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A PSEUDO PANEL ANALYSIS OF THE RETURNS TO FIELD OF STUDY

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This study employs pseudo-panel fixed-effects approach to estimate the returns to field of study in Turkey. Repeated cross sections of Turkish Labor Force Surveys between 2016-2019 are used. Year of birth and region are used as grouping variables. The results indicate significant earnings differences across field of study when cohort-fixed effects are controlled. Relative to the base field, Education Sciences, there are higher returns to Environmental Sciences & Mathematics & Statistics and Engineering & Manufacturing & Architecture and Health & Welfare. On the other hand, there are lower returns to Social Sciences & Journalism. The earnings differences are insignificant for the fields Art & Humanities & Languages and Business Administration & Law and Agriculture & Veterinary.

Keywords: Returns to field of study, pseudo-panel, Turkey

JEL Classification: C23, I26, O53

1. Introduction

Returns to formal education is an extensively accepted issue in the economics literature. Related with this topic, earnings differences across fields of study has received increasing attention with data availability. Most empirical studies indicate field of study as an important determinant of earning levels.

Turkey has been experiencing a transition period as a result of the so-called policy of "a university in every city" since 2006, which contributed to the number of workers with tertiary education to increase dramatically in the labor market. As a result of this fact, the significance of having a tertiary degree as an indicator of earnings differentials started to weaken and the field of study emerged as an important indicator to explain earnings differentials. This study employs pseudo-panel fixed-effects approach to estimate the returns to field of study in Turkey between 2016 and 2019 using Household Labor Force Surveys. The results indicate significant earnings differences across field of study when cohort-fixed effects are controlled.

The importance of the topic is twofold. First, significant wage differentials across different fields are important for an individual's subject choice at university. Second, education policies taking into account these differentials would allocate the resources to tertiary education more effectively.

This study relates to two strands of the literature. First, it relates to the returns to different fields of study. Daymont and Andrisani (1984), Altonji (1993), Rumberger and Thomas (1993) have constructed the theoretical basis for the returns to different field of study. It has been possible to analyze earnings differences across fields of study empirically with data availability. Blundell et. al. (2000), Finnie and Frenette (2003), Arcidiacono (2004), O'Leary and Sloane (2005), Kelly et. al. (2010), Grave and Goerlitz (2012), Altonji et al. (2014) are among empirical

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studies that analyze wage differentials across fields. Major findings of these studies imply significant differences in returns by different fields of study.

Second, in terms of methodology, it relates to the construction and estimation of pseudo-panel models. The pioneering study of Deaton (1985) suggests the use of repeated cross sections in the lack of genuine panel data. Warunsiri and McNown (2010), Himaz and Aturupane (2016), Karataş (2018), Güriş and Kaya (2019) Alvi and Dendir (2020) and Kemelbayeva (2020) are among the studies employing pseudo-panel approach to estimate returns to schooling, mainly for developing countries due to the lack of genuine panel data.

This study adds to the literature by providing estimates on the returns to field of study in Turkey between 2016 and 2019. As far as I am concerned, Di Paolo and Tansel (2017) is the only study that analyzes wage differentials by field of study in Turkey.[1] This study differs from Di Paolo and Tansel (2017) in two respects. First, the time period is more recent than the time period used in their study (2009-2015). Second, this study employs a different methodological approach to estimate the returns to field of study.

The rest of the paper is organized as follows: In Section 2 the empirical specification is explained. In Section 3, I describe the data and present some descriptive statistics. The estimation results are presented and discussed in Section 4. Section 5 concludes.

2. Empirical specification

The multivariate relationship between earnings and field of study can be estimated by a modified version of the Mincerian (1974) earnings function:

$$\log(w_{i)} = \beta_0 + \beta_1 X_i + \beta_2 F_i + \varepsilon_i \quad (1)$$

where $\log(w_i)$ is the logarithm of the hourly wages, X_i is a vector of human and job characteristics and F_i is a set of field of study dummy variables. This model is estimated by individual level cross sectional data. When a genuine panel data is available, the below model can be estimated:

$$\log(w_{it}) = \beta_0 + \beta_1 X_{it} + \beta_2 F_{it} + \alpha_i + \varepsilon_{it} \quad (2)$$

where subscripts i and t represent individuals and time periods, respectively. However, individual level panel data is seldom available for developing countries. This fact restricts the use of time dimension included methodologies for analyzing the returns to field of study for developing countries. In the absence of genuine panel data, Deaton (1985) suggests the use of repeated cross sections to aggregate individuals into fixed groups where in each group all individuals share the same chosen characteristics. Groups that satisfy some conditions are

[1] Eriş Dereli (2019) is a study about the returns to college major, however differently from this study it analyzes the returns to overeducation by college major.

constructed and group averages of variables in each period are treated as observations. A pseudo-panel version of the Mincerian model can be written as:

$$\overline{\log(w_{ct})} = \beta_0 + \beta_1\overline{X_{ct}} + \beta_2\overline{F_{ct}} + \overline{\alpha_{ct}} + \overline{\varepsilon_{ct}} \quad (3)$$

where c represents cohorts (groups) and each variable represents the mean of all individuals in a cohort c at time t. $\overline{\alpha_{ct}}$ is now the average cohort effect for a given cohort c at time t. This cohort effect is still time-varying and unobservable. However Verbeek (2008) argues that if there is a sufficiently large (greater than 100) cohort size, cohort effect can be treated as a fixed unknown parameter with $\overline{\alpha_{ct}} = \alpha_c$ over time. With fixed cohort effect, the model is rewritten as:

$$\overline{\log(w_{ct})} = \beta_0 + \beta_1\overline{X_{ct}} + \beta_2\overline{F_{ct}} + \alpha_c + \overline{\varepsilon_{ct}} \quad (4)$$

This equation is the benchmark of the pseudo-panel analysis in this study and can be estimated by (cohorts) fixed effects methodology. The error term can be assumed normal and independent. Homoscedasticity of the error term requires fixed cohort size over time. If the cohorts are different in size, Deaton (1985) states that heteroscedasticity should be corrected by weighting each cell with the cohort size's square root.

3. Data

The data come from a series of four repeated cross sections of the Turkish Household Labor Force Surveys between 2016-2019. [2] Turkish Household Labor Force Surveys comprise rich information at individual level. However genuine panel data cannot be constructed by Labor Force Surveys, as same individuals are not followed. Due to the lack of genuine panel data, below Mincerian equation in the pseudo-panel form is estimated:

$$\overline{\log(w_{ct})} = \delta + \beta_0\overline{age_{ct}} + \beta_1\overline{age_{ct}^2} + \beta_2\overline{female_{ct}} + \beta_3\overline{married_{ct}} + \beta_4\overline{divorced_{ct}} + \beta_5\overline{private_{ct}} + \beta_6\overline{medium_{ct}} + \beta_7\overline{large_{ct}} + \beta_8\overline{field1_{ct}} + \cdots + \beta_{14}\overline{field7_{ct}} + \alpha_c + \overline{\varepsilon_{ct}} \quad (5)$$

where log(w) is the natural log of real hourly wages, age is individual's age, age^2 is the age-squared, $female$ is a dummy variable which takes the value 1 if the individual is female and 0 otherwise, $married$ is a dummy variable which takes the value 1 if the individual is married and 0 otherwise, $divorced$ is a dummy variable which takes the value 1 if the individual is divorced or widowed and 0 otherwise, $private$ is a dummy variable which takes the value 1 if the individual is employed in private sector and 0 otherwise, $medium$ is a dummy variable which takes the value 1 if the individual is employed in a medium-sized firm and 0 otherwise, $large$ is a dummy variable which takes the value 1 if the individual is employed in a large-

[2] The starting year is restricted with the availability of consistent field of study series.

sized firm and 0 otherwise and the variables $field1$ to $field7$ are separate dummy variables for the field of study that an individual was educated in and and ε is the error term[3]. c represents cohorts (groups) and each variable is in the form of mean of all observations in a cohort c at time t.

The repeated cross sections are used to construct pseudo panels based on two different pseudo-cohorts. The grouping variables for the first pseudo-cohort are year of birth and region[4] and the first cohort ends up with 215 (43*5) cells[5] in each year. The average number of observations per cell is 841. The grouping variables for the second pseudo-cohort are of birth year of two-year intervals and regions and the second cohort ends up with 105 (21*5) cells[6] in each year. The average number of observations per cell is 876. The sample of the study consists of tertiary-educated wage earners aged between 25 and 64, working in a non-agriculture sector at the time of the survey.

The dependent variable is logarithm of real hourly wages, however hourly wages are not directly observed in the surveys. Instead, monthly earnings from the main job activity are reported. Making use of the information on monthly earnings, hourly wages are estimated through Equation 6. Then all wages are converted to 2016 constant prices using suitable GDP deflators.

$$hourly\ wage = (monthly\ earnings * 12)/(weekly\ actual\ working\ hours * 52) \qquad (6)$$

The covariates of interest are age, gender, marital status, private/public sector distinction, firm size and field of study. The fields of study are classified using the International Standard Classification of Education 2013 (ISCED−13) system and there are 22 distinct fields. The fields are aggregated to 10 distinct categories due to sample size reasons.[7]

Tables 1 and 2 present the field distribution in my sample and average hourly wages associated with each field, respectively.[8] With approximately 28% share, Business Administration & Law emerges as the largest field, followed by Education Sciences and Engineering & Manufacturing. Agriculture & Veterinary and Services and Environment sciences & Mathematics & Statistics are the smallest fields, at below 5%. From Table 2, it is observed that wage distribution display varying results for different fields. The average hourly wage ranges between 16.34 and 17.26 Turkish Liras between 2016 and 2019. Average hourly wages are highest for Health & Welfare and Education Sciences graduates and lowest for Business Administration & Law graduates in all years.

[3] The reference categories for marital status, firm size and the field of study are single, small and Education Sciences, respectively.

[4] Individuals born between 1952 and 1994 are included in the sample. The regions are İstanbul, East Marmara, Coastal, Central Anatolia and East.

[5] Cells with observations less than 100 are dropped and 852 cells remain for the first cohort for the whole period.

[6] Cells with observations less than 100 are dropped and 417 cells remain for the second cohort for the whole period.

[7] Table A1 in the Appendix provides summary statistics on all variables for the pseudo-panels.

[8] Figure A1 presents boxplots of hourly wages by field of study in 2016 and 2019.

Table 1: Distribution of field of study

	2016	2017	2018	2019
Education sciences	18.45	17.33	19.20	18.96
Arts, Humanities & Languages	8.09	8.37	7.91	7.93
Social sciences and journalism	7.81	7.68	6.96	6.90
Business Administration & Law	27.98	28.89	29.53	29.46
Environment sc, math. & stat.	4.90	4.57	3.76	3.96
Engineering, Manufacturing	15.63	15.48	15.32	15.27
Agriculture & veterinary	3.12	2.97	3.03	2.81
Health & Welfare	7.75	8.47	8.47	8.60
Services	4.88	4.79	4.40	4.64

Table 2: Average real hourly wages by field of study

	2016	2017	2018	2019
Education sciences	19.88	19.58	18.72	19.98
Arts, Humanities & Languages	17.36	16.57	15.90	16.89
Social sciences and journalism	17.26	16.80	16.02	16.66
Business Administration & Law	15.18	14.98	14.49	15.08
Environment sc, math. & stat.	19.17	18.79	18.18	18.75
Engineering, Manufacturing	16.44	16.02	15.82	16.23
Agriculture & veterinary	16.73	16.65	16.27	16.68
Health & Welfare	21.59	20.82	19.85	19.74
Services	15.18	15.54	15.29	15.93
Average	17.26	16.89	16.34	17.01

4. Results

The results on the impact of field of study, controlling for cohort-fixed demographic and job characteristics, on wages are reported in Table 3. Columns 1 and 2 present the results for the pseudo-panel specification where year of birth and region and then birth year of two-year intervals and region are grouping variables, respectively. The pseudo-panel models are estimated using Equation 5 with a fixed-effects methodology[9] and both include industry and time dummies to capture the industry-fixed and yearly-fixed effects.

The results indicate significant earnings differences across field of study. When the proportion of individuals who have completed their studies from Social Sciences & Journalism field with respect to Education Sciences within specified cohorts increase, the average hourly wages decrease significantly. If the proportion of individuals in a pseudo-cohort graduated from Social Sciences & Journalism field increases by one unit, than average hourly wages is expected to

[9] The model is estimated using OLS methodology including cohort-fixed effects since the square root of cohort sizes need to be included as weights and the panel fixed-effects methodology does not let inserting weights.

decrease approximately by 25% for that cohort. On the other hand, when the proportion of individuals who have completed their studies from the fields of Environmental Sciences & Mathematics & Statistics and Engineering & Manufacturing & Architecture and Health & Welfare with respect to Education Sciences within the specified cohort increase, the average hourly wages increases significantly. For example, if the proportion of individuals in a pseudo-cohort graduated from Engineering & Manufacturing & Architecture increases by one unit, than the average hourly wages is expected to increase by 7% for that cohort due the results in column 1.The effect of the change in the proportion of individuals who have completed their studies from the fields of Art & Humanities & Languages and Business Administration & Law and Agriculture & Veterinary with respect to Education Sciences is insignificant.

The effects of the other covariates in both specifications are robust. The earnings effect of age is concave. As the proportion of married and divorced or widowed workers in comparison with single workers within a specified cohort increase, the average hourly wages in that cohort increase. This significant positive effect holds for the proportion of workers employed in private sector in comparison with workers in public sector. The increase in the share of female with respect to the share of male in a cohort increases, the average hourly wages in that cohort decreases. The effect of firm size is insignificant.

Table 3: Returns to education by field of study

	(1)	**(2)**
Age	0.08***(0.01)	0.08***(0.01)
Age-squared	-0.003***(0.001)	-0.003***(0.001)
Female	-0.14**(0.06)	-0.16*(0.09)
Married	0.14**(0.06)	0.17***(0.09)
Divorced/widowed	0.35**(0.14)	0.54***(0.20)
Private	0.32***(0.08)	0.46***(0.12)
Medium	0.06(0.09)	0.09(0.13)
Large	0.22***(0.07)	0.07(0.09)
Arts, Humanities & Languages	-0.07(0.10)	-0.01(0.16)
Social sciences and journalism	-0.25**(0.10)	-0.26*(0.14)
Business Administration & Law	-0.10(0.09)	-0.19(0.11)
Environment sc, math. & stat	0.36***(0.13)	0.61***(0.21)
Engineering, Manufacturing & Architecture	0.07**(0.03)	0.26**(0.12)
Agriculture & veterinary	-0.03(0.17)	-0.25(0.19)
Health & Welfare	0.24*(0.13)	0.52***(0.18)
Observations	852	417
R-squared	0.775	0.676

5. Conclusion

The main purpose of this study is to analyze the returns to field of study in Turkey between 2016 and 2019 using a pseudo-panel approach. The results indicate significant earnings differences across field of study. This result is important when considerations about an individual's subject choice at university are taken into account. Another policy-relevant aspect of the findings is related with education policies aimed at effectively allocating the resources to tertiary education designing. Both implications are important when the rapid growth of the tertiary education and number of graduates with a university degree in Turkey are considered.

This study entails further improvements like defining different pseudo-cohorts, using different time periods, analyzing the returns through the wage distribution and inclusion of further covariates to the earnings function. Still, it contributes to the literature in terms of using a very recent dataset and employing a different methodological approach to estimate the returns to field of study.

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Appendix

Table A1: Summary statistics

	Pseodo-cohort1	**Pseudo-cohort2**
Hourly wage	2.726 (0.25)	2.768 (0.266)
Age	37.5 (8.448)	41.916 (11.614)
Female	0.396 (0.091)	0.352 (0.125)
Single	0.245 (0.256)	0.212 (0.26)
Married	0.719 (0.239)	0.745 (0.243)
Divorced/widowed	0.037 (0.035)	0.042 (0.039)
Private	0.448 (0.225)	0.411 (0.23)
Public	0.544 (0.225)	0.582 (0.231)
Small	0.2 (0.074)	0.197 (0.074)
Medium	0.086 (0.039)	0.081 (0.039)
Large	0.714 (0.092)	0.722 (0.093)
Education Sciences	0.171 (0.071)	0.185 (0.089)
Arts, Humanities & Languages	0.085 (0.036)	0.088 (0.036)
Social sciences and journalism	0.08 (0.041)	0.085 (0.044)
Business Administration & Law	0.294 (0.065)	0.272 (0.078)
Environment sc, math. & stat	0.044 (0.023)	0.044 (0.024)

ICT	0.012 (0.015)	0.01 (0.014)
Engineering, Manufacturing & Architecture	0.159 (0.056)	0.158 (0.056)
Agriculture & veterinary	0.029 (0.023)	0.03 (0.024)
Health & Welfare	0.079 (0.037)	0.083 (0.04)
Services	0.047 (0.031)	0.045 (0.029)

Notes: Means of variables with standard deviations in parenthesis are given.

Figure A1: Hourly wages by field of study, 2016 & 2019