



Private and Social Returns to Investment in Education: The Case of Turkey with Alternative Methods

Journal:	<i>Applied Economics</i>
Manuscript ID	APE-2020-0552.R1
Journal Selection:	Applied Economics incorporating Applied Financial Economics
Date Submitted by the Author:	13-Oct-2020
Complete List of Authors:	Patrinos, Harry; World Bank Group Psacharopoulos, George Tansel, Aysit; Middle East Technical University, Economics
JEL Code:	I21 - Analysis of Education < I2 - Education < I - Health, Education, and Welfare, J24 - Human Capital Skills Occupational Choice Labor Productivity < J2 - Time Allocation, Work Behavior, and Employment Determination/Creation < J - Labor and Demographic Economics
Keywords:	Education, Returns to education, Heckman Two-Step, Instrumental Variables, Turkey

SCHOLARONE™
Manuscripts

Private and Social Returns to Investment in Education: The Case of Turkey with Alternative Methods

Harry Anthony Patrinos¹

(Corresponding author)

World Bank

1818 H Street NW

Washington DC 20433, USA

Tel: +1 (202) 473-5510

hpatrinos@worldbank.org

George Psacharopoulos

Georgetown University, USA

gpsach@rcn.com

Aysit Tansel

Middle East Technical University, Ankara, Turkey

Institute of Labor Economics (IZA); Economic Research Forum (ERF)

atansel@metu.edu.tr

Abstract: This paper estimates private and social returns to investment in education in Turkey, using the 2017 Household Labor Force Survey (latest available at the time of writing) and alternative methodologies. The analysis uses the 1997 education reform of increasing compulsory education by three years as an instrument. This results in a private rate of return on the order of 16 percent for higher education and a social return of 10 percent. Using the number of children younger than age 15 in the household as an exclusion restriction, sample selection correction is applied, and it shown that the returns to education for females are higher than those for males. Contrary to many findings in other countries, private returns to those working in the public sector are higher than those in the private sector, and private returns to those who followed the vocational track in secondary education are higher than those in the general academic track. The paper discusses the policy implications of the findings.

JEL Codes: I21, I26, J24

Keywords: Education, Returns to Education, Heckman Two-Step, Instrumental Variables, Turkey

¹ Corresponding author: Harry Patrinos, World Bank, 1818 H Street NW, Washington DC 20433, USA. Tel: (202) 473-5510; email: hpatrinos@worldbank.org. The views expressed here are those of the authors and should not be attributed to their respective organizations. We would like to thank Murat Karakaş of TURKSTAT for his kind explanations about the data used in this study.

Introduction

Since the advent of human capital theory in economic thought, estimating the returns to investment in education has been a very popular subject among researchers (see, for example, Psacharopoulos and Patrinos 2018; Peet, Fink, Fawzi 2015; Trostel, Walker, Woolley 2002; Banerjee, Duflo 2005). Estimating the returns to education – that is, the wage benefit associated with investment in more schooling – is a useful way of summarizing the economic benefits of investing in people. It also provides policymakers with important information about how to allocate resources. People can use such information to guide their personal decisions about investments in their schooling.

Private returns can also explain the private demand for education. The literature suggests that each additional year of schooling produces a private (that is, individual) rate of return to schooling of about 8 to 10 percent a year (Psacharopoulos and Patrinos 2018; Montenegro and Patrinos 2014; Gunderson and Oreopoulos 2020). Globally, the returns to tertiary education are highest, followed by primary and then secondary schooling; this represents a significant reversal from many studies' prior results.

Yet, most of the recent estimates in this proliferating literature have several limitations. Conceptually, the authors rarely make a distinction between private and social returns, typically estimating only private returns – often not even using the word *private* in their papers (Schündeln and Playforth 2014; Psacharopoulos and Teixeira 2019; Psacharopoulos and Williams 1973; Psacharopoulos 1983). Methodologically, the estimates are done by using the convenient Mincerian earnings function rather than the full-discounting method (Patrinos and Psacharopoulos 2020; Heckman, Lochner and Todd 2006; Psacharopoulos and Mattson 1998; Becker 1964). Policy-wise, invalid recommendations could be made based on private returns alone (Patrinos 2016; Sianesi and van Reenen 2003;).

Also, there are important limitations to the typical analyses (Lemieux 2006). The relationship between schooling and earnings does not necessarily imply causality (Heckman, Lochner, Todd 2006). Typical earnings functions estimate provide private (that is, individual) returns to schooling, whereas public costs and benefits are needed to estimate social rates of return, which policy makers need to make informed choices (Oreopoulos and Petronijevic 2013). Also, as economies become more complex and technological developments alter the demand for education, decades-old cross-sectional data may not be informative about returns to current investment decisions (Card 1999; Patrinos 2016).

It should also be noted that the relationship between schooling and earnings does not necessarily imply causality (Brown and Sessions 2004). Estimates of the returns to education based on advanced econometric techniques that control for different characteristics come to an average rate of return that is similar to the global average presented in most reviews. These more selective studies focus on the causality debate between schooling and earnings; they confirm that the effect of ability and related factors does not have a significant impact on the general results for returns to education. Still, more research on causality is needed. (Angrist and Krueger 1991; Chevalier et al. 2004; Devereux and Hart 2010; Oreopoulos 2006).

Moreover, since earnings functions provide private returns to schooling, the only cost taken into account is the foregone earnings associated with attending school instead of earning a working wage. To obtain an estimate of the social return to schooling, one needs to identify other costs. Moreover, despite the usefulness of rate of return estimates, rapidly changing conditions (technological developments and increasing overall economic complexity) degrade the value of using historical cross-sectional data to make current investment decisions (Duflo 2001; Colclough, Kingdon and Patrinos 2010).

Turkey provides a useful ground for cost-benefit analysis of its education system. There are early efforts to estimate the returns to schooling going back to the 1960s (Krueger 1972). Our paper estimates private and social returns to investment in education – addressing the shortcomings of typical analyses, adding the social dimension, and attempting to ascertain causality – based on different methodologies using data from the 2017 Household Labor Force Survey (HLFS). The education system has shown remarkable improvement in the last 15 years in terms of better student performance and reduced inequality with an increase in enrollment.

Further, taking into account the limitations of the typical estimates of the returns to education, namely the causality question (Card 1999; Heckman et al. 2018), our analysis uses the 1997 education reform of increasing compulsory education by three years as an instrument. This is done to compute a more robust estimate of the returns to education and to compare it to the conventional estimates and to previous studies. It allows us to assess the impact of expanding educational opportunity in terms of relative rewards to schooling. We also improve on the estimate of returns to women’s education by accounting for selection (Heckman 1979), another critique of typical rate of return estimates. We use the number of children younger than age 15 in the household as an exclusion restriction. We also update estimates of returns to schooling by calculating private returns to those working in the public and private sectors and to those who followed the general or vocational track in secondary education. We present our private and social returns estimates using the full discounting method. Finally, the paper discusses the policy implications of the findings and concludes.

Methodology

There are essentially two ways to estimate returns to education: The earnings function method due to Mincer and the discounting method. The earnings function method is extended in several ways. We will consider two of these extensions namely, Heckman-Two-Step estimation and Instrumental Variable estimation.

Mincer Method

Following Mincer (1974), the earnings function method fits a regression of the form:

$$\ln W_i = \alpha + \beta S_i + \gamma_1 EX_i + \gamma_2 EX_i^2 + \varepsilon_i \tag{1}$$

where W is the individual’s earnings, S the number of years of schooling and EX years of labor market experience defined as $Age - S - School\ starting\ age$. In this function, the β coefficient on years of schooling can be interpreted as the average rate of return to one additional year of

schooling regardless of the education level to which it refers. This method assumes that forgone earnings represent the only cost of education, and so measures only the private rate of return. We use the Mincer equation but acknowledge its limitations. There could be small but significant ability bias (Griliches 1977; Card 2001). The relationship between schooling and earnings does not necessarily imply causality (Card 2001). Earnings functions provide private (i.e. individual) returns to schooling, whereas government/public costs and other benefits are needed to estimate social rates of return (Patrinos 2016). We also acknowledge that returns across different fields of study differ substantially (Webber 2014). There is also reference in the literature to misspecification of the earnings function and omitted variables (Polachek 2008).

Nevertheless, our specification of the Mincer equation is parsimonious. Other researchers do include other variables (see, for example, Harkness and Waldfogel 2003). The Mincer model could also be enhanced with employer-employee job match information. Better-matched individuals should be more productive and, as a result, have higher earnings (see, for example, Neumann, Olitsky and Robbins 2009). But the parsimonious earnings function (using only schooling, age and work hours) is typically able to account for up to 60 percent of the variation in (U.S.) annual earnings for adult white men (Polachek 2008). We use this basic specification to make it comparable to most other studies in the literature (see Annex Table A-1; and Chiswick 2006; Lemieux 2006; Patrinos 2016; Polachek 2008). Since a large part of earnings variation can be accounted for as a function of schooling and labor market experience using the Mincer equation, then this provides policymakers with important information about how to invest in education. Due to the comparability of Mincerian results, individuals can make use of these results to help guide their personal decisions about how much schooling they should invest in. Recent studies using the Mincer equation indicate that tertiary education, as opposed to primary education, may now provide the greatest returns to schooling; this represents a shift in the conventional wisdom (Psacharopoulos and Patrinos 2018).

We go beyond Mincerian estimates by using the full discounted method and bringing in the costs of education to get a social rate of return to schooling. We also augment the basic earnings function results by including the Heckman two-step estimation technique to control for labor force selection. We attempt to estimate causal returns to schooling by employing the instrumental variables approach using compulsory school laws as an instrument for schooling given how well this has performed in other studies (Card 2001). Such studies show that the estimates of the return to schooling are typically as large or larger than the corresponding ordinary least squares estimates.

Discounting Method

According to the discounting method, the social rate of return to investment in a given level of education is estimated by finding the rate of discount (r) that equalizes a stream of discounted benefits to the costs at a given point in time. In the case of university education lasting five years, for example, the formula is:

$$\sum_{t=1}^{42} \frac{(W_u - W_s)_t}{(1+r)^t} = \sum_{t=1}^5 (W_s + C_u)_t (1+r)^t$$

where $(W_u - W_s)$ is the earnings differential between a university graduate (subscript u) and a secondary school graduate (subscript s , the control group). C_u represents the direct costs of university education (tuition, fees, books), and W_s denotes the student's foregone earnings or indirect costs. A similar calculation can be made for the other levels of education. Omitting the direct cost of schooling in the formula would produce a private rate of return.

The two methods, and as demonstrated below, can give different estimates of the returns to education. In the first place, the earnings function method gives only private returns. Second, it tacitly assumes that primary school students aged 6 to 12 incur foregone earnings. This is certainly not true, even in agrarian settings. The result is that the earnings function method underestimates the true private returns. In this sense, the discounting method is a better way to estimate private and social returns as it allows to incorporate true direct and indirect costs of schooling.

Heckman-Two-Step Estimation

The wage equation (1) is observed only for a subpopulation of women wage earners which is not random. Estimates will be biased if the sample is treated as random. The probability of participating in wage employment is determined by the comparison of market wage offer and productivity in alternatives to non-wage activities (Heckman 1974). Therefore, we specify the following probit equation to explain the labor force participation of women as wage earner.

$$\text{Prob}(P = 1) = F(a'V) \tag{2}$$

where P is equal to one if women is a wage earner and zero otherwise; F is the cumulative density function, and V includes individual, household or community characteristics that influence women's choice and a is the parameters to be estimated. We employ the Heckman Two-Step estimation procedure to estimate (1) and (2) which provides consistent estimates of the wage equation for women. In the literature a number of different variables are suggested to include in V to identify the system. Such variables are expected to increase the value of women's time in non-market activities and self-employment.² The variable we chose in this paper for this purpose is the number of children in the household under 15 years of age which would reduce the probability of participation of women as a wage earner. The other variables which are common to both equations are years of schooling, experience and experience-squared.

This estimation procedure addresses the issue of sample selection into labor force which is more important for women than for men since in many developing countries like Turkey women's labor force participation is very low³ while men's participation is almost universal. In our estimation we consider only wage earners. We deal with selection of women into wage work with Heckman-Two-Step procedure described above. In the first step we estimate the probit equation for women and compute Inverse Mills Ratio (IMR). In the second stage, we estimate the wage equation (1)

² The examples of such variables used include amount of unearned income of the women, the amount of land owned, the number or age of children or the number of elderly in the household, the number of other wage earners in the household, years of schooling of father/ mother.

³ Turkey has the lowest female labor force participation rate among the OECD countries. It was 20 percent in 2007 and increased since then reaching to about 35 percent in 2018 (TURKSTAT 2020b).

by OLS by including the IMR as an additional variable. The resulting estimates of the returns to education are then consistent.

Instrumental Variable Estimation

While typical estimates of the returns to schooling are useful for gauging market signals, there is an issue about causal impact. The schooling variable may be endogenous due to omission of unobserved factors affecting wages such as ability, motivation and family connections. If these unobserved factors are correlated with schooling the resulting estimates will be biased and inconsistent. To what extent is the relationship between schooling and earnings causal? One way of estimating causal impact of schooling is to take advantage of institutional aspects of the education system to form instrumental variables (IV). School expansion brought about by legislative reforms is one way of obtaining valid instruments.⁴ That is, variables that predict schooling changes independent of the outcome of such an investment, in our case the earnings. The large-scale extension of compulsory years of schooling that took place in Turkey starting in 1997 allows us to calculate such an instrument and use it to obtain a consistent estimate of the true value of returns schooling. A good instrument must satisfy the exogeneity assumption as well as instrument validity. The 1997 reform was unexpected, politically motivate, not related to macroeconomic environment and other policies. Since we are using an instrument associated with, extension of compulsory years of schooling then we are calculating an average marginal (Card 1999, 2001) return to education which is especially for the group of students most directly affected by the reform. The causal rate of return calculated by using this instrumental variable approach gives us both an average marginal return to education which is causal and an estimate of impact of the expansion due to the 1997 reform. Further, IV estimation also takes into account the possible measurement error problem in the years of schooling variable.

Instrumental Variable estimation involves two stages. In the first stage we regress the years of schooling on the instrument and other variables and obtain predicted values of the years of schooling. In the second stage we estimate the wage equation by including the predicted years of schooling in place of the actual years of schooling. The resulting estimates will give the causal effect of schooling on wages. The first-stage equation is as follows:

$$S = \alpha_0 + \alpha_1 \text{PD1997} + \alpha_2 \text{AGE} + \alpha_3 \text{AGE}^2 + v \quad (3)$$

where PD1997 is the policy dummy which is defined to take a value of 1 for those students who were born in 1986 and after and zero for those students who were born before that date. This is our instrument for S as discussed above. In the first stage, we estimate Equation (3) by OLS and obtain predicted values of S. Then, in the second stage we estimate Equation (1) (also replacing EX by AGE) by OLS by replacing S by its predicted values obtained from the first stage.

⁴ Extension of the compulsory schooling is widely used as an instrument for schooling in the literature. Some recent examples are the following: Oreopoulos (2006) for the United Kingdom and Ireland; Devereux and Hart (2010) for the United Kingdom; Grenet (2013) for France, England and Wales; Chib and Jacobi (2016) for the United Kingdom, Fischer et al. (2016) for Sweden; and Aydemir and Kirdar (2017) for Turkey.

Previous studies

Though estimates of the returns are relatively recent undertakings in economics, estimates for Turkey were among the first to be published. Annex Table A-1 shows a plethora of previous rate of return estimates for Turkey, as early as 1968. Note that the early estimates were based on the discounting method, as this was the only available method based on the work of Becker (1964). Following the publication of Mincer (1974), earnings function estimates dominate, and social returns tend to disappear. Some studies have used both methodologies on the same data set, producing divergent estimates, such as Kara (2008).

Overall, previous estimates show increasing returns for men (Salehi et al. 2009; Tansel and Bodur 2012) and higher returns for women (Vural and Gulcan 2008). Using the same methodology over time, Montenegro and Patrinos (2014) show a slightly declining return overall from 10.8 percent in 2002 to 9.3 percent in 2010. The returns to primary and secondary education have been low for some time. The returns to primary schooling do not offer much policy relevant information since there are very few workers with less than primary schooling in the Turkish labor market. This is because until 1997 five years of primary schooling was compulsory. In 1997, compulsory schooling was extended to eight years covering the three years of middle school.

While Ozelli (1970) estimated a low 2.5 percent rate of return to higher education using the full discounting method for 1960, Krueger (1972) on the other hand, estimated the returns to higher education in 1968 at 26.0 percent using the full discounting method. In 1994, the full discounting returns to higher education are estimated at 13.2 percent by Kara (2008). By 2015, the OECD (2018) estimates the full discounting returns to higher education for men at 31.0 percent.

The Mincerian returns to higher education for men are estimated at 13.0 percent in 1987 (Tansel 1994) to 19.0 percent in 1994 (Tansel 2005). Overall, they range from 10.8 percent in 1994 (Kara 2008) to 13.1 percent in 2002 (Tansel and Bodur 2012), to 16.0 percent for the period 2009-14 (Karatas 2018). Using the same methodology over time, Montenegro and Patrinos (2014) show a consistently large private return to higher education of about 18 percent from 2002 to 2010, slightly higher for females. Di Paolo and Tansel (2017) analyze wage differentials by college major.

The estimates of the rate of return we review in this section vary widely by author, method and data set. In addition, considerable but unknown uncertainties are possible. These could arise from measurement uncertainties, unreliability of self-reporting, sampling errors, and exogenous variations in economic and labor market conditions. It is not possible to comment on whether the differences observed arise from the method used, the quality and reliability of the data sets, the period of time chosen, and the interaction of rates of return with changing labor market conditions. Therefore, we do not attempt to do so in this section.

The Data

We are using annual data from Turkey’s 2017 Household Labor Force Survey (HLFS), covering nearly 400,000 individuals aged 15 and over. The HLFS is a nationally representative survey of individuals. It is the official labor market survey conducted by the Turkish Statistical Institute

(TURKSTAT).⁵ It provides information on the supply side of the labor market. It covers non-institutional civilian population. The target population estimates were based on projections which use address-based population registry system (ADNKS). The survey was applied every month and the data were released monthly on a three-month moving average basis. The 2017 HLFS was the most recent survey available at the time of preparation of this study.

The sampling framework of the 2017 HLFS is a random, two-stage and stratified cluster procedure. In the first stage of the two-stage sampling plan, the sampling unit is a cluster made up of about 100 addresses. In the second stage the sampling unit is a house selected from among the selected clusters (for further information, see TURKSTAT 2020a).

Since 2004, the HLFS questionnaire therefore, 2017 questionnaire was aligned with EUROSTAT norms. It collects information on people's income, for individuals six years of age and over, highest level of education attained, age, sex, relation to the household head, for individuals 15 years of age and over employment, status at work, sector of work, occupation, unemployment and a range of other variables. Income information is collected only for wage earners.

The HLFS survey does not provide the number of years of education attained but only the highest degree achieved. Therefore, we estimated the number of years of schooling of the individual based on the highest educational level completed and taking into account the changes in the required years of schooling for a degree over time. There were several recent changes in the number of years of schooling required for a degree. Primary school degree required five years of schooling until 1997 which was the only compulsory level. Middle schools required 3 years and high schools required also 3 years for a degree until the educational reform of 1997. After 1997, the so-called Basic Education required completion of 8 years of schooling (5 years primary plus 3 years middle school) and 8 years became compulsory. The high-school degree requirement was three years until 2005 and increased to four years since then. In 2012 another major reform was introduced. Primary school requirement was reduced to four years from five. The middle schooling required four years of study for a degree. The high school degree requirement was four years since 2005. In summary, the current system is popularly referred to as a 4 + 4+ 4 system since 2012.⁶ These changes over time are taken into account depending on the birth year of the individual in our computation of the years of schooling for an individual. Those who were illiterate are assigned zero years of schooling and those who were literate without a degree are assigned two years of schooling assuming that literacy can be acquired in two years. There is a two-year college education leading to an associate degree as well as four-year education leading to a bachelor's degree. An additional three years is assumed if the individual is attained a post-graduate degree. We expect that our imputation of the years of schooling described above is a close approximation to the actual years of schooling since anecdotal evidence indicates that few people dropout of schools before attaining a degree.

⁵ The HLFS was conducted for the first time only once in October 1988. It was conducted twice a year in April and October between 1989 and 1999. Since 2000 the survey has been conducted every month. The data were released quarterly during 2000-2004 and monthly as three-month-moving averages since 2005.

⁶ A major educational reform took place in August 1997. Until then five years of primary schooling was the only compulsory level of schooling. In 1997, the compulsory level of schooling was extended to 8 years covering the middle school. This has increased enrollments at the compulsory eight-year level and also had spillover effects at the high school level. In 2012 the compulsory level of schooling was further extended to 12 years covering the high school as well.

Therefore, the likelihood of measurement error in our imputed years of schooling variable is low. In any case we expect that the IV estimation we provide deals with any measurement error problem in the years of schooling variable.

We use wage and other information for individuals aged 15 and over in full time dependent employment. We define a policy dummy variable equal to one for those who were affected by the 1997 educational reform that increased compulsory schooling from five to eight years (see Footnote 3). Children who were born in 1986 or later were bound by the new policy and were affected by the 1997 reform. Birth year is computed as the reported age minus the survey year. This policy dummy is used as an instrument for schooling in our IV estimates.

For the wage-earners the questionnaire asks the wages of the last month from the main job. Wages are the sum of cash earnings and bonuses. The annual earnings are obtained by multiplying the monthly earnings by 12 since there were no information on the number of months worked during a year. The annual earnings in dollars are obtained by dividing the annual earnings in Turkish Liras (TL) by the exchange rate of June 2017 which was equal to 3.52 TL/\$ as reported by the Republic of Turkey Central Bank (TCMB 2018).

The labor market experience variable is not reported in the HLFS. We used the potential experience for the individual. The potential experience is computed as equal to ‘age-years of schooling-6’ where 6 is mostly the school starting age. Potential experience is a good proxy for actual experience for men. However, it may overstate the actual experience for women who may withdraw from the labor market during child bearing years. The formal workers are defined as those who are registered with the Social Security Institution (SGK) and those who are not registered are defined as informal workers. Public/ private sector distinction was also provided in the survey (see Footnote 7 for more on this). Since 2014 the rural/urban location distinction is not available in the HLFS surveys. Therefore, we were not able to incorporate this distinction into our analysis.

Table 1 gives summary statistics. We restricted the sample to individuals 15-65 years of age. For the working population, the average years of schooling is 7.5. Only 11 percent of the sample has no educational degree, most have primary or secondary, and 16 percent have higher education. For those with secondary schooling only, about 47.5 percent, attended a vocational school. For the working wage earners who report positive labor market earnings, the average years of schooling is 10.1 and more than three-quarters are employed in the private sector.

Table 1: Descriptive Statistics of Key Variables, Turkey, 2017

Variable	Mean
<i>Whole sample (N = 378,691)</i>	
Years of schooling	7.5
<i>Educational level (percent):</i>	
None	11
Primary	39
Secondary	34
Higher	16
<i>Secondary school type (percent):</i>	
General	52.4
Vocational	47.5
Education reform 1997 affected (percent)	28.7
Children aged 15 or less in household	1.0
<i>Wage Earner Workers (N = 97,050)</i>	
Annual earnings (\$US)	7,341.8
Years of schooling	10.1
Years of labor market experience	20.7
Private sector employee (percent)	73.6
Public sector employee (percent)	26.4

Source: 2017 Turkish Household Labor Force Survey (HLFS)

Notes: The official exchange rate in June 2017 was 3.52 Turkish Liras per US dollar (TCMB, 2018).

Earnings function estimates

Table 2 presents our earnings function estimates of the private overall rate of return to one extra year of schooling by gender, economic sector and secondary school curriculum.

Table 2: Private Rates of Return to A Year of schooling
Mincerian estimates (%), Turkey, 2017

Reference group	Ordinary least squares	Heckman Two-Step
All wage workers	8.8	
Males	8.3	
Females	10.3	13.4
<i>Economic sector:</i>		
Private	6.5	
Public	7.9	
<i>Secondary school graduates:</i>		
General curriculum	2.4	
Vocational curriculum	4.2	

Source: 2017 HLFS

Note: All coefficient estimates are statistically significant. See full results in Annex Table A-2 and Annex Table A-3

There are several points to note in Table 2. First, the selectivity corrected estimate for women is substantially larger than the OLS estimate. We use the number of children under 15 living in the family as an exclusion restriction frequently invoked in the female labor force participation decision. We find that variable estimate has a negative sign indicating that it reduces participation of women as expected. This is like the studies by Martins (2001), Chang (2011) and Huber and Mellace (2014). This variable potentially impacts the caregiving activities of women but does not affect their earnings. Several previous studies also find higher selectivity corrected estimates than the OLS estimates for Turkey (see, for example, Tansel 1994, 2001, 2005, 2010).

Second, returns to education for females are larger than those to males. This is also found in the previous studies for Turkey cited above. In their global survey, Psacharopoulos and Patrinos (2018) also report higher returns for females than for males as a general pattern for many countries. Dougherty (2005) investigates the reasons for this finding and attributes this general observation to discrimination, tastes and circumstances.

Third, returns to education in the noncompetitive public sector are higher than that in the competitive private sector.⁷ This is contrary to what is observed for many countries of the world by Psacharopoulos and Patrinos (2018). However, Tansel (2005), in her study using 1994 Household Income and Expenditure Survey for Turkey, taking selection effects into account, finds lower returns in the public sector than in the private sector for both men and women, which is a result similar to many countries of the world. In a number of Middle East and North Africa

⁷ Our definition of private sector wage workers includes also those who work in the informal sector which constituted about 18 percent of the total wage earners in 2019. Further, private sector excludes foundations, associations, cooperatives, political parties, international organizations, non-governmental organizations and embassies.

(MENA) countries, college graduates were rewarded with government jobs and higher than market salaries. As a result, most studies on MENA countries find higher public sector wage premiums compared to the private sector wage earners (see Tansel et al. 2020). For instance, Egypt had a policy of guaranteed public sector employment for all secondary school or above graduates since the early 1960s – abandoned in the late 1990s. In a panel data study for the period 1998-2018 in Egypt, Tansel et al. (2020) find a significant public sector wage penalty for men and a significant public sector wage premium for women. There has never been a guaranteed public employment policy in Turkey. However, during some years, the government may let public wages erode in the face of inflation. This may have happened in 1994, which was a year of austerity due to crisis (Tansel 2005). During the more recent years the government has been providing inflationary adjustments twice a year to public wages. It is also known that during election years the temporary public sector workers were advanced to permanent positions increasing the number of public employees.

We can get some idea about the situation in the public versus private sectors although a comparison of the mean wages in these two sectors is not the same as the comparison of the returns to education in these two sectors. The mean wages in the public sector is larger than the mean wages in the private sector in the HLFS data in 2017 and in several years before. This observation is also confirmed with the recent Survey of Income and Living Conditions (SILC). Casual observation also supports this fact. Most people in the private sector work at the minimum wage while public sector salaries are much higher than the minimum wage. There are two points to note here. One is that the presence of large numbers of Syrian refugees since 2011 has lowered the private sector wages substantially. Second, the informal sector in Turkey, although it declined over time, could be considered rather large. About 18 percent of wage earners were in the informal sector in 2019 (TURKSTAT 2020b). Informal wage earners are defined as those who are not registered with the social security organization. It is well-known that the wages in the informal private sector are much lower than in the formal private sector (Tansel 2000; Tansel and Kan 2016).

The fourth observation to note in Table 2 relates to the returns to education by the curriculum of the secondary school. We find that the return to the vocational secondary school is much higher than to the general secondary school. This is consistent with the previous studies on Turkey (Tansel 1994, 1989, 2005; Tansel and Bodur 2012). (This is confirmed with an extended Mincerian earnings function, which estimates private returns to secondary education by curriculum type, over primary education, at 5.7 percent for general secondary and 6.5 percent for vocational secondary (see Annex Table A-5.)). However, it is contrary to the general pattern observed in the most countries of the world, as discussed by Psacharopoulos and Patrinos (2018). In Turkey, most vocational high schools are public and have little competition from the private sector. They are also more likely to graduate students with a specific, labor market skill; whereas general high schools do not. Rather, the latter prepare students for entry into higher education. Therefore, it is not surprising that vocational school graduates experience a higher private rate of return to their education.

We now compare the estimates for 2017 in Table 2 with those in Annex Table A-1 which provides the estimation results from several previous studies in Turkey. The estimates in the two tables are not directly comparable because they pertain to different years. Further, the methodologies employed may also differ. In this section we concentrate on the estimates using the Mincerian

earnings function approach. Tansel (1994) is the first study to estimate returns to education in Turkey using the Mincerian method. We note common findings in Tansel (1994), Tansel (2001), Tansel (2005) and Tansel and Bodur (2012). Looking at the results for men, we observe that the return to primary school is rather very low in all four studies. This is because the five-year primary schooling was the compulsory schooling during those years, and it was almost universal. Another common observation in these studies is that the return to vocational schooling is higher than to general schooling. Finally, all these studies show very high returns to higher education than to other levels of schooling. This is consistent with the very high demand for university level education albeit restricted with the very competitive entrance examinations. Karatas (2018) also obtains results like Tansel (2001). The higher returns to vocational education than to general education is a similar finding to our estimates in Table 2 for 2017, although our estimates for 2017 are much smaller in size than those obtained by Tansel (2001).

However, one of the benefits of general secondary education is that it opens up opportunities for further study at the post-secondary level (Appleton 1996; Comay et al. 1993; Eide and Waehrer 1998; Shafiq 2007; Stange 2012; Weisbrod 1962). That is, since general secondary education specifically prepares students for the national, competitive entrance examination to qualify for higher education, then general secondary education has a future benefit for graduates. However, this is not the case for vocational school graduates who also qualify to take the competitive, national examination albeit with a lower chance to succeed.

Salehi et al. (2009) report the overall Mincerian estimates for men for 1988, 1994 and 2003. Their estimate for 1988 is lower than our 2017 estimate, but their estimates for 1994 and 2003 are higher than our 2017 estimate. Vural and Gulcan (2008) report estimates for 1994 and 2004. Their estimate for 1994 males is about the same as our 2017 estimate, but for females it is lower than our estimate. In 2004 for both females and males, their estimates are higher than our 2017 estimates. In contrast, Güriş and Çağlayan (2012) find estimates in 2003 and 2006 for females and males much lower than our 2017 estimates. Tansel and Bodur (2012) report similar overall estimates of around 8 percent for 1994 and 2002 which are similar to ours. Tansel and Daoud (2014) also report similar overall estimates for 2004 and 2008, around 12 percent, which are higher than ours. Bakis (2012) reports for 2008 an overall estimate of 10 percent. Mocan (2014) reports a surprising overall estimate of zero percent for men and 14 percent for women.

Turkey’s 1997 reform-affected returns

Turkey’s 1997 reform of basic education had a forward-looking vision for the education system that defined the kind of citizens that the system would develop:

“To raise individuals of the information age who are devoted to the principles and reforms of Atatürk, whose thinking, perception, and problem-solving capabilities have been developed, who are democratic, devoted to freedom, faithful to moral values, open-minded, and aware of their personal duties and responsibilities...”
(8th Five Year Development Plan, paragraph 675).

The Basic Education Law (Law No. 4306) passed on August 16, 1997 mandated eight years of compulsory education. This launched an unprecedented expansion of public primary schooling.

The eight-year Basic Education Program involved a broad range of actions. As a result, enrollment in basic education increased by over 1.1 million students, raising the gross enrollment ratio from 85.63 percent in 1997 to 96.30 percent in 2002. Enrollment rates for girls, especially in rural areas, made particularly impressive gains. For example, in the nine provinces in the eastern and southeastern regions of Turkey that had the largest gender disparity, female enrollment increased 160 percent. Using a combination of government and private contributions, the Ministry of National Education built 81,500 new primary-education classrooms during the five-year period 1997–2002, increasing classroom supply by 30 percent (World Bank 2005).

The 1997 reform extended compulsory schooling from grade five to grade eight. We use it here as a natural policy experiment in the subsequent analysis. This type of policy-related instrument (based on compulsory schooling) is frequently viewed as an ideal instrument. It provides the return to persons who decide to enroll only because of the policy change. This reform affected 24 percent of the wage earners in the 2017 HLFS survey. The first stage results are shown in Table A-4. The estimates indicate that the reform increases the years of schooling by about a year and a half for women and by about a year for men. The instrument is highly correlated with schooling, satisfying instrument relevance for both women and men. The effect on women is larger than that of men consistent with descriptive evidence. For both female and male estimates the F-statistics are higher than the recommended levels in the literature.

Overall, the reform produced a significantly higher return to schooling for men. This is in contrast to a previous study using the same reform based on an earlier survey (Aydemir and Kirdar 2017). They find that the return from an extra year of schooling is about 8 percent for women and no more than 2.5 percent for men. Torun (2018) also uses the 1997 reform as an instrument and finds small effects on the earnings of men but large positive effects on earnings of women. In Turkey, the low level of the estimates for men is explained by low attainment overall, while the much higher returns for women are because women were more likely to complete high school because of the reform (Aydemir and Kirdar 2017) and move into higher skill and formal sector jobs (Torun 2018).

A consistent finding among studies using instrumental variables based on institutional changes in the education system is that the estimated returns to schooling are 20 to 40 percent (Card 1999) above the corresponding OLS estimates. Part of the explanation for this finding may be that marginal returns to schooling for certain subgroups – particularly relatively disadvantaged groups with low education outcomes – are higher than the average marginal returns to education in the population as a whole (see, for example, Oreopoulos 2006; Card 2011).

It is interesting to note that other instruments have been used for Turkey. Ozturk and Tumen (2018) refer to the student protests of the 1970s and the subsequent military coup and the decline in university graduation which compressed wages and use the unexpected decline in educational attainment as an instrument to estimate returns to schooling. They find that the returns to an additional year of schooling range between 11 and 12 percent for men in post-secondary education.

Overall, the results show a decent return to schooling. Women receive considerably higher returns to schooling compared to men's OLS results. But men receive higher returns when we instrument for schooling. Table 3 shows the returns, ranging from 8.8 percent overall based on OLS to a high

of 13.4 percent for women when corrected for selection. The IV results for men are 18 percent and 11 percent for women.

Most estimates from studies using compulsory schooling laws as instrumental variables for completed education reveal that the resulting estimates of the return to schooling are typically as big or bigger than the corresponding ordinary least squares estimates (Card 2001; Arabsheibani and Mussurov 2007; Duflo 2001; Heckman and Li 2004; Oyelere 2011; Patrinos and Sakellariou 2005; Sakellariou 2006). The typical interpretation of this finding is that marginal returns to education among the low-education subgroups typically affected by supply-side innovations tend to be relatively high, reflecting their high marginal costs of schooling. In the literature, IV estimates are almost always higher than OLS. There are also several instances where men’s returns estimated by IV are much higher than the OLS estimate as we have found for Turkey. This is found in: Ireland, where men’s returns estimate by IV using school reforms are 13.6 percent compared to 8.0 percent using OLS (Denny and Harmon 2000); the United Kingdom, where men’s returns estimate by IV using school leaving age reforms are 14.0-15.2 percent compared to 4.9-6.1 percent using OLS (Harmon and Walker 1995, 1999); and in Spain, where men’s returns estimate by IV using education policy changes are 10.7 percent compared to 6.4 percent using OLS (Pons and Gonzalo 2002).

Compulsory schooling reforms affect mainly the individuals at the lower end of the distribution of educational attainment (Brunello, Fort and Weber 2009). Huang and Zhu (2020) also find higher IV returns for men following a substantial higher education expansion in China. In fact, the returns to schooling increased from 4.9 percent in OLS to 16.5 percent for men, and from 6.2 percent in OLS to 12.4 percent for women. They concluded that the reform allowed previously disadvantaged males to benefit more from the reform.

In Turkey, wage earning women have higher levels of education than do wage earning men (Tansel 1994, 2001, 2010). In 2017, working women have almost a year more of schooling than do men, at 10.7 years for women compared to 9.9 years for men. Such disadvantaged men may start work life earlier in age. After the implementation of the reform, they start work life at a later age, with a higher degree and possibly with higher earnings. Such disadvantaged men may have put the returns estimates at a higher level for men than for women whose behavior may have changed less.

Table 3: Summary of Returns to Schooling, Turkey 2017 (percent)

All	Males	Males	Females	Females	Females
OLS	OLS	IV	OLS	Heckman	IV
8.8	8.3	18.0	10.3	13.4	11.2

Source: 2017 HLFS. See Annex Tables A-2, A-3, A-4 for full results.
Notes: All coefficient estimates are statistically significant.

One might wonder if there has been a bulge in the number of graduates after the implementation of the 1997 Reform at the end of completion of the new compulsory level of schooling of eight years and what might be its possible effects of this on the labor market and on the returns to education. We would like to emphasize that there have not been a bulge in the number of graduates. The change at this period has been gradual. Some of the graduates are absorbed in the labor market

The extension of compulsory schooling from five to eight years in Turkey has increased substantially the graduation from the eight year of schooling. However, in addition to this, it has substantially increased the continuation onto high school education and the grade completion rates at the high school level (Kirdar et al. 2016). This, in turn, may have affected the number of those who seek tertiary education. Therefore, a bulge of completers of eight years of schooling was not created. The effect on the labor market of the 1997 Reform in this respect has been gradual. Also, we can surmise that the younger cohorts may have higher returns, which may be due to their better technological skills. Tansel (1994) investigates the returns for younger versus older cohorts.

Cost-benefit estimates

We use a subsample of 97,050 workers aged 15-65 years who had positive earnings from dependent employment. Annual earnings were converted to \$US using the 2017 exchange rate in June, which was equal to 3.52 TL. Table 4 gives their mean earnings by level of education.

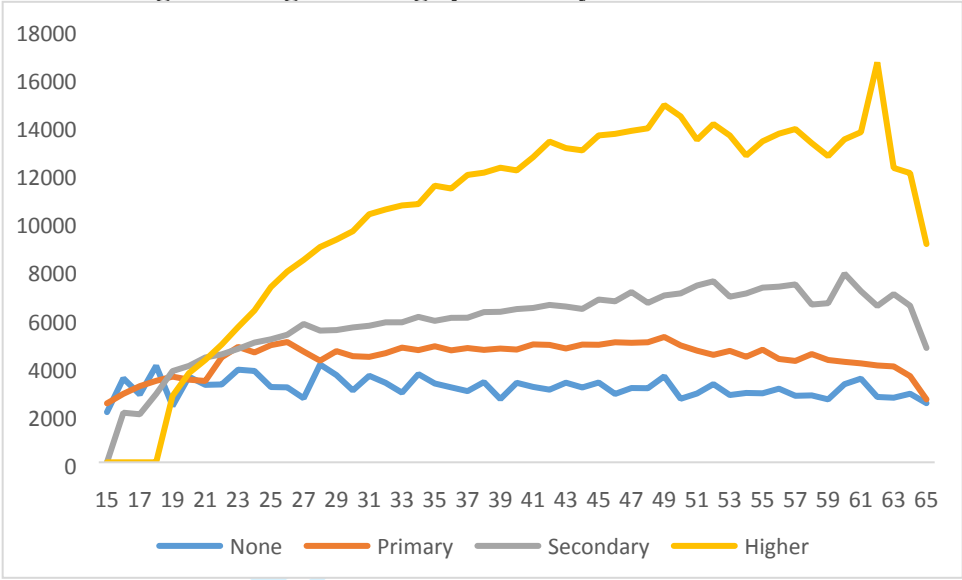
**Table 4: Mean Annual Earnings by Educational Level
Turkey, 2017**

Educational level	Mean annual earnings (\$US)	Number of observations
None	3,714	1,528
Primary	5,278	24,850
Secondary	5,974	38,567
Higher	10,756	32,105
All	7342	97,050

Source: 2017 HLFS

We observe a sharp rise in mean annual earnings for those with higher education. This is consistent with the very high demand for university education as well as the restriction on the university admissions by the highly competitive university entrance examination. There is very high demand for university education for several reasons. First, in addition to high income, the university degree confers a prestigious position in Turkish society. Secondly, although the rules are somewhat mixed, there may be some advantages while serving in the army for men with university education. These factors are behind the high demand for higher education. The age-earnings profiles by level of education show a very sharp earnings premium for higher education graduates.

Figure 1: Age-earnings profiles by level of education



The discounting formula presented above was applied to the earnings profiles to estimate the returns assuming a 6-6-4 duration of primary, secondary and higher education, and two years of foregone earnings for primary education graduates. The direct resource cost of schooling appears in Table 5. The resulting returns appear in Table 6.

Table 5: Cost per Student/Year, Turkey, 2017	
Level of Education	Cost 2017 (\$US)
Primary	1,582
Secondary	1,998 ^a
Higher	3,736
Source: TURKSTAT (2018) website	
a. Average of lower secondary (1,600) and upper secondary upper (2,395)	

We remark on two noteworthy findings presented in Table 6. First, comparing with Mincerian estimates of the returns to education of the previous section, we observe that the private returns by the discount method are much higher. Second, the private returns are substantially higher than the social returns, which is to be expected since social benefits are not included. The lowest private and social returns are at the secondary education level while highest returns are attained at the higher education level.

**Table 6: Private and Social Returns to Investment in Education
by Discount Method, Turkey, 2017 (%)**

Educational level	Private	Social
Primary	13.0	6.0
Secondary	11.4	5.2
Higher	15.8	10.4

Source: 2017 HLFS. See Annex Table A-5 for full results.

Notes: All coefficient estimates are statistically significant.

Returns to schooling over time

Between 1987 and 2017 schooling levels doubled, from about 4.9 years of schooling on average to more than 10 years. During that period the private returns to schooling first increased gradually to more than 12 percent by 2003, then declined to the present level as schooling levels continued to increase. In 1985, more than 1/3 of the Turkish population had no schooling; this declined to less than 10 percent by 2010 (Barro and Lee 2014). The private returns to primary schooling have not changed much and remain low over the last 30 years. This is most likely because the proportion of workers with at least primary schooling has been high over this period as it was the compulsory level of schooling. The private returns to secondary schooling have declined by 2/3 since 1968. At the same time, the proportion of the population with secondary schooling experience a four-fold increase (Barro and Lee 2014). There were significant expansion of tertiary education in 1992 and then in 2005, although it is argued that most of the newly established universities lacked the desired quality. In spite of this, the private returns to tertiary have remained high. In 1987, they were 13 percent and by 2017 had actually increased to 14.5 percent. This shows that the massive increase in schooling has not dissipated the demand for higher order skills. Also, the social returns to higher education have increased over time. In 1960, they were estimated at only 1.5 percent (Ozelli 1970), but climbed to 8.5 in 1968 (Krueger 1972), and increased since then to 10.4 percent. At this point we remark that there is a potential selection bias issue at the higher education level. In fact, those who complete university education are not randomly drawn from the population of secondary school graduates. This is due to the national, competitive examination which secondary school graduates take to enter a university program. Thus, the entrance examination selects the better ability students from among the population of secondary school graduates. This issue of selection bias based on ability is one of our reasons for undertaking the IV estimation.

Conclusion

While Turkey has had the highest growth in the respective region in recent years and aspires to become a high-income economy in the next decade, the country has witnessed a slowdown in economic growth since 2011, as private investment and productivity stagnated. This was in marked contrast to the previous decade, when total factor productivity growth made a considerable contribution to GDP growth. Therefore, productivity dynamics deserve attention from researchers and policy makers searching for reasons for the growth slowdown and ways to reverse it (World Bank 2016). Turkey faces downside risks if structural changes—in the education and training system, and the economy more broadly—are not made to ensure that contributions to economic growth come from improvements in productivity (Del Carpio 2018).

High returns to education, and especially to higher education, have been estimated for the case of Turkey since the 1960s. The returns explain the high demand for higher education in Turkey. The educational achievement of Turkey's population has increased many times in the past few decades. From only 1.1 years of schooling on average in 1950 to 3.6 years in 1980 to more than 7 years by 2010. Other aspects of educational development include the improvement in performance in terms of student performance and reduced inequality.

Using a variety of estimation methods and the latest survey, we find the average rate of return to schooling to be 8.8 percent, which puts it at just about the global average. Women receive higher returns to schooling compared to men, at least two percentage points higher. This, too, is in line with global findings. The returns to schooling are high for women even when we control for selection. We used the number of children under 15 years of age living in the household as an exclusion restriction frequently invoked in the female labor force participation decision. This is similar to the studies by Martins (2001), Chang (2011) and Huber and Mellace (2014). This variable potentially impacts the caregiving activities of women but does not affect earnings.

We use the 1997 education reform to instrument schooling. IV estimates are significantly higher than OLS estimates. This is consistent with previous findings. It is argued that the higher returns reflect the fact that disadvantaged youth benefitted from the reform that expanded educational opportunities. We find that the reform was associated with a higher return for men than for women. The instrumental variable's sharp increase of returns for both women and men is *prima facie* evidence of the productive, rather than screening, function of education. It also demonstrates the causal impact of schooling in Turkey, and the fact that schooling is an excellent policy for encouraging the educational and economic performance of women and disadvantaged men.

Surprisingly, the average rate of return to schooling is higher in the public sector at 7.9 percent, compared to 6.5 percent in the private sector. Also, the private return to vocational secondary education is higher than general secondary education, 6.5 percent vs. 5.7 percent.

Using the full discounting method, we estimate the private and social returns to education. Private returns are highest at the tertiary level and the lowest private returns are for secondary education. This is in line with recent global trends. This justifies cost-sharing at the tertiary level, as this level of schooling needs to continue to expand and improve its quality. This demonstrates the need for further expansion of higher education and improve its quality and justifies some level of public subsidy.

The size of the returns is much higher than any reasonable alternative private social discount rate, pointing to the need for higher investment in education. The size of the private returns to higher education suggests the need for selective cost-recovery, while the social returns suggest some level of public subsidy is warranted, especially through student loans for efficiency and equity.

Future research could address the equity implications of education financing reforms. In addition, future research could look into the interaction between changes in educational quality over time and the effect on returns to education. This would call for new data that incorporates learning outcomes into standard household or labor force surveys. Finally, COVID-19 and the ensuing recession give researchers other areas to investigate. These include looking at the responses of

government to expenditure levels and effects on labor market outcomes. During past crises, evidence from many other countries suggest that returns to schooling do not decline. Is that going to be the same this time around, both globally and in Turkey?

For Peer Review

References

- Angrist, J.D. and A.B. Krueger. 1991. "Does compulsory school attendance affect schooling and earnings?" *Quarterly Journal of Economics* 106(4): 979-1014.
- Appleton, S., J. Hoddinott and J. Knight. 1996. "Primary education as an input into post-primary education: a neglected benefit." *Oxford Bulletin of Economics and Statistics* 58(1): 211–219.
- Arabsheibani, G.R. and A. Mussurov. 2007. "Returns to schooling in Kazakhstan." *Economics of Transition* 15(2): 341-364.
- Aydemir, A. and M.G. Kirdar. 2017. "Low wage returns to schooling in a developing country: Evidence from a major policy reform in Turkey." *Oxford Bulletin of Economics and Statistics* 79(6): 1046-1086.
- Bakış, O. 2012. Türkiye’de eğitimin bireysel getirisi: 1988-2008 (Private returns to education in Turkey: 1988-2008). *TUSIAD-Sabancı*.
- Banerjee, A.V. and E. Duflo. 2005. "Growth theory through the lens of development economics." In P. Aghion, S. Durlauf (eds.), *Handbook of Economic Growth* 1A. Amsterdam: Elsevier.
- Becker, G.S. 1964. *Human Capital Theory*. New York: Columbia University Press.
- Brown, S. and J.G. Sessions. 2004. "Signalling and screening." In G. Johnes, J. Johnes (eds.), *International Handbook on the Economics of Education*. Cheltenham: Edward Elgar.
- Brunello, G., M. Fort and G. Weber. 2009. "Changes in compulsory schooling, education and the distribution of wages in Europe." *Economic Journal* 119(536): 516-539.
- Card, D. 2001 "Estimating the return to schooling: Progress on some persistent econometric problems." *Econometrica* 69(5): 1127-1160.
- Card, D. 1999. "The causal effect of education on earnings," in O. Ashenfelter, D. Card, eds., *Handbook of Labor Economics* 3A. Amsterdam: Elsevier.
- Chang, S. K. 2011. "Simulation estimation of two-tiered dynamic panel Tobit models with an application to the labor supply of married women." *Journal of Applied Econometrics*, 26 (5): 854-871.
- Chevalier, A., C. Harmon, I. Walker and Y. Zhu. 2004. "Does education raise productivity, or just reflect it?" *Economic Journal* 114(499): F499–F517.
- Chib S. and L. Jacobi. 2016. "Bayesian fuzzy regression discontinuity analysis and returns to compulsory schooling." *Journal of Applied Econometrics* 31: 1026-1047.

- Chiswick, B R. 2006. "Jacob Mincer, experience and the distribution of earnings." In S Grossbard (ed.), *Jacob Mincer: A Pioneer of Modern Labor Economics*. New York: Springer.
- Colclough, C., G. Kingdon and H. Patrinos. 2010. "The changing pattern of wage returns to education and its implications." *Development Policy Review* 28(6): 733–747.
- Comay, Y., A. Melnik and M.A. Pollatschek. 1993. "The option value of education and the optional path for investment in human capital." *International Economic Review* 14(2): 421–435.
- Del Carpio, X. 2018. "How low human capital can limit productivity improvements: Examples from Turkey and Peru". <http://blogs.worldbank.org/education/how-low-human-capital-can-limit-productivity-improvements-examples-turkey-and-peru>
- Denny, K.J. and C.P. Harmon. 2000. "Education Policy Reform and the Return to Schooling from Instrumental Variables." Papers 00/12, College Dublin, Department of Political Economy.
- Devereux, P. J. and R.A. Hart. 2010. "Forced to be rich? Returns to compulsory schooling in Britain." *Economic Journal* 120: 1345–1364.
- Di Paolo, A. and A. Tansel. 2017. "Analyzing wage differentials by fields of study: Evidence from Turkey." July 2017, IZA Discussion Paper No. 10915.
- Dougherty, C. 2005. "Why are the returns to schooling higher for women than for men?" *The Journal of Human Resources* 40 (4): 969–988.
- Duflo, E. 2001. "Schooling and labor market consequences of school construction in Indonesia: Evidence from an unusual policy experiment." *American Economic Review* 91(4): 795–813.
- Eide, E. and G. Waehrer. 1998. "The role of the option value of college attendance in college major choice." *Economics of Education Review* 17(1): 73–82.
- Fischer M., M. Karlsson, T. Nilsson and N. Schwarz 2016. "The sooner the better? Compulsory schooling reforms in Sweden." IZA Discussion Paper 10430.
- Grenet J. 2013. "Is extending compulsory schooling alone enough to raise earnings? Evidence from French and British compulsory schooling laws." *Scandinavian Journal of Economics*, 115(1): 176–210.
- Griliches, Z. 1977. "Estimating the returns to schooling: Some econometric problems." *Econometrica* 45(1):1–22.
- Gunderson, M. and P. Oreopoulos. 2020. "Returns to education in developed countries." In *The Economics of Education* (pp. 39–51). Academic Press.

- Güriş, S. and E. Çağlayan. 2012. "Returns to education and wages in Turkey: Robust and resistant regression." *Quality & Quantity* 46 (5): 1407-1416.
- Harkness, S. and J. Waldfogel. 2003. "The family gap in pay: Evidence from seven industrialized countries." *Research in Labor Economics* 22(1): 369-414.
- Harmon, C. and I. Walker. 1995. "Estimates of the Economic Return to Schooling for the United Kingdom." *American Economic Review* 85: 1278-1286.
- Harmon, C. and I. Walker. 1999. "The Marginal and Average Return to Schooling in the UK." *European Economic Review* 43: 879-887.
- Heckman, J.J. 1974. "Shadow Prices, Market Wages and Labor Supply." *Econometrica* 42: 679-694.
- Heckman, J.J. 1979. "Sample selection bias as a specification error." *Econometrica* 47(1): 153-161.
- Heckman, J.J., J.E. Humphries and G. Veramendi. 2018. "Returns to education: The causal effects of education on earnings, health, and smoking." *Journal of Political Economy* 126(S1): S197-S246.
- Heckman, J.J. and X. Li. 2004. "Selection bias, comparative advantage and heterogeneous returns to education: Evidence from China in 2000." *Pacific Economic Review* 9(3): 155-171.
- Heckman, J.J., L.J. Lochner and P.E. Todd. 2006. "Earnings functions, rates of return and treatment effects: The Mincer equation and beyond." In E. Hanushek, F. Welch (eds.), *Handbook of the Economics of Education* Volume 1. Amsterdam: Elsevier.
- Huang, B. and Y. Zhu. 2020. "Higher Education Expansion, the Hukou System, and Returns to Education in China." IZA Discussion Paper No. 12954.
- Huber, M. and G. Mellace. 2014. "Testing exclusion restrictions and additive separability in sample selection models." *Empirical Economics* 47 (1): 75-92.
- Kara, O. 2008. "Comparing Two Approaches to the rate of return to investment in education." *Education Economics* 18 (2): 153-165.
- Karatas, H.M. 2018. "The returns to formal schooling in Turkey using pseudo-panel data." *Giresun Üniversitesi İktisadi ve İdari Bilimler Dergisi* Yıl.4. Sayı. 8, ss. 13-33.
- Kirdar, M., M. Dayioğlu-Tayfur and I. Koç. 2016. "Does longer compulsory education equalize educational attainment? Evidence from a major policy reform." *World Bank Economic Review* 30(3): 549-579.

- Krueger, A.O. 1972. "Rates of return to Turkish higher education." *Journal of Human Resources* 7 (4): 482-99.
- Lemieux, T. 2006. "The 'Mincer equation' thirty years after Schooling, Experience, and Earnings." In S. Grossbard (ed.), *Jacob Mincer: A Pioneer of Modern Labor Economics*. New York: Springer.
- Martins, M.F.O. 2001. "Parametric and semiparametric estimation of sample selection models: an empirical application to the female labour force in Portugal." *Journal of Applied Econometrics* 16 (1): 23-39.
- Mincer, J. 1974. *Schooling, Experience and Earnings*. New York: Columbia University Press.
- Mocan, L. 2014. "The impact of education on wages: Analysis of an education reform in Turkey." Koç University-TUSIAD Economic Research Forum Working Papers Working Paper No. 1424.
- Montenegro, C.E. and H.A. Patrinos. 2014. "Comparable estimates of returns to schooling around the world." World Bank Policy Research Working Paper No. 7020.
- Neumann, G., N. Olitsky and S. Robbins. 2009. "Job congruence, academic achievement, and earnings." *Labour Economics* 5(16): 503-509.
- OECD. 2018. *Education as a Glance*. Paris: OECD.
- Oreopoulos, P. 2006. "Estimating average and local average treatment effects of education when compulsory schooling laws really matter." *American Economic Review* 96(1): 152-175.
- Oreopoulos, P. and U. Petronijevic. 2013. "Making College Worth It: A Review of the Returns to Higher Education." *Future of Children* 23(1): 41-65.
- Oyelere, R.U. 2011. "Have returns to education changed in Nigeria? Uncovering the role of democratic reforms." *Journal of African Economies* 20(5): 737-780.
- Ozelli, M.T. 1970. "The estimates of private internal rates of return on educational investment in the First Turkish Republic, 1923-1960." *International Journal of Middle East Studies* 1 (2): 154-176.
- Ozturk, A. and S. Tumen. 2018. "Education and labor market consequences of student protests in late 1970s and the subsequent military coup in Turkey." IZA Discussion Papers No. 11733, Institute of Labor Economics (IZA), Bonn.
- Patrinos, H. 2016. "Estimating the return to schooling using the Mincer equation." *IZA World of Labor* 2016: 278 (doi: 10.15185/izawol.278).

- 1
2
3 Patrinios, H.A. and G. Psacharopoulos. 2020. "Returns to education in developing countries."
4 In *The Economics of Education* (pp. 53-64).
5
6
7 Patrinios, H.A. and C. Sakellariou. 2005. "Schooling and labor market impacts of a natural policy
8 experiment." *Labour* 19 (4): 705-719.
9
10 Peet, E.D., G. Fink and W. Fawzi. 2015. "Returns to education in developing countries: Evidence
11 from the living standards and measurement study surveys." *Economics of Education*
12 *Review* 49: 69-90.
13
14 Polachek, S.W. 2008. "Earnings over the life cycle: The Mincer earnings function and its
15 applications." *Foundations and Trends in Microeconomics* 4(3): 165-272.
16
17
18 Pons, E. and M.T. Gonzalo. 2002. "Returns to schooling in Spain: how reliable are instrumental
19 variable estimates?" *Labour* 16(4): 747-770.
20
21
22 Psacharopoulos, G. 1983. "Education and Private Versus Public Sector Pay." *Labour and Society*
23 8(2): 123-33.
24
25 Psacharopoulos, G. and R. Mattson. 1998. "Estimating the Returns to Education: A Sensitivity
26 Analysis of Concepts and Methods." *Journal of Educational Planning and Administration*
27 12(3): 271-287.
28
29
30 Psacharopoulos, G. and H.A. Patrinos. 2018. "Returns to investment in education: A Decennial
31 review of the global literature." *Education Economic*, 26 (5): .445-458.
32
33
34 Psacharopoulos, G. and P. Teixeira. 2019. "Rates of Return to Education: Conceptual and
35 Methodological Issues." In *Encyclopedia of International Higher Education Systems and*
36 *Institutions*. Springer: Dordrecht, Germany, pp.1-8.
37
38 Psacharopoulos, G. and G. Williams. 1973. "Public Sector Earnings and Educational Planning."
39 *International Labour Review* 108(1): 43-57.
40
41
42 Sakellariou, C. 2006. "Education policy reform, local average treatment effect and returns to
43 schooling from instrumental variables in the Philippines." *Applied Economics* 38(4): 473-
44 481.
45
46 Salehi-Isfahani, D., I. Tunalı and R. Assaad. 2009. "A comparative study of returns to education
47 of urban men in Egypt, Iran, and Turkey." *Middle East Development Journal* 1 (2): 145-
48 187.
49
50
51 Schultz, T.W. 1961. "Education and economic growth," in *Social Forces Influencing American*
52 *Education*. Chicago: National Society for the Study of Education.
53
54
55 Schündeln, M. and J. Playforth. 2014. "Private versus social returns to human capital: Education
56 and economic growth in India." *European Economic Review* 66: 266-283.
57
58
59
60

- Shafiq, M.N. 2007. "Household rates of return to education in rural Bangladesh: Accounting for direct costs, child labour, and option value." *Education Economics* 15(3): 343-358.
- Sianesi, B. and J.V. Reenen. 2003. "The returns to education: Macroeconomics." *Journal of Economic Surveys* 17(2): 157-200.
- Stange, K.M. 2012. "An empirical investigation of the option value of college enrollment." *American Economic Journal: Applied Economics* 4(1): 49-84.
- Tansel, A. 1994. "Wage employment, earnings and returns to schooling for men and women in Turkey." *Economics of Education Review* 13 (4): 305-320.
- Tansel, A. 2000. "Formal and informal sector choice of wage earners and their wages in Turkey," in *Informal Sector I*, ed. by Tuncer Bulutay, State Institute of Statistics, 2000, Ankara. pp.125-150.
- Tansel, A. 2001. "Self-employment, wage-employment, and returns to schooling by gender in Turkey," in *Labor and Human Capital in the Middle East: Studies of Markets and Household Behavior*, ed. by Djavad Salehi-Isfahani, Ithaca Press, 2001, Reading, UK. pp.637-667.
- Tansel, A. 2005. "Public-private employment choice, wage differentials and gender in Turkey." *Economic Development and Cultural Change* 53 (2): 453-477.
- Tansel, A. 2010. "Changing returns to education for men and women in a developing country: Turkey, 1994-2005." Paper presented at the ESPE conference, June 18-21, 2008, in London, ECOMOD conference, July 2-4, 2008 in Berlin, MEEA conference, March 20-23, 2009 in Nice, France and ICE-TEA conference, September 1-3, 2010 in Girne, Republic of Northern Cyprus.
- Tansel, A. 2017. "Returns to education in turkey: IV estimates from a developing country." Paper presented at the Economic Research Forum (ERF) 23rd Annual Conference, 18-20 March 2017, Amman, Jordan.
- Tansel, A. and F.B. Bodur. 2012. "Wage inequality and returns to education in Turkey: A quantile regression analysis." *Review of Development Economics* 16 (1): 107-121.
- Tansel, A. and Y. Daoud. 2014. "Comparative essay for returns to education in Palestine and Turkey." *Perspectives on Global Development and Technology* 13: 347-378.
- Tansel, A. and E. Ö. Kan. 2016. "The formal/informal employment earnings gap: Evidence from Turkey." *Research On Economic Inequality*, Volume, F24. Editors: John A. Bishop and Juan Gabriel Rodriguez. (pp. 123-156). ISSN: 1049-2585.
- Tansel, A., H. I. Keskin and Z.A. Ozdemir. 2020. "Public- private sector wage gap by gender in

- Egypt: Evidence from quantile regression on panel data, 1998-2018.” *World Development* 135 (November).
- TCMB (Republic of Turkey Central Bank) (2018). Exchange Rate Statistics web page accessed January 2019. <https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Statistics/Exchange+Rates>
- Torun, H. 2018. “Compulsory schooling and early labor market outcomes in a middle-income country.” *Journal of Labor Research* 39 (3): 277-305.
- Trostel, P., I. Walker and P. Woolley. 2002. “Estimates of the economic return to schooling for 28 countries.” *Labour Economics* 9(1): 1-16.
- TURKSTAT (Turkish Statistical Institute). 2018. Education Expenditure Statistics web page accessed January 2019. www.tuik.gov.tr
- TURKSTAT (Turkish Statistical Institute). 2020a. Meta Information on Household Labor Force Statistics web page accessed October 2020. <http://www.turkstat.gov.tr/UstMenu.do?metod=metabilgi>
- TURKSTAT (Turkish Statistical Institute). 2020b. Labor Force Statistics web page accessed June 2020. www.tuik.gov.tr
- Vural, B.M. and Y. Gülcan. 2008. “Impact of education on individual earnings in Turkey”. *International Journal of Economic Perspectives* 2(3): 124-132.
- Webber, D. 2014. “Is the return to education the same for everybody?” *IZA World of Labor* 92 doi: 10.15185/izawol.92.
- Weisbrod, B. 1962. “Education and investment in human capital.” *Journal of Political Economy* 70(5): 106-123.
- World Bank. 2016. *Productivity dynamics in Turkey: evidence from firm-level data*. Turkey focus note. Washington, D.C.: World Bank.
- World Bank. 2005. *Turkey: Education Sector Study: Sustainable Pathways to an Effective, Equitable and Efficient Education System for Preschool through Secondary School Education*. Washington, D.C.: World Bank.

For Peer Review

Annex Table A-1: A Sampling of Previous Findings

Year	Level	Rate of return (%)		Method/sample	Source
		Private	Social		
1960	Secondary	19.0	14.0	Full discounting	Ozelli (1970)
	Higher	2.5	1.5		
1968	Secondary-general	24.0	8.5	Full discounting	Krueger (1972)
	Secondary-vocational	22.0			
	Higher	26.0			
1987	Primary	1.9		Mincerian, men, OLS	Tansel (1994)
	Middle	8.6			
	Secondary-general	8.6			
	Secondary-vocational	11.0			
	Higher	13.0			
1988	Overall	6.5		Mincerian, men	Salehi et al (2009)
1994		9.6			
2003		12.4			
1994	Males	9.0		Mincerian	Vural and Gulcan (2008)
	Females	8.0			
2004	Males	10.0			
	Females	14.0			
2003	Males	4.1		Mincerian	Guris and Caglayan (2012)
	Females	5.2			
2006	Males	2.5		Mincerian	
	Females	2.4			
1989	Primary	1.7		Mincerian, men, OLS	Tansel (2001)
	Middle	7.2			
	Secondary-general	10.1			
	Secondary-vocational	13.0			
	Higher	16.9			
1994	Primary	24.6		Full discounting, men	Kara (2008)
	Secondary-general	13.6			
	Secondary-vocational	11.3			
	Higher	13.2			
1994	Primary	6.0		Mincerian	Kara (2008)
	Secondary-general	12.0			
	Secondary-vocational	13.9			
	Higher	10.8			
1994	Primary	2.4		Mincerian, private sector, men	Tansel (2005)
	Middle	6.3			
	Secondary-general	13.3			
	Secondary-vocational	16.2			
	Higher	19.0			
1994	Overall	7.7		Mincerian	Tansel and Bodur (2012)
	Primary	4.4			
	Middle	4.1			
	Secondary-general	8.5			
	Secondary-vocational	13.3			
	Higher	14.0			

2002	Overall	7.6	Mincerian	Tansel and Bodur (2012)
	Primary	3.6		
	Middle	3.2		
	Secondary-general	7.1		
	Secondary-vocational	9.8		
	Higher	13.1		
2004	Overall	11.7	Mincerian	Tansel and Daoud (2014)
2008		11.8		
2008	Overall	10.0	Mincerian	Bakis (2012)
2011-12	Overall	0.0	Mincerian, men	Mocan (2014)
		14.0	Mincerian, women	
2009-14	Overall	9.0	Mincerian	Karatas (2018)
	Primary	2.6		
	Middle	3.9		
	Secondary-general	6.1		
	Secondary-vocational	7.3		
	Higher	16.0		
2015	Higher	31.0	9.0	Full discounting, men
				OECD (2018)

Annex Table A-2: Earnings Function Estimates, Turkey, 2017

Variable	All	Males	Females	
	OLS	OLS	OLS	Heckman ^a
Constant	7.257 (214.6)	7.315 (971.4)	7.057 (492.7)	6.095 (69.3)
Schooling	0.088 (214.6)	0.831 (182.4)	0.103 (121.8)	0.134 (44.6)
Experience	0.049 (135.3)	0.054 (126.3)	0.038 (58.0)	0.054 (33.5)
Experience ²	-0.001 (99.2)	-0.001 (96.0)	-0.001 (37.0)	-0.001 (24.7)
<i>First stage</i>				
NKIDS				-0.119 (29.0)
Constant				-2.168 (119.9)
Schooling				0.106 (94.1)
Experience				0.056 (70.1)
Experience ²				-0.001 (72.7)
Lamda (IMR)				0.382 (11.1)
Rho				0.627
R ²	0.37	0.39	0.39	
N	97,050	68,726	28,324	28,324

Source: 2017 HLFS.
Notes: Dependent variable is the natural logarithm of annual earnings in \$US. Experience is potential experience. NKIDS is the number of children under 15 years of age in the household. t-(or z) statistics are provided in the parenthesis. All coefficients are statistically significant at the 1% level or better. a. STATA run on the female sub-sample: heckman ylog s ex exsq, select(NKIDS(number of children under 15 years of age) s ex exsq) twostep

**Annex Table A-3: OLS Estimates of Earnings Functions by
Sector of Employment and Secondary School Curriculum, Turkey, 2017**

Variable	Sector of employment	
	Public	Private
Constant	7.612 (491.9)	7.512 (919.0)
Schooling	0.079 (89.2)	0.065 (124.5)
Experience	0.048 (63.6)	0.042 (103.4)
Experience-squared	-0.001 (43.5)	-0.001 (84.3)
R-squared	0.35	0.28
Number of observations	22,876	74,176

Source: 2017 HLFS

Notes: Dependent variable is the natural logarithm of annual earnings in \$US.
Experience is potential experience, t- statistics are provided in the parenthesis
and all coefficients are statistically significant at 1 percent level or better.

Annex Table A-4: Returns to Education from IV using 1997 Reform: Turkey, 2017

	Females	Males
Constant	5.876 (58.6)	5.016 (43.3)
Schooling	0.112 (12.9)	0.180 (16.6)
Age	0.067 (33.6)	0.086 (65.0)
Age-squared	-0.001 (15.0)	-0.001 (35.8)
Number of observations	28,324	68,726
Wald chi2(3)	3315.500	7625.9
Prob > chi2	0.000	0.000
Root MSE	0.527	0.626
<i>First stage</i>		
Constant	6.506 (15.9)	7.556 (30.4)
Age	0.330 (18.1)	0.162 (14.4)
Age-squared	-0.006 (28.5)	-0.003 (20.7)
Instrument (reform)	1.481 (13.6)	0.922 (14.3)
R-squared	0.159	0.044
Partial R-squared	0.007	0.003
Number of observations	28,324	68,726
F-statistic	186.1	205.7
P-value	0.000	0.000
Root MSE	4.444	4.001

Source: 2017 HLFS

Notes: Dependent variable is the natural logarithm of annual earnings in \$US, z- and t- statistics are provided in parentheses; all coefficients are statistically significant at 1 percent level or better

Annex Table A-5: Extended Earnings Function, Turkey, 2017

Variable	Coefficient	<i>t</i> -value
Constant	7.743	(880.1)
<i>Educational level:</i>		
Primary	0.145	(17.9)
Middle	0.291	(33.8)
Secondary-general	0.487	(54.0)
Secondary-vocational	0.535	(60.3)
University-short	0.781	(84.2)
University-4 years	1.065	(122.6)
Masters/PhD	1.504	(134.2)
Experience	0.041	(115.8)
Experience-squared	-0.001	(89.3)
R ²	0.43	
N	97,050	

Source: 2017 HLFS

Notes: Dependent variable is log annual earnings in US dollars; omitted education dummy is those with less than primary; experience is potential experience; all coefficients are statistically significant at the 1% level or better