increase for each successive level of education. In addition, the returns on education are higher for men as compared to women for all education levels.

The returns on different higher education programs are also estimated, and the results significantly indicate that three higher education programs—namely, law, health, and security—have higher returns than other higher education fields. This information is especially crucial for both prospective higher education students and policymakers. Specifically, based on the results, we can develop a number of policy recommendations. In the first place, more resources should be allocated to education. This is crucial for the development of a relatively high-quality workforce in a country such as Turkey. Highly skilled human capital can play a vital role in innovation, research, and development. Secondly, government should increase enrolment in those fields that yield higher returns on higher education. Lastly, there should be a separate policy to cope with disadvantaged groups such as women and bad health groups in education processes.

The study also estimates social returns on higher education. The result is small as compared with private returns. However, it is in line with other results found in the literature.

Although this study provides private and social returns on different levels of education using Turkish data, there are a number of limitations. One such limitation arises from datasets. Time and data on various variables have restricted further analysis.

Further studies may focus on estimating the social returns on higher education programs by employing different methods. This is especially necessary since there are few studies on this issue.

APPENDIX

Table A
DATASETS USED IN THE STUDY

Datasets	
Income and Living Conditions (2008-2015)	Household Labor Force (2010-2016)
Dependent Variable	Dependent Variable
Independent Variable	Independent Variable
Log Annual Earnings	Log Monthly Earnings
Education (schooling)	If Teacher training and education science=1
Parent's Education (schooling)	If Arts =1
Partner's Education (schooling)	If Humanities =1
If registered Social Security =1	If Social and behavioral science =1
Experience	If Journalism and information =1
Experience ²	If Business and administration =1
If married =1	If Law =1
If female =1	If Life science =1
If health conditions bad =1	If Physical science =1
Primary School	If Mathematics and statistics =1
Secondary School	If Computing =1
High School	If Engineering and engineering trades =1
Vocational School	If Manufacturing and processing =1
Higher Education	If Architecture and building =1
	If Agriculture, forestry and fishery =1
	If Veterinary =1
	If Health =1
	If Social services =1
	If Personal services =1
	If Transport services and environmental protection =1
	If Security services =1
	Experience
	Experience ²
	If married =1
	If female =1

Table B
POLS, FIXED EFFECT, AND RANDOM EFFECT RESULTS

Variables	POLS	FE	RE
Education	0.07*** (0.00)	0.05*** (0.01)	0.07*** (0.00)
Experience	0.06*** (0.00)	0.05*** (0.00)	0.06*** (0.00)
Experience ²	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)
Married	-0.25*** (0.01)	-0.15*** (0.03)	-0.23*** (0.01)
Female	-0.12*** (0.01)	N/A	-0.13*** (0.01)
Bad Health	-0.08*** (0.02)	-0.01 (0.03)	-0.08** (0.02)
Registered Social Security	0.40*** (0.00)	0.19*** (0.05)	0.38 (0.02)
Constant	8.00***	8.39***	7.96***
N	43,251	43,251	43,251
R ²	0.18	0.17	0.18

Standard errors in parentheses, *p < 0.10 , ** p < 0.5 , *** p < 0.00

Table C
RETURNS ON AVERAGE EDUCATION FOR NUTS1

NUTS1	Education	Coefficient	Std. Error	p-value	NUTS1	Education	Coefficient	Std. Error	p-value
TR2	Primary	0.07	0.02	0.00	TR7	College	0.05	0.01	0.00
TR2	Secondary	0.08	0.02	0.00	TR7	Postgrad	0.03	0.02	0.18
TR2	High School	0.05	0.02	0.01	TR8	Primary	0.10	0.02	0.00
TR2	College	-0.03	0.02	0.12	TR8	Secondary	0.10	0.02	0.00
TR2	Postgrad	-0.01	0.03	0.55	TR8	High School	0.09	0.02	0.00
TR3	Primary	0.01	0.01	0.10	TR8	College	0.06	0.02	0.00
TR3	Secondary	0.01	0.01	0.18	TR8	Postgrad	0.05	0.03	0.06
TR3	High School	0.00	0.01	0.73	TR9	Primary	0.09	0.02	0.00
TR3	College	-0.03	0.01	0.00	TR9	Secondary	0.07	0.02	0.00
TR3	Postgrad	0.00	0.02	0.99	TR9	High School	0.02	0.02	0.43
TR4	Primary	0.07	0.01	0.00	TR9	College	-0.01	0.02	0.56
TR4	Secondary	0.05	0.01	0.00	TR9	Postgrad	0.05	0.04	0.17
TR4	High School	0.03	0.01	0.02	TR10	Primary	0.00	0.01	0.62
TR4	College	-0.04	0.01	0.00	TR10	Secondary	-0.00	0.01	0.74
TR4	Postgrad	-0.00	0.02	0.86	TR10	High School	-0.02	0.01	0.09
TR5	Primary	0.11	0.01	0.00	TR10	College	0.00	0.01	0.94
TR5	Secondary	0.12	0.01	0.00	TR10	Postgrad	-0.03	0.03	0.21
TR5	High School	0.10	0.01	0.00	TR11	Primary	-0.04	0.01	0.00
TR5	College	0.12	0.01	0.00	TR11	Secondary	-0.03	0.01	0.01
TR5	Postgrad	0.07	0.02	0.00	TR11	High School	-0.05	0.01	0.00
TR6	Primary	0.13	0.01	0.00	TR11	College	-0.05	0.01	0.00
TR6	Secondary	0.12	0.01	0.00	TR11	Postgrad	-0.03	0.03	0.23
TR6	High School	0.12	0.01	0.00	TR12	Primary	0.01	0.01	0.09
TR6	College	0.07	0.01	0.00	TR12	Secondary	0.00	0.01	0.86
TR6	Postgrad	0.04	0.02	0.05	TR12	High School	0.04	0.01	0.00
TR7	Primary	0.10	0.01	0.00	TR12	College	0.10	0.01	0.00
TR7	Secondary	0.10	0.01	0.00	TR12	Postgrad	0.06	0.03	0.05
TR7	High School	0.07	0.01	0.00					

Table D
SOCIAL RETURNS ON HIGHER EDUCATION DESCRIPTIVE STATISTICS

Variable	Obs	Mean	Std. Dev.	Min	Max	Description
log_earnings	499,116	713.83	0.59	230.25	111.56	Log of montly earnings
Education	499,116	103.39	472.35	0	18	Number of years of individual education
Married	499,116	0.73	0.43	0	1	Dummy if individual married =1
Female	499,116	0.24	0.43	0	1	Dummy if individual female =1
Experience	499,116	674.75	778.83	0	51	Calculated as the difference between worker's started work at the survey date
NUTS_1 (string value)	499,116					NUTS1 (TR1,...,TR12)
NUTS_2 (string value)	499,116					NUTS2 (TR1,...,TR26)
Unemployment rate	487,812	0.09	0.03	0.03	0.21	Related year regional unemployment rate
College_number	499,116	133.60	178.95	2	56	Number of college in the region
College_share	499,116	0.29	0.04	0.22	0.40	Ratio of college graduates in the region (college grad. Number / Total)
NUTS_1 average education	499,116	10.34	0.61	8.80	11.73	Average education in the region
Year	499,116	2013.07	214.51	2010	2016	Years

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