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Added value of post-secondary education in Estonia

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Abstract

Education is seen in the human capital literature as one of the determining factors for labour market outcomes (Blázquez et al., 2018), measured through multiple variables. The aim of the current study is to examine the change in the earnings of graduates from Estonian post-secondary education institutions. This is achieved by comparing graduates who had studied from 2013 to 2016 in four fields: engineering, information technology, economics and natural sciences. To assess the change in pre- and post-entry earnings difference-in-differences regression was used. The results indicate there are differences between disciplines in terms of added value. In economics gender differences have the smallest and entrepreneurial activities the largest impact for the change in earnings. The study contributes to our understanding of added value of post-secondary education by combining educational, tax and social data, and analysing the change in graduates' earnings pre- and post-entry.

Keywords: *Earnings; Estonia; Labour market success; Post-secondary education; Value added.*

1. Introduction

Education is seen in the human capital literature as one of the determining factors for labour market outcomes (Blázquez et al., 2018). In order to analyse and predict the post-secondary education (PSE) graduates' success in the labour market a combination of data sources has been used, including self-reported data, tax data and educational data. Graduates' earnings are a measure of the added value of education (Cunha & Miller, 2014), utilised for assessing the quality of education (Milla et al., 2016).

Previous studies have focused mainly on the comparison of the earnings of the graduates' groups. Thus, it has been found that the earnings of graduates from engineering, mathematics and computer science, and business dominate over other fields (Finnie, 2016). In addition, women's earnings tend to be lower across all levels of educational attainment (Behr & Theune, 2016; Bredtmann & Otten, 2014), related to gender differences in different sectors and the types of occupation (OECD, 2018).

The primary aim of the current study is to examine the change in earnings of graduates from Estonian PSE institutions. The additional aims were to build a platform for further research into graduates' earnings and demonstrate the feasibility of linking educational, tax and social data. This was achieved by analysing the earnings of people who had studied from 2013 to 2016 in four fields: engineering, information technology, economics (with synthetic knowledge base) and natural sciences (with analytic knowledge base). Difference-in-differences regression was used to assess change in pre- and post-entry earnings.

The results indicate there are differences between areas in terms of added value of post-secondary education. In natural sciences studying while working leads to the largest decrease in earnings. In economics gender differences are the smallest as being male has the least significance for increased earnings, but entrepreneurial activity in the form of earning dividends has the largest. The study contributes to our understanding of added value of PSE by combining data from different sources, i.e. linking educational, tax and social benefits data, and analysing change in graduates' pre- and post-entry earnings.

The rest of the paper is structured as follows. The subsequent section provides an overview of previous studies addressing added value in PSE. Then the overview of research methodology is presented, followed by analysis results. The results are discussed and conclusions drawn in the final part of the paper.

2. Literature review

The human capital literature indicates the positive returns of education for the labour market experience (Blázquez et al., 2018), although a number of factors other than education also play a role in individuals' earnings. Graduates' earnings are a measure of the

added value of education (Cunha & Miller, 2014) or one of the numerous variables to develop a methodology for assessing the quality of education from post-secondary education institutions (Milla et al., 2016).

The tax linkage approach entails linking PSE (post-secondary education) institutions' administrative information to income tax data in order to track and analyse graduates' labour market outcomes. This approach is becoming a standard in the analysis of PSE graduates' earnings in the OECD, which was developed an initial tax linkage project that appeared in the Education at Glance in the fall of 2016 (Finnie et al., 2018).

Recently researchers from the University of Ottawa linked institutional records with income tax data to track the earnings of graduates from 14 colleges and universities in four provinces. The main findings that engineering, mathematics & computer science, and business graduates generally had higher incomes and greater earnings growth than others (Finnie, 2016). It has been also found that in many countries, earnings are systematically lower for women than men across all levels of educational attainment (Behr & Theune, 2016; Bredtmann & Otten, 2014). This may be related to gender differences in the sectors where they work and the types of occupation (OECD, 2018). The current study looks at the change in earnings pre-and post entry to PSE institutions, rather than analysing the total earning of different graduates' groups.

The economic sectors differ in terms of the dominating knowledge base leading to differences in the innovation process. Previous research has distinguished between analytic, synthetic and symbolic knowledge base (Asheim & Gertler, 2005; Asheim, 2007; Tödtling & Grillitsch, 2014), resulting in different knowledge sources, patterns of cooperation and innovation outcomes. The current study employs the divide between sectors with analytic and synthetic knowledge base by including natural sciences as an example of the former and engineering, information technology, economics representing the latter.

3. Methodology

The study is designed as analysis of secondary statistics. In order to examine the added value of PSE the information from the following state registries was combined: Estonian Education Information System, Tax and Customs Board, Social Insurance Board and Unemployment Insurance Fund. The sample included 7278 graduates from 16 PSE institutions in Estonia, who had started their studies in 2013 and graduated in 2016 (Table 1). Their earnings (in real value, adjusted according the change of index of consumer prices) covered the period from 2012 to 2017. Four areas: engineering, information technology, economics and natural sciences were compared.

Table 1. Sample overview.

	Engineering	Information technology	Economics	Natural sciences	Total
Tallinn University of Technology (TalTech)	1155	460	1038	207	2860
Other PSE institutions	341	577	2769	731	4418
Total	1496	1037	3807	938	7278

Source: Authors' calculations.

In order to assess the impact of obtaining PSE for earnings difference-in-differences (DID) method was used. A DID estimator requires repeated observations of the treated and nontreated groups. Whereas the before-after estimator compares the outcomes of the treated group after the change to the outcomes before the change, the DID estimator eliminates common time trends by subtracting the before-after change in the non-treated outcomes from the before-after change for the treated outcomes (Caliendo & Hujer, 2005). DID integrates the advances of the fixed effects estimators with the causal inference analysis when unobserved events or characteristics confound the interpretations (Villa, 2012).

The numerical value of the DID estimator can be obtained from a regression formulation. Let *Tt* be a time dummy that switches on for observations obtained after the policy change and *di* be a dummy for people in the treatment group.

$$y_{it} = \alpha X_{it} + \beta_1 d_i + \beta_1 T_t + \gamma(d_i * T_t) + u_{it}$$

This model includes two main effects for treatment and time and an interaction term indicating treatment status, which is a dummy variable that marks observations from treated subjects after policy change. The coefficient γ in front of it indicates the treatment effect. This kind of regression formulation of the DID model offers a convenient way to construct DID estimations with standard errors (Angrist & Pischke, 2009).

The relationship between earnings and education was assessed using ordinary least squares (OLS) method. The assessments were based on Mincer's earnings formula, which pre-supposes that dependent variable or earnings is exponentially increasing function regarding independent variables (Humphreys, 2013). The assessments of coefficients in Mincer's earnings formula indicate by which percentage income increases/decreases, in case respective independent variable changes by one unit. Mincer's earnings formula takes the following form:

$\ln(wage_{it}) = \alpha X_{it} + \beta_1 University_i + \beta_1 PostEntry_t + \gamma(University_i * PostEntry_t) + u_{it}$

Where $\ln(wage_{it})$ is individual i's the natural logarithm of wage in period t and X_i is a vector of control variables.

The regression model included comparison of treated and nontreated groups' indicators before and after the change:

- Dummy variables regarding treated and nontreated groups and time period (pre- and post-entry);
- Interaction term: impact of studying at Tallinn University of Technology ($University_i * PostEntry_t$).

4. Results

The change in earning pre- and post-entry is statistically significant only in economies (6.8% increase). Although not statistically significant, it was the lowest in natural sciences (0.3%).

In terms of demographics, holding all other variables constant the results of the analysis indicate increases in age and being male provide higher earnings post-entry in all areas: engineering, information technology, economics and natural sciences (Table 2). Age leads to increased earnings especially in engineering (36.6%), but also in natural sciences (32.9%). Being male is the least important in economics in terms of post-entry added value (6.2%). The number of children is statistically significant only in engineering, where having more children leads to lower post-entry earnings.

Regarding activity rate of persons and the types of activities, studying in parallel to working leads to lower earnings in all areas under study. The effect is the most pronounced in natural sciences (46.7%). The same applies as could be expected to being unemployed or looking for a job, which means it leads to a lower earnings (except in natural sciences where the results are not statistically significant). Various family benefits (incl. family allowance and parental support) and social benefits (either provided by the state or local government) also lead to lower post-entry earnings, as these measures are designed to substitute for the lack of earnings, namely in information technology and economics.

Entrepreneurship-related activities assessed via two proxies: earning dividends and being self-employed, have different impact. When earning dividends (consisting of dividend income and equity disbursements) leads to higher post-entry earnings in information technology and economics, the impact of being registered as a self-employed person is not statistically significant in any of the areas. Earning dividends is, however, especially important for higher post-entry earnings in economics (34.1%).

University context also plays a role regarding the added value. Having studied in TalTech (the only university of technology in the country) leads to higher earnings in two areas: information technology and economics, while in engineering and natural sciences studying in other HEIs provides a larger increase in earnings. Studying in TalTech has led to increased earnings in information technology to the extent of 29.4% and in economics 11.5%.

Table 2. Difference-in-differences assessments by areas.

	Engineering	**Information technology**	**Economics**	**Mathematics and natural sciences**
	Coefficient	**Coefficient**	**Coefficient**	**Coefficient**
Age in given year	0.366*** (0.026)	0.285*** (0.033)	0.278*** (0.012)	0.329*** (0.055)
Age squared	-0.005*** (0)	-0.004*** (0.001)	-0.003*** (0)	-0.005*** (0.001)
Gender (female vs male)	-0.245*** (0.037)	-0.233*** (0.055)	-0.062** (0.031)	-0.214*** (0.06)
No. of children	-0.131** (0.052)	-0.018 (0.047)	-0.04 (0.025)	0.025 (0.146)
Studying	-0.296*** (0.045)	-0.386*** (0.053)	-0.252*** (0.028)	-0.467*** (0.082)
Unemployed	-0.201** (0.083)	-0.418*** (0.132)	-0.161*** (0.052)	0.035 (0.129)
Receiving family allowance	0.076 (0.076)	-0.121 (0.094)	-0.233*** (0.039)	0.087 (0.119)
Receiving parental benefit	-0.233 (0.414)	-0.781*** (0.268)	-0.211** (0.085)	-
Receiving state social benefits	-0.085 (0.232)	-0.525*** (0.136)	-0.238* (0.124)	-0.236 (0.339)
Receiving local government social benefits	0.062 (0.122)	0.019 (0.121)	-0.1* (0.059)	0.074 (0.136)
Self-employed person	0.21 (0.327)	-0.055 (0.541)	0.058 (0.179)	0.009 (0.852)
Receiving income from dividends	-0.043 (0.096)	0.2* (0.112)	0.341*** (0.066)	0.266 (0.183)
Constant	1.037*** (0.392)	2.433*** (0.481)	2.02*** (0.19)	1.638* (0.787)
PostEntry (=1 since 2014)	0.092 (0.092)	0.059 (0.078)	0.068** (0.035)	0.003 (0.087)
University (=1 if TalTech)	0.05 (0.086)	-0.035 (0.095)	0.027 (0.054)	-0.124 (0.136)
DID (=1 if University=1 & PostEnry=1))	0.08 (0.099)	0.294*** (0.11)	0.115* (0.063)	0.045 (0.156)
R2	0.415	0.413	0.378	0.235
F-statistic (p-value)	69.913 (0.000)	45.94 (0.000)	153.599 (0.000)	20.201 (0.000)
Observations	1496	1037	3807	938

Source: Authors' calculations. Note: ***p<0.01, **p< 0.05, *p<0.1

These results are robust to the choice of control variables. We also split the graduates into age (up to 24 and above) and wage groups. The results indicate significant differences for pre- and post-entry earnings for the under 24 years old group, but not for wage groups.

5. Discussion and conclusion

The paper aimed primarily at examining the change in earnings of graduates from Estonian post-secondary institutions. The additional aims included building a research platform for further research into graduates' earnings and demonstrating the feasibility of linking educational, tax and social benefits data.

The results indicate there are differences between areas in terms of pre- and post-entry earnings. In engineering, holding all other variables constant, older age, being male and having smaller number of children, provide higher post-entry earnings. Studying and being unemployed leads to decrease in earnings. Having studied natural sciences is to some extent similar to graduating from engineering, although they don't share a similar knowledge base (Asheim & Gertler, 2005). What is unique for natural sciences is that in this area studying while working leads to the largest decrease in earnings, indicating the difficulties in accommodating studies and work life.

Information technology and economics differ from engineering and natural sciences as receiving social and family benefits leads to decrease in earnings in these areas, whereas earning dividends leads to an increase. In information technology and economics, also having graduated from TalTech leads to larger increase in earnings. Economics is, however, different from the other areas in terms of the significance of gender as being male has the least significance for increased earnings and earning dividends has the largest.

The study contributes to our understanding of added value of PSE by combining data from different sources and linking educational, tax and social data. It examines the change in earnings pre- and post-entry, rather than analysing the total earnings of different graduates' groups. The study also offers implications for future research. Further studies should examine in more detail the differences between study levels (bachelor, master and doctoral) and include additional fields (with symbolic knowledge base). Also, work experience and academic excellence data was unavailable for the current study, but further studies should include the length of work experience and graduates' abilities.

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