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Heterogeneity in Labor Market Returns to Adult Education

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Abstract

We study the earnings and employment effects of enrollment in formal adult education in Finland using a combination of matching and panel data methods. We also conduct cost-benefit analyses.

The results show that adult education increases earnings and employment both in secondary and higher education, but the magnitude depends on the original level of education. The earnings and employment effects are the largest for the less educated group (those with only compulsory education). For those already having a degree from higher education, the employment and earnings effects are small.

There is substantial heterogeneity behind the average effects. The earning gains differ by field and type of education both in secondary and higher education.

Cost-benefit analysis shows that at the individual level, the benefits exceed the costs for those with compulsory and secondary education but not for those with higher education. When the societal costs and benefits are considered, we find that the benefits exceed the costs mostly when the individuals upgrade their level of education and are young enough.

The results suggest that public investments in adult education should be carefully targeted. This could for example mean targeting individuals who upgrade their qualifications.

Tiivistelmä

Aikuiskoulutuksen työmarkkinavaikutukset ovat heterogeenisiä

Aikuiskoulutus on osa jatkuvan oppimisen kokonaisuutta, jolla pyritään vastaamaan teknologisen kehityksen ja globalisaation aiheuttamaan murrokseen työmarkkinoilla. Ei ole kuitenkaan selvää, kuinka hyvin aikuiskoulutus auttaa murrokseen sopeutumisessa, sillä aikuiskoulutuksen ansio- ja työllisyysvaikutuksia ei tunneta kovin hyvin ja erityisesti kustannus–hyötyanalyysejä on tehty vähän.

Tässä tutkimuksessa esitellään tuoreita suomalaisia tuloksia aikuisena aloitettujen tutkintojen ansio- ja työllisyysvaikutuksista. Tulokset osoittavat, että aikuisena aloitetut opinnot nostavat ansioita ja parantavat työllisyyttä. Vaikutuksissa on kuitenkin huomattavaa vaihtelua eri koulutusalojen välillä. Vaikutukset ovat suurimpia perusasteen suorittaneilla, jotka suorittavat toisen asteen tutkinnon. Pienimpiä vaikutukset ovat heillä, joilla on jo korkea-asteen tutkinto opinnot aloittaessaan.

Kustannus–hyötyanalyysit osoittavat, että tyypillisesti aikuiskoulutuksen taloudelliset hyödyt eivät riitä kattamaan sen järjestämisestä aiheutuvia kustannuksia. Perusasteen suorittaneiden osalta hyödyt ovat kuitenkin usein kustannuksia suurempia.

Yhteiskunnan koulutuspanokset tulisi kohdistaa siten, että hyödyt ovat mahdollisimman suuria kustannuksiin nähden. Tämä voisi tarkoittaa esimerkiksi kohdennusta aikuisiin, jotka pyrkivät nostamaan koulutustasoaan.

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Asiasanat: Aikuiskoulutus, Työllisyys, Ansiot

JEL: I21, I26, J31

Introduction

Technological change and globalization affect the skills demanded in the labor market because they affect occupational structures (Goos and Manning 2007, Acemoglu and Autor 2011, Goos et al. 2014) and skill requirements within occupations (Spitz-Oener 2006). These developments challenge the skills of the workforce, and life-long learning has accordingly become an important policy objective (e.g., OECD 2021). Substantial resources are devoted to life-long learning, and a large share of adults participate in education and training[1]. Increasing participation (and expenditure) in further adult education is also a widely shared goal (OECD 2019).

It is not clear that these massive investments in adult education yield positive returns. First, adult education has substantial opportunity costs due to income forgone during studying. Moreover, the time to reap the benefits is much shorter compared to youth education. Hence, the discounted life-cycle benefits of adult education may not exceed the costs.[2]

Despite the political importance of the topic, we still know relatively little about the effects of adult learning on earnings and employment (Field 2012, Midtsundstad 2019).[3] Empirical work from Finland, Sweden, and the US provides some evidence that higher education has positive earning and employment effects, but the effects are heterogeneous by gender and field of study (Hällsten 2012, Jepsen et al. 2014, Böckerman et al. 2017, Carruthers and Sanford 2018, Böckerman et al. 2019, Stevens et al. 2019). Moreover, secondary education has been shown to improve labor market performance (Stenberg 2011, Stenberg et al. 2014), especially when upgrading education level (Bennett et al. 2020). However, more credible research on the labor

[1] According to the OECD (2020, 25-26), 14% of Finnish adults participated in formal learning in 2016. The share is similar to that in the UK, Spain, and other Nordic counties, but is much higher compared to the EU average, which is around 5 percent. In monetary terms, Finland spends about 1.2 billion euros annually on secondary and tertiary education of adults (individuals over 25-years-old at the secondary level and over 30-year old at the tertiary level) (Opetus- ja kulttuuriministeriö 2021).

[2] Adult education may obviously have other important goals and objectives besides improving labor market performance (increasing health, job satisfaction, etc.). In this paper we focus on labor market outcomes. These measures are policy-relevant since adult education is typically motivated by its potential importance to employment and earnings.

[3] While it is recognized that measures of the impact of adult education on labor market outcomes are important for policymakers and individuals making decisions about educational investments (e.g. OECD 2019, Chapter 4, page 67), the quality of data is poor. For example, the OECD (2019) uses self-reported data on employment effects and wage impacts of training estimated from cross-sectional data.

market impacts of adult education is needed to determine which types of adult education improve earnings and employment outcomes and who benefits from adult education the most.

We contribute to the prior literature by exploiting the rich Finnish registry data that contains information on all types of formal education in secondary and higher education (various levels, fields, types of provision, etc.) and allows for a long follow-up period. Furthermore, we explore heterogeneity across several dimensions, such as the initial level of education, gender, and labor market status. To estimate causal effects, we use propensity score matching to create a balanced sample that we analyze with panel data methods. A similar approach has been used in many recent studies (e.g. Hällsten 2012, Böckerman et al. 2019, Cellini and Turner 2019).

We also add to the scarce literature conducting cost-benefit analysis on the adult education investment (Stenberg 2011, Stenberg and Westerlund 2016).[4] Our cost-benefit analyses consider economic benefits at three levels: individual, public sector, and social. From an individual's perspective, the benefits come from higher wages and better employment, and the costs are opportunity costs. For public finance, the effects are caused by changes in taxes and social transfers. In the Finnish system, the costs of provisions for education are also covered by the public sector. For society as a whole, we sum the individual and public sector results. These analyses provide new information on conditions when the returns to adult education exceed the costs, i.e., what type of education and for whom is education more likely to produce a positive present discounted value.

We find that formal adult education increases earnings and employment both in secondary and higher education. The earnings and employment effects are the largest for the lowest educated group (those with only compulsory education). This agrees with human capital theory, which suggests that the economic benefits of adult education are likely to be larger when education leads to qualification upgrades. For those already having a degree from higher education, the employment and earnings effects are small.

There is substantial heterogeneity behind the average effects. In secondary education, the earning gains differ by field of education (health and welfare and social science have the largest effects), by type of education (school-based education fares worse than apprenticeship training and

[4] It is also striking that cost-benefit analyses are rarely mentioned in the policy discussion. For example, recent OECD publications (2019, 2021) do not mention cost-benefit analyses at all.

vocational certificates), and by type of degree (specialized vocational degree, a type of further vocational study, has the largest wage returns). Additionally, in higher education, the earning gains differ by the field of education (health and welfare, social science, and education have the largest effects) and by type of education (degrees at higher levels tend to have higher wage returns).

Cost-benefit analyses show that at the individual level, the benefits exceed the costs for most students. The benefits of new education may never surpass the opportunity costs only for those with a higher education and entering studies as late as 55 years old. When the societal costs and benefits are considered, we find that the benefits exceed the costs mostly when the individuals upgrade their level of education and are young enough. These findings provide an important step toward guiding the decisions of individuals and governments about investments in adult education.

Related Literature

Economic returns to formal adult education have been studied in several countries in recent years. In the USA, the literature has considered community colleges. Stevens et al. (2019) study career technical education in California community colleges. They use individual fixed effects models with individual-specific trends and find large wage returns to obtaining a certificate. The results are heterogeneous by field, and the returns are largest in healthcare. Carruthers and Sanford (2018) in turn study Tennessee Colleges of Applied Technology, which offers programs aimed at adults seeking part-time training for specific skills. They also use individual fixed effects models with individual-specific trends and find that diplomas lead to significant wage and employment returns. Jepsen et al. (2014) study the economic returns to associate's degrees, diplomas, and certificates in Kentucky community colleges. Using individual fixed effects models, they find that associate's degrees and diplomas have large wage and employment returns, but certificates have much lower returns. The results vary substantially by field, and returns are larger for women. Taken together, these papers demonstrate that attending community college increases earnings, but the results are heterogeneous by field of education and gender. None of these papers contain a cost-benefit analysis to demonstrate whether the estimated benefits surpass the costs of education.

In Sweden, the adult education offered by Komvux[5] has been studied in two papers. Stenberg (2011) uses matching methods combined with individual fixed effects and finds modest wage returns for adult education in Komvux. He also conducts cost benefit analysis and shows that private benefits barely exceed the total costs. Based on this analysis, he maintains that substantial social benefits are necessary to support large investments in adult education. Stenberg et al. (2014) performs a similar exercise but focuses on older employees. They find positive wage returns for women but not for men. Their cost-benefit analysis has similar results to that of Stenberg (2011). In another paper concerning Sweden, Hällsten (2012) studies people with secondary education who complete a degree at the tertiary level after turning 30 years old. Using individual fixed effects methods combined with matching, he finds large employment effects and modest earnings effects if employed. He does not conduct a cost-benefit analysis.

Two recent papers consider the university of applied sciences (UAS) in Finland. Böckerman et al. (2017) study post-secondary vocational education (lower UAS degrees). Using individual fixed effects methods combined with matching, they find substantial wage and employment returns. The returns vary by field, and the largest employment effects are seen in healthcare. Böckerman et al. (2019) conduct similar analysis but consider higher vocational education (higher UAS degrees). They also find substantial wage and employment returns.

Blanden et al. (2012) study how attaining qualifications in adulthood affects individuals' earnings using data from the UK. Using fixed effects methods, they find positive wage gains for women but none for men. In another study concerning the UK, Dorsett et al. (2016) find that upgrading qualifications in adulthood increases wages for men.

Bennett et al. (2020) differs methodologically from the rest of the literature by considering a natural experiment that enabled access to high school education for adults in Norway. They find that the reform increased educational attainment and earnings for women but did not have any effects for men.

Overall, the literature shows that adult education has positive earnings and employment effects, but that the effects are heterogeneous by gender and field of study. Cost-benefit analyses are,

[5] This is a form of secondary education for adults that is offered by municipalities.

however, rare, and few of the papers try to estimate the opportunity costs of adult education. Thus, it is still an open question for whom the benefits exceed the costs.

This paper shares the methodological approach that has been popular in the recent literature, namely the combination of matching and individual fixed effects methods. We differ from the recent literature in that we do not focus on a particular type of adult education but simultaneously study all possible forms of formal adult education. We also study heterogeneity by the initial level of education, which is important for policy purposes since a particular concern is how to increase the educational attainment of those with only compulsory education (see e.g. Bennett et al. 2020). Our paper ends with a section on cost-benefit analysis, which is typically absent in the recent literature.

Adult Education Institutions

There are several institutions in Finland that support participation in adult education. All education offered by the public sector is free of charge[6], and adults can apply to all formal education. Furthermore, employees have a right to take a study leave. The Act on Study Leave gives employees the right to take a study leave for up to two years within a period of five years if the employment with the given employer has lasted for at least one year. The employee must be reinstated in the previous job with the previous terms of employment after the study leave. This law was passed in 1980.

There are also several types of financial support for adult education. For those with at least eight years of employment history, the Adult Education Allowance is available. This is an earnings-related allowance that compensates for the earnings lost during study. The allowance period varies between 2 and 15 months, and in 2017, the average monthly allowance was about 1500€ (OECD 2020, 35). Adult education allowance is thus a substantial aid for the employed. More details about the allowance and evaluation of its effectiveness can be found in Kauhanen (2021). Other forms of financial support are available from the Finnish Social Insurance Institution KELA, including a study grant, a government-guaranteed student loan, and housing allowance (subject to eligibility criteria)[7].

These features of the Finnish education system make it possible for adults to pursue new degrees. Next, we briefly outline the structure of adult learning provisions in Finland. We focus on formal education that leads to a degree, since this is our focus in the empirical analysis[8]. Although adults also actively participate in non-formal and informal education, formal education certainly constitutes the most expensive form of adult learning.

Secondary level includes general upper secondary qualification, vocational upper secondary qualification (initial vocational education), further vocational qualification, and specialist vocational qualification. Of the vocational qualifications, the further and specialist qualifications are intended for individuals who are already in the workforce. There are roughly 40–60 vocational qualifications at each level.

[6] Some small fees may be charged especially in vocational education.
[7] The amount of a study grant varies roughly between 250–350 € per month for adults and the amount of government-guaranteed student loans is about 650€ per month.
[8] For more details on the Finnish system, see OECD (2020, 40-44).

Vocational qualifications may be obtained in three ways: school-based, apprenticeship training, and vocational certificate. School-based qualification is the traditional method of provision, where learning takes place in school. Apprenticeship training mostly takes place in a workplace, although some of the learning takes place in an educational institution. Vocational certificates can be obtained by showing that the individual has the skills needed to fulfill the requirements of the certificate. This typically entails some preparatory studies in an educational institution.

In higher education, the qualifications are provided by universities and UAS. The universities are more research-oriented, whereas the UAS have a more practical orientation and tighter links to working life. The UAS offer higher vocational bachelor's and master's degrees. Vocational master's degrees have a work experience requirement. Universities offer bachelor's, master's, and doctoral degrees.

We analyze these different forms of formal education at secondary and higher levels. Next, we show how participation in adult education developed from 2000–2019.

Trends in Adult Education Participation

To set the stage, we start by showing the enrollment trends by level and type of education in 2000–2019 in Figure 1. This figure shows the number of 35–55-year-old individuals enrolling at a given level and type of education.

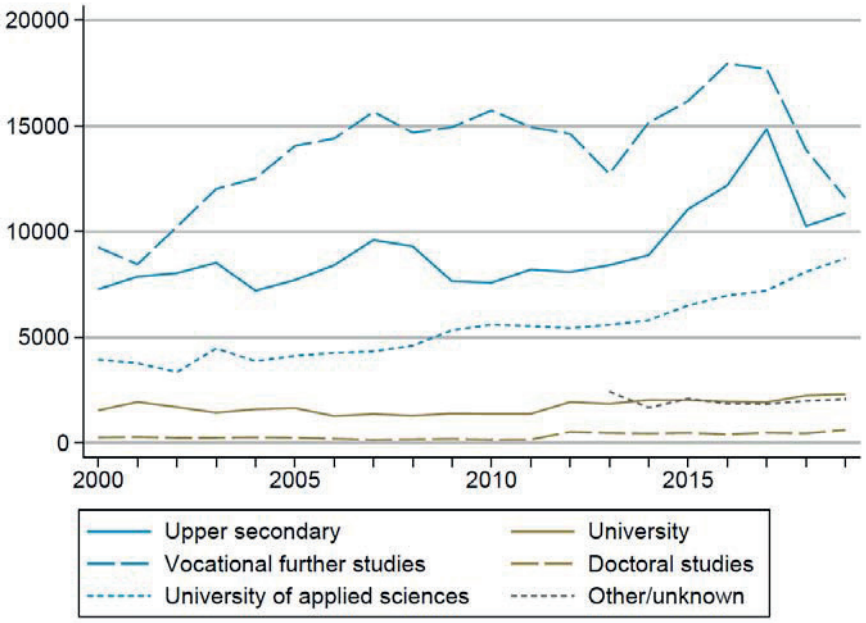

Figure 1 Enrollment trends by level and type of education

It is seen from the figure that upper secondary education and further vocational studies are the most common education alternatives among adults, and their shares rise in the time period considered. The decrease after 2017 is most likely explained by a reform of vocational secondary education that coincided with budget cuts. Enrollment in a UAS increases steadily over time, whereas enrollment at the university level is fairly flat. The category other/unknown begins only in 2013 and is stable over time.

It is important to perform separate analyses based on the educational background of students entering adult education. It has been argued that low-skill individuals may underestimate the benefits of adult education (OECD 2020, page 78), and improving possibilities for less educated individuals to upgrade their qualifications is seen as an important policy objective (Bennett et al. 2020). Hence, we might expect substantial heterogeneity based on the prior educational level.

Figure 2 shows the number of 35–55-year-old individuals enrolling at the secondary level or in higher education from 2000–2019 by their prior level of education. Secondary education includes both general and vocational upper secondary education, as well as further vocational studies (vocational degree or specialized vocational), whereas studies at a UAS or university are included in higher education.

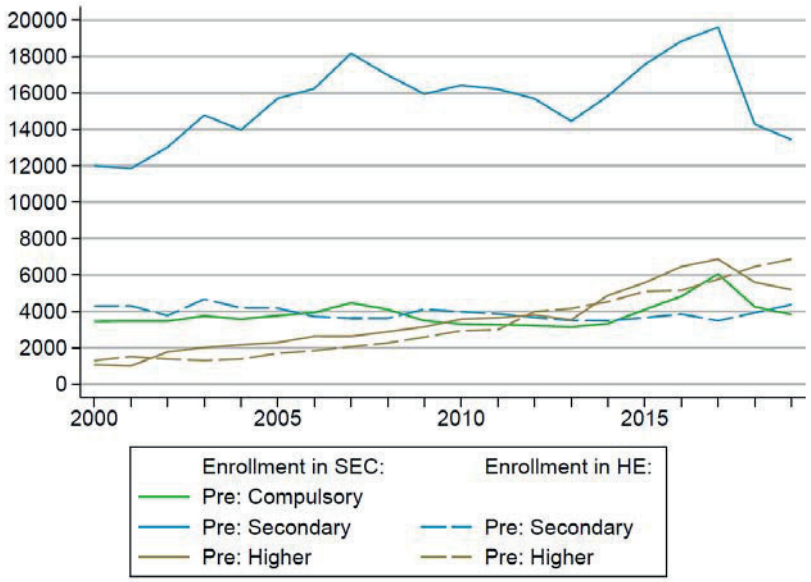

Figure 2 Enrollment trends by prior education

As seen in Figure 2, the most common groups are individuals with secondary education enrolling at the secondary level. This is partly due to the structure of vocational studies at the secondary

level; individuals having completed basic vocational education may return to complete a vocational degree or specialized vocational degree as adults. This group also grows over time, especially until 2017. The number of individuals with secondary education enrolling in higher education is quite flat over time, and the number of individuals is much smaller compared to those enrolling at the secondary level.

Individuals who have already completed higher education enroll at the secondary level and to a higher level of education just as often. Thus, roughly half of the highly educated who pursue studies as an adult do so at a lower educational level compared to their prior degree.

Individuals with compulsory education are eligible only at the secondary level, and the number of individuals is maintained at about 4000 enrollees. This group is considered the most vulnerable in the labor market, and an important policy objective is to increase the participation of this group in adult education.

Data and Sample

We use population-wide register data from Statistics Finland. The FOLK database is an individual-level annual database that contains information on earnings, employment, occupation, and demographic background variables. It also contains unique individual identifiers, which makes it possible to match the information to other data sources. All information is based on official registers and is thus reliable and accurate. We use information from 1997 to 2019.

The key dependent variables are earnings and employment. The earnings measure originates from Finnish tax authorities and includes earnings from employment and taxable social benefits[9]. Employment status is measured during the last week of the year. An individual is classified as employed if they have a valid wage and salary earner's or self-employed person's pension insurance during the last week of the year. An individual is classified as employed even though they would be studying full time if the definition of being employed is fulfilled[10].

Information on enrollment in education and the completion of degrees are available from Student and Degree Registries. These registries contain all post-compulsory enrollments and degrees at the individual level. We use this information to measure the level of education of individuals and

[9] The variable we use is called the earned income total in state taxation.
[10] An individual studying full time during the autumn term but being seasonally employed in the last week of the year would be classified as employed.

identify individuals who enroll in an educational institution. From these registries, we also obtain information on the level and field of study.

Our treatment group comprises 35–55-year-old individuals entering education from 2007–2009. We set the lower age limit at 35 to exclude youth education from the analysis. This is especially relevant for those entering higher education, since in Finland, the average age of entering higher education is quite high. We set the upper age limit at 55 years old so that retirement does not affect our analyses. This age group comprises most adult students. We focus on the years 2007–2009 to have long enough periods before and after entering education. Prior analyses have shown that long post-education periods may be needed to observe the impacts (Stenberg et al. 2014). The control group includes 35–55-year-old individuals who do not begin new studies in year *t=0*. We use a balanced panel for the period *t=–10, +10.*

Table 1 Adult education participants and total population in 2007–2009

	Years 2007–2009		**Estimation sample**	
	Enrolls in education	All 35–55 year olds	Treatment	Control
Individual characteristics				
Age	43.5	45.4	43.5	43.6
Female	0.60	0.49	0.60	0.60
Foreign-born	0.06	0.05	0.03	0.01
Mother tongue: Finnish	0.92	0.91	0.92	0.94
Mother tongue: Swedish	0.04	0.05	0.04	0.04
Mother tongue: other	0.04	0.04	0.04	0.02
Dwelling: urban	0.66	0.67	0.68	0.67
Dwelling: semiurban	0.17	0.16	0.17	0.17
Dwelling: rural	0.17	0.17	0.15	0.16
Family characteristics				
Married	0.59	0.56	0.60	0.56
Has children under age 7	0.20	0.16	0.20	0.20
Has children under age 18	0.59	0.48	0.59	0.55
Educational background				
Compulsory education	0.13	0.18	0.14	0.13
Secondary education	0.46	0.43	0.46	0.49
Further vocational education	0.23	0.19	0.23	0.21
Higher education	0.17	0.18	0.17	0.17
Doctoral studies	0.00	0.01	0.01	0.01
Employment status				
Employed	0.84	0.81	0.84	0.85
Unemployed	0.09	0.07	0.09	0.08
Student	0.03	0.02	0.03	0.02

Pensioner	0.01	0.05	0.01	0.01
Other	0.03	0.04	0.03	0.03
N	90 306	4 558 460	88 249	158 140
N per year	30 102	1 519 487	29 416	52 713

The first two columns of Table 1 show the characteristics of adult education participants (the potential treatment group) and the 35–55-year-old population (the potential control group) in 2007–2009. As seen in the table, adult education enrollees are about 2 years younger and 11 percentage points more likely to be female. They are also more likely to be married and have children. Those with only compulsory education are underrepresented in the treatment group, but the difference is not that large (0.12 vs. 0.17). Individuals with secondary and further vocational education are overrepresented in the treatment group. There are small differences with respect to employment status.

To create a more balanced sample of controls, we follow Imbens (2015) and Imbens and Rubin (2015) who suggest using matching to create an analysis sample in settings with a large number of potential controls relative to treated individuals. To generate the matched sample, we use propensity score matching on individual demographic characteristics and wage and employment histories. We match with replacement and find two matches for everyone in the treatment group. A similar approach has been used by Hällsten (2012), Böckerman et al. (2019), and Cellini and Turner (2019). The matching variables we use are gender, nationality, level, and field of education in t–1 and t–10, the outcome variables (earnings, enrollment, new degree, employment status[11]) in each year between t–1 and t–10, the average of annual working months, and months of unemployment between t–1 and t–10. The matching is done separately for individuals with different initial levels of education (compulsory, secondary, higher), levels of pursued education (secondary, higher), and year (2007 to 2009). Matching works well, and the average standardized differences are small, ranging from 0.02% to 0.74% across the different groupings[12].

The last two columns of Table 1 show the characteristics of the estimation sample for both treated and control individuals. The treatment group is a subset of those enrolling in education (shown in column 1) because to be part of the treatment group, one must have non-missing values for the matching variables. Overall, the differences between the treatment and control groups are small.

[11] Employment status can take the following values: employed, unemployed, pensioner, student, or other.
[12] These results are available upon request.

The largest differences are seen in the following variables: foreign-born, mother tongue other, married, and children under age 18. This reflects the requirement that 10 years of data is available for everyone. This decreases the number of foreign-born individuals in the sample.

Estimation

To estimate the effects of adult education on earnings and employment, we estimate fixed effects models on the matched sample. We show results from two specifications: an event-study specification and a reduced form specification. The event-study specification is useful for the cost-benefit analysis, while the reduced form specification is more practical for heterogeneity analyses.

The event-study specification we use has the following form:

$$y_{it} = \alpha_i + \tau_t + \sum_{k=-10}^{10} \beta_k D_{itk} + \sum_{j=25}^{65} \delta_j [1(age = j)]_{it} + \varepsilon_{it} \quad (1)$$

where α_i is the individual fixed effect, τ_t are year dummies, D_{itk} are leads and lags of the treatment indicator, δ_j are the coefficients on the age dummies, and ε_{it} is an error term that is clustered at the individual level. The coefficients β_k show the effect of adult education on earnings and employment when $k \geq 0$ and measure the pre-trends when $k < 0$. The key identifying assumption here is that the pre-trends are zero. We use year $t - 3$ as the comparison period. The dependent variable $y_{it}$is either enrollment, completing a degree, log earnings, or employment.

The reduced form specification has the following form:

$$y_{it} = \alpha_i + \tau_t + \beta Treat_{it} + \pi Enroll_{it} + \sum_{j=25}^{65} \delta_j [1(age = j)]_{it} + (X_{it}\gamma) + \varepsilon_{it} \quad (2)$$

where $Treat_{it}$ is a dummy variable for beginning studies in secondary or higher education (equals one for all years after enrolling in education, zero otherwise) and$Enroll_{it}$is an indicator for the years in education (equals one for the years when enrolled in education, zero otherwise). For robustness, we also explore specification with background variables, X_{it} (marital status, number of children under 7- and 18-years-old, and characteristics of the municipality of the residence). Here β measures the treatment effect of beginning studies and $\beta + \pi$ measures the opportunity cost of studying. In the reduced form specification, we concentrate on log earnings and employment as the dependent variables.

Results

We start by showing the results for the event-study specification. Figure 3 concentrates on secondary education and shows results from the event study specification by previous level of education. Here, we consider four dependent variables: enrollment, completing a degree, log earnings, and employment.

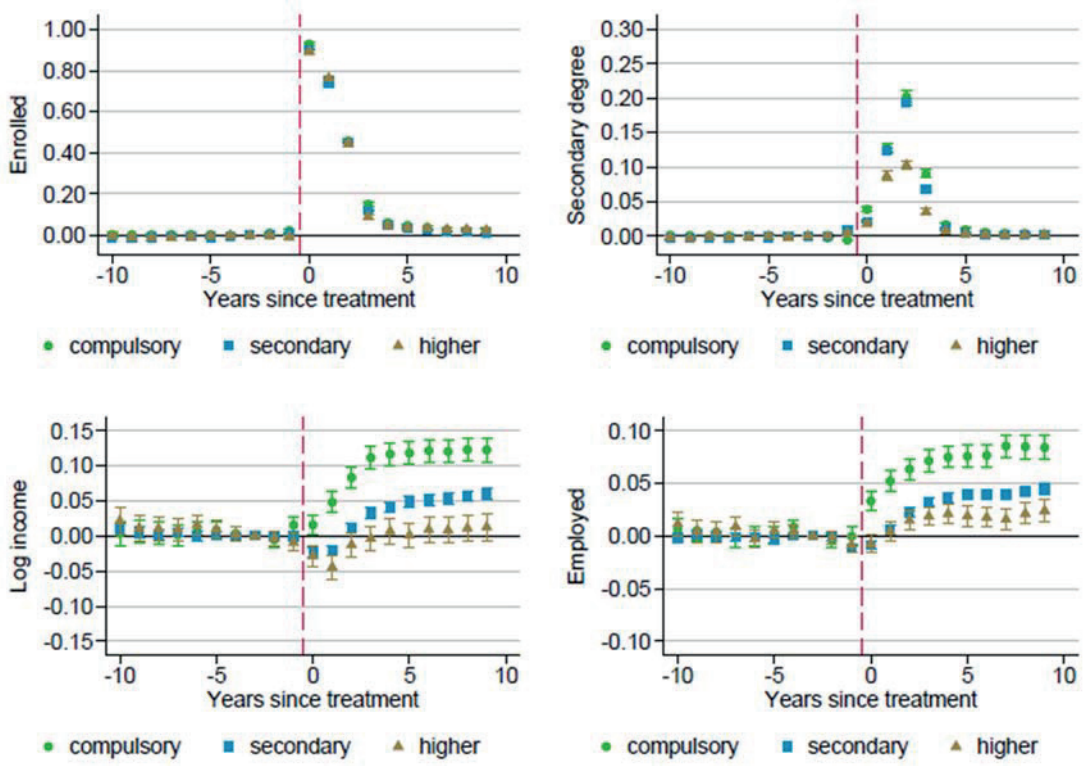

Figure 3 Effect of enrollment in secondary education by previous level of education

The upper left corner shows the results for enrollment. The pre-trend in enrollment is clean, which indicates that matching is successful. There is still approximately 75 percentage points difference in the likelihood of studying in formal education in the second year, but the difference in enrollment declines rapidly after that and returns to near zero in about five years. The figure looks very similar for all three educational groups.

The upper right corner shows the results for completing a degree. The pre-trend in completing a degree at the secondary level is clean. Those with compulsory or secondary education complete their degrees more often than those with higher education. The impact is seen in years 0 to 5.

The lower left corner considers log earnings. The pre-trend in log earnings is clean. The earnings of individuals with compulsory degrees increase immediately after enrollment and stabilize after about 5 years to a 0.1 log-point higher level than that before treatment. For those with secondary

education, the earnings dip in years 0 and 1 and start to increase afterwards. Five years after the treatment, the earnings stabilized to a 0.05 log-point higher level than before treatment. For those with higher education, treatment leads to a dip in earnings, and the earnings return to pre-treatment levels in about two years. Thus, the earnings gains clearly decrease with the initial level of education.

The lower right corner considers employment. Again, the pre-trend in employment is clean. The probability of being employed increases for all three groups after treatment. The impact is larger the lower the previous level of education, and the impacts range from two to eight log-points. The employment results show that individuals can combine studying and working, since there is not a notable dip in the share of employed persons even though a large share is enrolled in an educational institution. However, the earnings dip shows that they must take some time off for studying.

Figure 4 shows the results from the event study specification by previous level of education but focuses on higher education. Here we only have two educational groups to consider (those with secondary education and those with higher education) since individuals with only compulsory education cannot enroll in higher education.

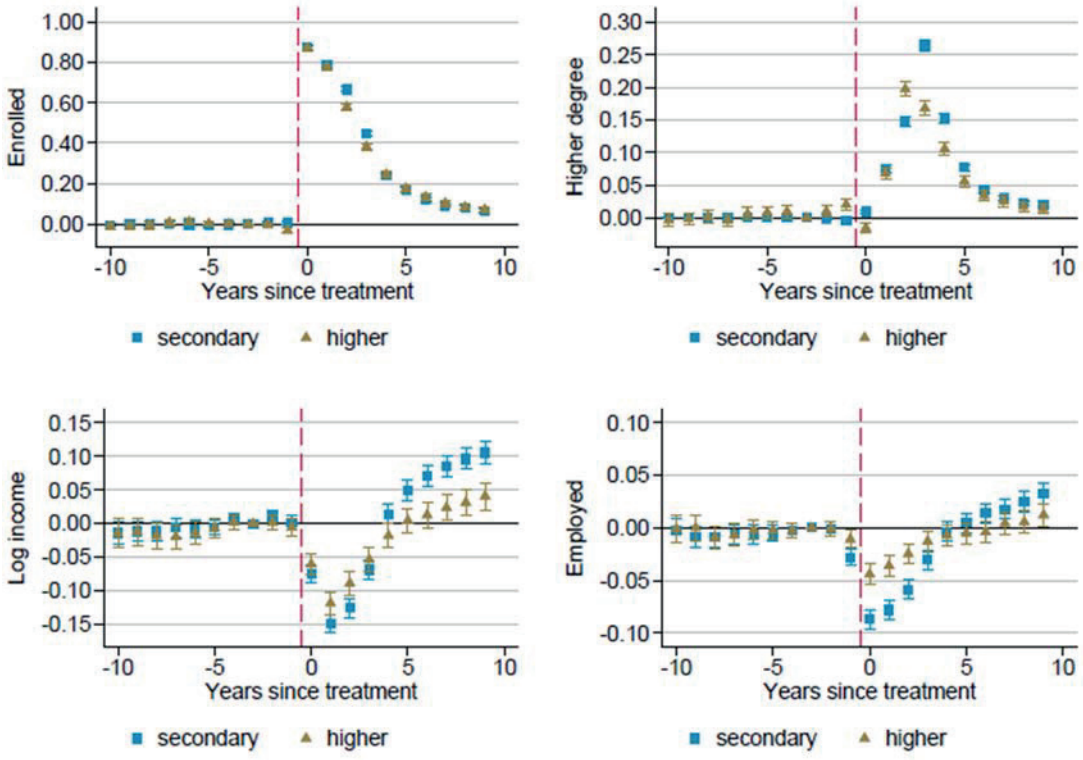

Figure 4 Effect of enrollment in higher education by previous level of education

It is seen from the upper left corner that the pre-trend in enrollment is clean. There is still close to 80 percentage points difference in the likelihood of studying in formal education in the second year. The difference in enrollment declines after that but remains positive even 9 years after treatment. The figure looks very similar for both educational groups. A notable difference from the previous figure is that the study times at the secondary level are much shorter than in higher education.

The upper right corner shows that the pre-trend in completing a degree at the secondary level is clean and that those with secondary education complete their degrees more often than those with higher education. Completing the degrees takes a longer time compared to degrees at the secondary level.

The lower left corner shows the results for log earnings. The pre-trend is again clean. For those with secondary education, the earnings dip in the years 0 and 5 and exceed the pre-treatment levels afterwards. Ten years after the treatment, the earnings stabilized to a 0.1 log-point higher level than before treatment. For those with higher education, treatment leads to a similar dip in earnings, but the earning gains are smaller compared to those with secondary education.

The lower right corner shows the results for employment. The probability of being employed decreases for both groups following treatment and remains below pre-treatment levels for about five years. The employment rate exceeds the pre-treatment levels by a couple of percentage points ten years after treatment. The employment results differ markedly from those in Figure 3, since here the employment dip is larger, and the longer-term results are much weaker.

To summarize, the opportunity costs of adult education are larger in higher education compared to the secondary level, and the earnings and employment impacts are smaller.

Now, we turn to the reduced form results. We first present the basic results concerning earnings and employment, and then we turn to heterogeneity analyses. Table 2 shows results from the reduced form specification for log earnings and employment by the prior level of education separately for enrollment in secondary and higher education. This is the same structure that we use in Figure 3 and Figure 4.

Table 2 Effect of enrollment in secondary and higher education

	Log income			**Employment**		
	Compulsory	Secondary	Higher	Compulsory	Secondary	Higher

	A. Enrollment in secondary education					
Treatment effect	0.117***	0.057***	0.032***	0.084***	0.049***	0.027***
	(0.005)	(0.003)	(0.007)	(0.003)	(0.001)	(0.003)
Year in enrollment	-0.073***	-0.107***	-0.177***	-0.054***	-0.070***	-0.073***
	(0.003)	(0.002)	(0.004)	(0.002)	(0.001)	(0.002)
Mean at t=-1	9.9	10.0	10.4	0.78	0.85	0.91
Mean income at t=-1	24 472	26 787	40 030			
N treated	13 679	47 033	7 905	13 854	47 440	7 952
N controls	19 052	88 269	14 663	19 675	89 748	14 804
	B. Enrollment in higher education					
Treatment effect		0.063***	0.046***		0.022***	0.019***
		(0.005)	(0.007)		(0.003)	(0.003)
Year in enrollment		-0.167***	-0.195***		-0.081***	-0.075***
		(0.003)	(0.004)		(0.002)	(0.002)
Mean at t=-1		10.1	10.4		0.86	0.91
Mean income at t=-1		28 536	36 852			
N treated		10 103	6 287		10 139	6 308
N controls		19 254	11 665		19 515	11 777

Note. The table reports coefficients and standard errors (in parentheses) from the estimation of equation (2), * p<0.05, ** p<0.01, *** p<0.001. The standard errors are clustered at the individual level.

We start by discussing the relationship of the reduced form results to the event-study results. Consider the results for the individuals with compulsory education who enroll at the secondary level. The treatment effect in Table 2 is 0.12 log-points, and a year in enrollment decreases earnings by 0.073 log-points. These numbers summarize the information in Figure 3, which can be seen as follows. From the lower left corner in Figure 3, it is seen that in year t+1, the earnings effect is slightly positive. This is because most individuals are still studying, so the reduced form results imply a 0.117–0.073=0.044 log-point earnings effect. When the share of individuals still enrolled starts to decline, the earnings effect rises to a little over 0.1 log-points in Figure 3. This is the treatment effect identified by the reduced form estimation.

As seen in Table 2, at the secondary level, the treatment effects are decreasing in the prior level of education for both earnings and employment. Thus, those with only compulsory education gain the most in terms of earnings and employment. The opportunity costs (measured by the estimates of "year in enrollment") are increasing in the prior level of education. This is natural, since earnings and employment rates are higher in the groups with higher education. The long-term

earnings gains are 11% for those with compulsory education, about 6% for those with secondary education, and 3% for those with higher education. These numbers are similar to, for example, Stenberg (2011), who finds average treatment effect of about 4% and higher returns to the less educated.

In higher education, the treatment effects on earnings are somewhat larger for those with secondary education than those with higher education (0.06 vs 0.05 log-points). The treatment effects on employment are similar for these two groups, implying a 2-percentage point increase in the employment rate. The opportunity costs are increasing in the prior level of education for annual earnings but are similar for employment. Compared to enrollment at the secondary level, enrollment in higher education is economically worse; the treatment effects are never larger, but the opportunity costs are larger for both groups.

Heterogeneity

Prior literature has shown that the effects of adult education are likely to depend on the characteristics of the individuals (e.g., gender), as well as the characteristics of the education pursued (e.g., field of study). Next, we address the heterogeneity of the effects found in Table 2.

Heterogeneity by individual characteristics

Many papers in the literature have considered the effects of adult education by gender. We present these results in Table 3.

Table 3 Effect of enrollment in secondary and higher education by gender

	Enrollment in secondary education		**Enrollment in higher education**	
	Men	Women	Men	Women
		A. Log income		
Treatment effect	0.059***	0.069***	0.049***	0.077***
	(0.003)	(0.003)	(0.008)	(0.005)
Year in enrollment	-0.109***	-0.131***	-0.175***	-0.193***
	(0.002)	(0.002)	(0.004)	(0.003)
Mean at t=-1	10.2	9.9	10.4	10.1
N treated	29 373	40 080	5 622	12 426
		B. Employment		
Treatment effect	0.045***	0.058***	0.024***	0.024***
	(0.002)	(0.002)	(0.004)	(0.003)
Year in enrollment	-0.068***	-0.072***	-0.073***	-0.084***
	(0.001)	(0.001)	(0.002)	(0.002)

Mean at t=-1	0.86	0.83	0.89	0.87
N treated	29 731	40 358	5 679	12 481

Note. The table reports coefficients and standard errors (in parentheses) from the estimation of equation (2), * p<0.05, ** p<0.01, *** p<0.001. The standard errors are clustered at the individual level.

As seen in Table 3, women have slightly higher treatment effects both in terms of earnings and employment, but the opportunity costs are also larger. However, in economic terms, the differences are small. Prior literature has tended to find larger effects for women than men (Blanden et al. 2012, Hällsten 2012, Jepsen et al. 2014, Böckerman et al. 2017, Bennett et al. 2020), although some studies find small differences between men and women (Stevens et al. 2019).

The other individual characteristic that we consider is employment status in t–1, that is, the year preceding enrollment[13]. We estimate equation (2) separately for the employed and unemployed.

Table 4 Effect of enrollment in secondary or higher education by employment status

	Enrollment in secondary education		**Enrollment in higher education**	
	Employed	Unemployed	Employed	Unemployed
		A. Log income		
Treatment effect	0.057***	0.114***	0.076***	0.022
	(0.002)	(0.007)	(0.004)	(0.016)
Year in enrollment	-0.115***	-0.145***	-0.171***	-0.260***
	(0.001)	(0.004)	(0.002)	(0.008)
Mean at t=-1	10.2	9.3	10.3	9.4
N treated	57 911	11 542	15 461	2 587
		B. Employment		
Treatment effect	0.031***	0.155***	0.016***	0.064***
	(0.001)	(0.004)	(0.002)	(0.009)
Year in enrollment	-0.065***	-0.075***	-0.071***	-0.108***
	(0.001)	(0.003)	(0.001)	(0.005)
Mean at t=-1	0.95	0.24	0.96	0.29
N treated	58 248	11 841	15 484	2 675

Note. The table reports coefficients and standard errors (in parentheses) from the estimation of equation (2), * p<0.05, ** p<0.01, *** p<0.001. The standard errors are clustered at the individual level.

[13] The "mean before" in the employed sample is 0.95 and not 1 because the employed sample is defined based on year t=0 and the mean before is measured at t–1. The same comment naturally applies to the unemployed sample.

As seen in Table 4, for enrollment in secondary education, the unemployed have larger treatment effects than those that are employed for both earnings and employment. For enrollment in higher education, the treatment effects on employment are larger for the unemployed, but the opposite applies for the treatment effects on earnings. The opportunity costs are always larger for the unemployed. Overall, the results show that current employment status matters for the effects of adult education. The unemployed gain more from adult education, except in terms of earnings following enrollment in higher education.

Heterogeneity by characteristics of education at the secondary level

Now, we turn to heterogeneity by the characteristics of education. We start by considering different types of degrees at the secondary level. As seen in Table 5, the effect on earnings is in the range of 0.05–0.06 log-points for high school, basic vocational, and vocational degrees but about 0.11 log-points for specialized vocational degrees. The opportunity costs are fairly similar across the different degrees. The employment effects vary less than the earnings effects, ranging from 3.8 (for high school) to 6.4 percentage points (vocational degree). Overall, the employment and earnings effects are larger for the vocational degrees compared to the high school degree, but the economic significance is not substantial.

Table 5 Effect of enrollment in secondary education by type of education

	High school	Basic vocational degree	Vocational degree	Specialized vocational degree
		A. Log income		
Treatment effect	0.050***	0.062***	0.051***	0.113***
	(0.013)	(0.004)	(0.003)	(0.003)
Year in enrollment	-0.155***	-0.146***	-0.132***	-0.134***
	(0.002)	(0.002)	(0.002)	(0.002)
Mean at t=-1	10.1	10.0	10.0	10.1
N treated	1 230	24 200	28 458	15 614
		B. Employment		
Treatment effect	0.038***	0.053***	0.064***	0.040***
	(0.008)	(0.002)	(0.002)	(0.002)
Year in enrollment	-0.088***	-0.083***	-0.076***	-0.075***
	(0.001)	(0.001)	(0.001)	(0.001)
Mean at t=-1	0.85	0.84	0.84	0.86
N treated	1 280	24 423	28 723	15 663

Note. The table reports coefficients and standard errors (in parentheses) from the estimation of equation (2), * p<0.05, ** p<0.01, *** p<0.001. The standard errors are clustered at the individual level.

Vocational education at the secondary level can be provided in different forms. In addition to traditional school-based education, the same degrees may be obtained in apprenticeship training or by acquiring a vocational certificate (see section Adult Education Institutions for more details). Knowing the labor market effects of these various ways to provide education is important, since the costs of provisions differ by the type of provision and flexible provision (part-time, distance learning, modular, or credit-based programs) may reduce barriers to participation in adult education (OECD 2019, 43). Table 6 shows the estimates of equation (2) for the three types of provision of vocational education.

Table 6 Effect of enrollment in secondary education by type of vocation education

	School-based	Apprenticeship training	Vocational certificate
		A. Log income	
Treatment effect	-0.086***	0.104***	0.041***
	(0.010)	(0.003)	(0.003)
Year in enrollment	-0.161***	-0.116***	-0.147***
	(0.002)	(0.002)	(0.002)
Mean at t=-1	10.0	10.1	10.0
N treated	3 178	34 735	30 310
		B. Employment	
Treatment effect	-0.030***	0.068***	0.045***
	(0.006)	(0.001)	(0.002)
Year in enrollment	-0.093***	-0.061***	-0.087***
	(0.001)	(0.001)	(0.001)
Mean at t=-1	0.84	0.86	0.84
N treated	3 210	34 971	30 628

Note. The table reports coefficients and standard errors (in parentheses) from the estimation of equation (2), * p<0.05, ** p<0.01, *** p<0.001. The standard errors are clustered at the individual level.

It is seen from Table 6 that the treatment effects of school-based education are negative and large, but this group only consists of 3178 individuals. The treatment effects for apprenticeship training are high, and opportunity costs are relatively low. Vocational certificates are designed to

lower opportunity costs, but they are still relatively high, and the earnings effect is low compared to apprenticeship. These results suggest that ways of provision that enable combining work and studying deliver the best outcomes.

Prior literature has shown that the effects of adult education may vary substantially by the field of education (see e.g. Böckerman et al. 2017, Stevens et al. 2019). Table 7 shows the estimates of equation (2) by the field of education.

Table 7 Effect of enrollment in secondary education by field

	Education	Humanities and arts	Social science	Business and administration	Natural Sciences	ICT	Technology	Agriculture and forestry	Health and welfare	Services	Unknown
					A. Log income						
Treatment effect	0.038	-0.122***	0.229***	0.051***	-0.212***	-0.014	0.006	-0.106***	0.195***	0.062***	0.112***
	(0.034)	(0.011)	(0.030)	(0.004)	(0.028)	(0.011)	(0.005)	(0.012)	(0.005)	(0.005)	(0.003)
Year in enrollment	-0.156***	-0.155***	-0.155***	-0.141***	-0.155***	-0.154***	-0.142***	-0.155***	-0.159***	-0.141***	-0.133***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Mean at t=-1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.0	10.0	10.1
N treated	136	2 600	254	13 587	578	1 801	9 879	2 673	12 099	11 596	15 941
					B. Employment						
Treatment effect	0.010	-0.024***	0.153***	0.044***	-0.052***	-0.019***	0.015***	-0.021***	0.158***	0.065***	0.040***
	(0.018)	(0.006)	(0.017)	(0.002)	(0.013)	(0.007)	(0.003)	(0.006)	(0.003)	(0.003)	(0.002)
Year in enrollment	-0.088***	-0.088***	-0.088***	-0.080***	-0.088***	-0.087***	-0.082***	-0.088***	-0.088***	-0.080***	-0.075***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Mean at t=-1		0.85	0.85	0.85	0.85	10.1	0.85	0.85	0.84	0.84	0.86
N treated		2 643	254	13 730	587	1 818	10 031	2 718	12 134	11 673	16 043

Note. The table reports coefficients and standard errors (in parentheses) from the estimation of equation (2), * p<0.05, ** p<0.01, *** p<0.001.
The standard errors are clustered at the individual level.

As seen in Table 7, there is notable heterogeneity in the earnings and employment effects across fields. This is consistent with earlier results from the US and Europe. The opportunity costs in terms of earnings and employment vary much less than the treatment effects. Health and welfare and social science have the largest treatment effects in terms of earnings and employment. This is also consistent with earlier evidence (see e.g. Böckerman et al. 2017, Stevens et al. 2019). The most negative treatment effects can be found in humanities and arts, natural sciences[14], and agriculture and forestry. Negative effects may seem surprising, but they have also been found in the prior literature on a detailed level based on the field of education (see e.g. Stevens et al. 2019, Figure 2). These are also fields that are related to occupations that offer declining employment prospects (e.g., agriculture) and low wages (e.g., performing arts). ICT has a negative employment effect, which can be considered more surprising. However, at the secondary level, these degrees lead to employment in IT support, for example.

[14] These fields prepare students to work in, for example, nature tourism and reindeer husbandry (https://studyinfo.fi/wp2/en/vocational-education-and-training/fields-of-vocational-education-and-training/natural-sciences-2/).

Heterogeneity by characteristics of education in higher education

Next, we turn our attention to higher education. Table 8 shows the estimates of equation (2) by the level of education.

Table 8 Effect of enrollment in higher education by the level of education

	Lower UAS	Lower university	Higher UAS	Higher university	Doctoral studies
			A. Log income		
Treatment effect	0.039***	0.051***	0.160***	0.105***	0.123***
	(0.005)	(0.012)	(0.007)	(0.013)	(0.026)
Year in enrollment	-0.186***	-0.200***	-0.176***	-0.188***	-0.187***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Mean at t=-1	10.2	10.2	10.2	10.2	10.2
N treated	10 743	2 223	2 877	1 739	466
			B. Employment		
Treatment effect	0.022***	0.028***	0.034***	0.023***	0.035***
	(0.003)	(0.005)	(0.004)	(0.006)	(0.010)
Year in enrollment	-0.086***	-0.085***	-0.077***	-0.081***	-0.082***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Mean at t=-1	0.87	0.88	0.89	0.88	0.88
N treated	10 792	2 273	2 881	1 770	480

Note. The table reports coefficients and standard errors (in parentheses) from the estimation of equation (2), * p<0.05, ** p<0.01, *** p<0.001. The standard errors are clustered at the individual level.

As seen in the table, treatment effects on employment are similar across different levels, and they vary between 2 to 3 percentage points. There is some heterogeneity in the treatment effects on earnings; a lower UAS and lower university have treatment effects of about 0.04–0.05 log-points, and a higher UAS and higher university degrees have effects of 0.16 and 0.1–0.12 log-points, respectively. The opportunity costs are similar, being about 0.19 log-points. Our estimates of the treatment effects are similar to those found in Sweden (Hällsten 2012) but lower than what is typically found for U.S. community colleges (e.g. Jepsen et al. 2014, Carruthers and Sanford 2018, Stevens et al. 2019).

The results on higher UAS differ from Böckerman et al. (2019): our earnings and employment estimates are much larger. Their earnings estimate is in the range of 7–8 percent, and the employment effect is close to zero. This likely reflects the differences in the time period studied, the age group studied, the sample composition (they include only those who have lower UAS as their prior degree), and details of the method used (e.g., variables included in matching).

The results on lower UAS also differ from Böckerman et al. (2017), especially with respect to earnings; their employment estimate is about 2.5 percent, and the earnings effect is about 3700€ per year[15]. This earnings estimate is about 13 percent, which is substantially larger than that in this study. Again, there are several differences between the studies that likely explain these differences. The qualitative conclusions from our results are similar to Böckerman et al. (2017) and Böckerman et al. (2019): both lower and higher UAS degrees substantially increase the employment rate and earnings of attendees.

The last heterogeneity analysis that we conduct concerns the fields of study in higher education. Table 9 shows the estimates of equation (2) by the field of education. As seen in this table, there is substantial heterogeneity across fields, similar to the secondary level. Health and welfare, social science, and education have the largest treatment effects in terms of earnings and employment. The negative treatment effects on earnings can be found in humanities and arts, ICT, natural sciences, and agriculture and forestry. These are mostly the same fields that had negative treatment effects at the secondary level. This, of course, raises the question of why individuals enroll in these fields. One possibility is that these fields offer non-monetary benefits. Alternatively, the individuals and policymakers who make decisions about the resources devoted to various fields are not aware of the earnings and employment impact of these choices.

[15] These results are found in their Table 1.

Table 9 Effect of enrollment in higher education by field

	Education	Humanities and arts	Social science	Business and administration	Natural Sciences	ICT	Engineering	Agriculture and forestry	Health and welfare	Services	Unknown
					A. Log income						
Treatment effect	0.115***	-0.075***	0.118***	0.049***	-0.080	-0.087***	0.007	-0.018	0.154***	0.081***	0.091***
	(0.015)	(0.017)	(0.016)	(0.009)	(0.055)	(0.016)	(0.009)	(0.023)	(0.006)	(0.013)	(0.023)
Year in enrollment	-0.192***	-0.194***	-0.188***	-0.178***	-0.189***	-0.186***	-0.179***	-0.187***	-0.201***	-0.183***	-0.186***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Mean at t=-1	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
N treated	909	1 345	874	3 061	223	1 083	2 983	558	6 417	1 159	263
					B. Employment						
Treatment effect	0.045***	0.004	0.034***	0.003	0.002	-0.054***	-0.025***	-0.025**	0.077***	0.014**	0.008
	(0.008)	(0.008)	(0.007)	(0.004)	(0.022)	(0.008)	(0.004)	(0.011)	(0.003)	(0.007)	(0.013)
Year in enrollment	-0.084***	-0.082***	-0.083***	-0.079***	-0.084***	-0.082***	-0.082***	-0.082***	-0.089***	-0.080***	-0.083***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Mean at t=-1	0.88	0.87	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
N treated	914	1 363	886	3 084	225	1 088	2 997	563	6 439	1 168	263

Note. The table reports coefficients and standard errors (in parentheses) from the estimation of equation (2), * p<0.05, ** p<0.01, *** p<0.001.
The standard errors are clustered at the individual level.

Cost-Benefit Analysis

To quantify the economic impact of adult education, we evaluate monetary costs and benefits at the individual, public sector, and social levels. For individuals, we consider the effects on earnings through retirement, whereas for the public sector, we analyze changes in tax returns and social transfers, as well as the costs of provision of education. For society as a whole, we sum the individual and public sector results.

As emphasized by Stenberg (2011), a cost-benefit analysis requires substantial untestable assumptions, and thus, the results should be interpreted with caution. Our calculations omit, for example, possible effects on health, the displacement effect on younger persons, and the impact of increased earnings on employer's social insurance contributions and indirect taxation.

Individual-level CBA

To illustrate the costs and benefits at the individual level, we calculate the present value of the net earnings premium for individuals starting their studies at the ages of 35, 45, and 55. We calculate the net benefits until the age of 65 according to the following formula:

$$PDV^{I}(age_0) = \sum_{age=age_0}^{65} \frac{net\ earnings\ premium(age)}{(1+r)^{age-age_0}}$$

where $age_0 = 35{,}45{,}55$, $r = 0.03$, and $net\ earnings\ premium(age) = (1 - MTR(earnings))\ \beta^{earnings}(\ age)$.

The net earnings premium is calculated based on the event-study specification and assumes a constant annual return after 10 years. We use the mean of the return 9 and 10 years after enrollment for all years until the age of 65. We use marginal tax rates of 40 and 48.2% in the calculations, which correspond to annual earnings in the range 20000–30000 and 34000–51000€, respectively[16]. We choose the marginal tax rate depending on the average annual income in the given population.

Table 10 shows the results of these calculations. For those with compulsory education, the results are positive for all age groups but larger for younger groups. For example, for the 35-year-olds

[16] https://www.veronmaksajat.fi/luvut/Laskelmat/Palkansaajan-veroprosentit

with compulsory education, the present value of enrolling in secondary education is about 31 000€.

For those with secondary education, the results are more positive when they enroll in higher education compared to enrollment in secondary education. For example, for 35-year-olds, the present value of enrolling in secondary education is about 11 000€, whereas it is about 26 000€ for enrollment in higher education.

For those with higher education, the results are smaller compared to the other educational groups, and the magnitude is similar across different levels of education. To summarize, the largest present values are found when younger adults upgrade their level of education.

Table 10 Individual-level cost-benefit analysis

	Enrollment in secondary education			**Enrollment in higher education**	
	Compulsory	Secondary	Higher	Secondary	Higher
Age at entry 35 years	30 787	11 255	6 188	26 146	7 735
Age at entry 45 years	22 533	7 738	3 928	16 611	3 895
Age at entry 55 years	11 442	3 011	891	3 796	-1 265

Public sector CBA

For the public sector, the economic benefits of adult education may be obtained from increased tax returns and decreased social transfers, while the costs come mainly from the cost of providing the education. We calculate the present discounted value with the following formula:

$$PDV^{PS}(age_0) = \sum_{age=age_0}^{65} \frac{tax\ returns(age) - transfers(age)}{(1+r)^{age-age_0}} - C$$

where $tax\ returns(age) = MTR(earnings)\ \beta^{earnings}(\ age)$, $transfers(age) = (average\ monthly\ payments)\beta^{moths\ of\ employment}(\ age)$, and C is the cost of education. The tax returns and transfers are calculated based on the event-study specification, and we do the calculations for individuals starting their studies at the age 35, 45, and 55.

We assume a transfer of 800€ per month for an unemployed person. This is based on our calculations on average transfers that include flat-rate labor market support, general housing allowance, and social assistance.[17]

We estimate the cost of a year in education to be 7000€. This is based on statistics from the Finnish National Agency[18]. The estimate of years spent in education is based on our calculations of the duration of schooling at different levels. The variation in the costs of education comes from the different average lengths of studies for the different cases considered in Table 11.

Table 11 shows the cost-benefit analysis for the public sector. As seen in the table, for those with compulsory education, the benefits exceed the costs for the two youngest age groups, but not for those starting their studies at 55 years old. For those with secondary education and higher education, the benefits do not exceed the costs in any of the considered cases. In summary, the accumulated returns exceed the costs of education only when the individuals with compulsory education enter secondary education and are young enough.

Table 11 Cost-benefit analysis for public investment

	Enrollment in secondary education			**Enrollment in higher education**	
	Compulsory	Secondary	Higher	Secondary	Higher
Age at entry 35 years					
Accumulated returns	35 249	14 149	9 303	19 677	7 075
Costs of education	16 730	16 870	17 220	24 150	22 190
Total effect on public finance	18 519	-2 721	-7 917	-4 473	-15 115
Age at entry 45 years					
Accumulated returns	26 054	10 012	6 280	11 823	3 100
Costs of education	16 730	16 870	17 220	24 150	22 190
Total effect on public finance	9 324	-6 858	-10 940	-12 327	-19 090
Age at entry 55 years					
Accumulated returns	13 696	4 452	2 217	1 268	-2 241
Costs of education	16 730	16 870	17 220	24 150	22 190
Total effect on public finance	-3 034	-12 418	-15 003	-22 882	-24 431

[17] http://raportit.kela.fi/ibi_apps/WFServlet?IBIF_ex=NIT150AL&YKIELI=S; https://tutkimusblogi.kela.fi/arkisto/5743
[18] https://vos.oph.fi/rap/vos/v21/v06yk6s21.html

Social returns

The social-level cost-benefit analysis is obtained by summing the individual-level and public sector-level cost-benefit analyses, as shown by the following formula:

$$PDV^S(age_0) = PDV^I + PDV^{PS} = \sum_{age=age_0}^{65} \frac{earnings\ return(age) - transfers(age)}{(1+r)^{age-age_0}} - C$$

where $earnings\ returns(age) = \beta^{earnings}(age)$. The results of this analysis are presented in Table 12. The table shows that for those with compulsory education the benefits exceed the costs for all age groups. For those with secondary education, the benefits exceed the costs when they belong to the two youngest age groups, but the returns are much larger when they enroll in higher education. For those with higher education, the benefits do not exceed the costs in any of the considered cases. In summary, the accumulated returns exceed the costs of education mostly when the individuals upgrade their level of education and are young enough.

Table 12 Social cost benefit analysis

	Enrollment in secondary education			Enrollment in higher education	
	Compulsory	Secondary	Higher	Secondary	Higher
Age at entry 35 years					
Accumulated returns	66 035	25 404	15 492	45 823	14 810
Costs of education	16 730	16 870	17 220	24 150	22 190
Total effect	49 305	8 534	-1 728	21 673	-7 380
Age at entry 45 years					
Accumulated returns	48 587	17 750	10 209	28 434	6 996
Costs of education	16 730	16 870	17 220	24 150	22 190
Total effect	31 857	880	-7 011	4 284	-15 194
Age at entry 55 years					
Accumulated returns	25 139	7 463	3 108	5 064	-3 506
Costs of education	16 730	16 870	17 220	24 150	22 190
Total effect	8 409	-9 407	-14 112	-19 086	-25 696

Robustness checks

We conclude the analysis by considering the robustness of the results to alternative ways of forming the control group and adding more control variables. Our baseline uses information from the years t–10 to t–1 in the matching. The alternatives that we consider are using information only

from the years t–5 to t–1 or selecting the control group randomly, without matching. The additional control variables that we consider are marital status, number of children under 7- and 18-years old, and characteristics of the municipality of the residence. The results are presented in Table 13.

Table 13 Effect of enrollment: Robustness to sampling

	Log income			Employment		
	Compulsory	Secondary	Higher	Compulsory	Secondary	Higher
			A. Enrollment in secondary education			
Controls matched 10 years						
Baseline specification	0.117***	0.057***	0.032***	0.084***	0.049***	0.027***
	(0.005)	(0.003)	(0.007)	(0.003)	(0.001)	(0.003)
Baseline specification +	0.114***	0.055***	0.030***	0.082***	0.048***	0.027***
additional covariates	(0.005)	(0.003)	(0.007)	(0.003)	(0.001)	(0.003)
Controls matched 5 years	0.098***	0.053***	0.025***	0.073***	0.046***	0.022***
Baseline specification	(0.005)	(0.003)	(0.007)	(0.003)	(0.001)	(0.003)
Random sample of controls						
Baseline specification	0.094***	0.059***	0.016***	0.076***	0.055***	0.039***
	(0.005)	(0.002)	(0.006)	(0.003)	(0.001)	(0.003)
			B. Enrollment in higher education			
Controls matched 10 years						
Baseline specification		0.063***	0.046***		0.022***	0.019***
		(0.005)	(0.007)		(0.003)	(0.003)
Baseline specification +		0.061***	0.045***		0.021***	0.018***
additional covariates		(0.005)	(0.007)		(0.003)	(0.003)
Controls matched 5 years		0.062***	0.041***		0.014***	0.013***
Baseline specification		(0.005)	(0.007)		(0.003)	(0.003)
Random sample of controls		0.158***	0.055***		0.067***	0.039***
Baseline specification		(0.005)	(0.006)		(0.003)	(0.003)

The table shows the coefficient on Treat in the reduced form specification for three different samples: matching using 10 years of history (the baseline), matching using 5 years of history, and a randomly selected control group (no matching). For the baseline sample, the table also shows results with additional covariates.

As seen in the table, the two matching samples produce very similar results. The results using a random sample are also fairly similar to the baseline, with a couple of exceptions. Overall, the results are not very sensitive to alternative ways of specifying the control group. The additional covariates have a very small effect on the estimated treatment effects.

Discussion

In this paper, we study the earnings and employment effects of enrollment in formal adult education in Finland using a combination of matching and panel data methods. We also conduct cost-benefit analyses.

The results show that adult education increases earnings and employment both in secondary and higher education, but the magnitude depends on the original level of education. The earnings and employment effects are the largest for the less educated group (those with only compulsory education). For those already having a degree from higher education, the employment and earnings effects are small.

There is substantial heterogeneity behind the average effects. The earning gains differ by field and type of education both in secondary and higher education.

Cost-benefit analysis shows that at the individual level, the benefits exceed the costs for those with compulsory and secondary education but not for those with higher education. When the societal costs and benefits are considered, we find that the benefits exceed the costs mostly when the individuals upgrade their level of education and are young enough.

Considering these results, it seems that the benefits of adult education may be inflated in public discourse. Even though the earnings and employment effects are positive after finishing education, studying entails significant opportunity costs in terms of earnings and employment.

The results also suggest that public investment should be carefully targeted. Public investments should be targeted to studies that offer skills that are in demand in the labor market (our results show, for example, that studies in humanities and arts lead to negative earnings and employment effects) and for individuals who upgrade their qualifications (our results show that for these individuals the benefits may exceed the costs). The OECD has recently made similar suggestions for Finland (OECD 2020, 62-63).

In Finland, adults participate a lot in formal adult education in degree programs that have been designed for initial education for the youth. These programs may be too extensive and ill-suited for the needs of adults. Such extensive programs lead to higher direct and opportunity costs of education and thus worse outcomes in terms of costs and benefits.

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