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Working Paper

Back to School? Labor-Market Returns to Vocational Postsecondary Education

IZA Discussion Papers, No. 9079

Provided in Cooperation with:

IZA – Institute of Labor Economics

Suggested Citation: Böckerman, Petri; Haapanen, Mika; Jepsen, Christopher (2015) : Back to School? Labor-Market Returns to Vocational Postsecondary Education, IZA Discussion Papers, No. 9079, Institute for the Study of Labor (IZA), Bonn

This Version is available at:

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IZA DP No. 9079

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May 2015

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ABSTRACT

Back to School? Labor-Market Returns to Vocational Postsecondary Education^{*}

Outside the U.S., little is known about the labor-market returns to vocational (or polytechnic) postsecondary education. This paper focuses on the labor-market returns to polytechnic bachelor's degrees in Finland. Using detailed administrative data, we estimate person fixed effect models to study returns for individuals with labor-force attachment prior to polytechnic school enrollment. We find sizable earnings and employment impacts for polytechnic bachelor's degrees, although the returns vary by personal characteristics and field of study.

JEL Classification: J24, I26

Keywords: vocational education, postsecondary education, labor-market returns

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^{*} This study is part of a project supported by the Academy of Finland (project no. 251071), Yrjö Jahnsson Foundation (project no. 6621) and the European Union's Seventh Framework Programme (FP7-PEOPLE-2013-CIG) under project identification number 618400 - PSE RETURNS. We thank Celeste Carruthers, Ohto Kanninen, and seminar participants at the meeting of the Finnish Economic Association (Helsinki, 2015), Irish Economic Association (Dublin, 2015), Summer Seminar of Finnish Economists (Jyväskylä, 2014), Labour Institute for Economic Research (2014), University of Tennessee (Knoxville, 2014) for the useful comments, and Hannu Karhunen for data assistance.

1. Introduction

The worldwide economic crisis of the last decade has dramatically altered the labor-market prospects of workers. Low-skilled workers are particularly vulnerable, as they have higher unemployment and lower wages than more educated workers. In 2012, the EU average employment rate for individuals with little or no postsecondary education is around 70 percent, compared with rates over 80 percent for individuals with postsecondary education.¹ Unemployment rates are also substantially higher for workers without postsecondary education. One potential opportunity for low-skill individuals to improve their labor-market success is to obtain additional schooling.

Finland offers an excellent opportunity to study the labor-market returns to vocational postsecondary degrees. The first polytechnics were created in 1991. They provide a high level of vocational postsecondary education for students by offering polytechnic bachelor's degrees that take approximately 3.5 to 4 years of full-time study (OECD 2003, p. 138). The length of study for polytechnics in Finland is typically of many European countries. In contrast, vocational postsecondary degrees in the U.S., usually offered by community colleges, require two years of full-time study.

In this paper, we focus on the labor-market returns to vocational bachelor's degrees offered by polytechnics. Because our preferred method is a person fixed-effects model, we restrict the sample to students who have some meaningful labor-force attachment before entering polytechnics. This paper contributes to an extremely thin literature on the labor-market returns to polytechnics, especially for students with prior working experience.

In the preferred person fixed-effects model, the completion of a polytechnic bachelor's degree corresponds with annual increases of €6,300 in earnings and 8.5

¹ Information obtained from Eurostat website (<http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home>) in April 2014 for individuals aged 20 to 64. The comparison is between individuals with International Standard Classification of Education (ISCED) education levels 3 and 4, defined as "Upper secondary and postsecondary non-tertiary education," and levels 5 and 6, "First and second stage of tertiary education." The vocational postsecondary education studied in this paper is level 5.

percentage-points in employment. The returns are similar when we use a matching estimator to compare polytechnic entrants with non-entrants. The results are more pronounced for younger individuals and individuals with weaker labor-force attachment, although the weak labor-force attachment for these individuals may not represent their true earnings and employment capabilities. Men have much higher earnings returns but lower employment returns than women. Individuals who attended polytechnics in the Helsinki metropolitan area have lower returns than those who attended polytechnics elsewhere in Finland. There is also variation in returns by the field of study. Technology corresponds with the largest increases in earnings, but health corresponds with the largest increases in employment.

2. Relationship to Previous Literature

The overwhelming majority of studies on postsecondary vocational education focus on the returns to U.S. community colleges. These colleges offer associate's degrees in academic and vocational areas of study, and these degrees typically require two years of full-time study. Community colleges also offer shorter-term vocational diplomas and certificates. In studies using panel data to control for ability bias and the non-random selection of students into community college, degrees and diplomas in vocational areas are associated with higher earnings and employment, particularly for women (see Jepsen, Troske, and Coomes (2014), Carruthers and Sandford (2015), and the references therein).² Returns for short-term certificates are smaller and, in some cases, provide no discernable labor-market gains. Jacobson, LaLonde, and Sullivan (2005a, 2005b) also find positive effects of community college attendance on earnings for displaced workers. For-profit colleges offering vocational postsecondary education also appear to boost labor-market outcomes (Cellini and Chaudhary, 2014; Deming, Goldin, and Katz, 2012; Lang and Weinstein, 2013).

² Studies using less rigorous controls for selection also tend to find positive effects of community college degrees on labor-market outcomes, although many of these studies combine the effects of academic and vocational degrees. Grubb (2002a, 2002b) and Belfield and Bailey (2011) provide thorough reviews on this literature.

Böckerman, Hämäläinen, and Uusitalo (2009) study the labor-market effects of the conversion of vocational colleges to polytechnics in the early 1990s. Specifically, they exploit the geographical variation in the timing of the conversion to compare labor-market outcomes between graduates of the new polytechnics and graduates of the old vocational colleges. Using this setting, they find positive effects of the reform on the earnings and employment of graduates in business and administration, but the effects are generally small and statistically insignificant for other fields of study. Outcomes are measured one to two years after graduation. In a previous paper, Hämäläinen and Uusitalo (2008) show that the earnings gains for business school students represent both the human capital and signaling values of education. The creation of the Finnish polytechnic education system has also been used to study the effects of education on within-country migration (Böckerman and Haapanen, 2013).

There are few studies on the labor-market returns to vocational postsecondary education elsewhere in Europe. Riphahn et al. (2010) compare labor-market returns between polytechnics and universities in Germany, and, using OLS regressions on survey data, they find that universities have higher returns. Schomburg and Teichler (2000) provide descriptive information on differences in employment and, in some cases, earnings from surveys in 12 countries, predominantly in Europe.

This paper contributes to a small literature on returns to vocational postsecondary education, where the vast majority of the research is based on U.S. community colleges. Associate's degrees in U.S. community college require two years of full-time study, compared with four years of full-time study in Finland and elsewhere in Europe. Therefore, results from Finland are much more representative of the returns to vocational postsecondary education in Europe. The current paper provides four contributions relative to previous work on Finland (Hämäläinen, and Uusitalo, 2008; Böckerman, Hämäläinen, and Uusitalo, 2009).

First, we look at the returns to the established vocational system rather than studying the returns to the creation of a new polytechnic system. Second, we focus on returns to students returning to education after working compared to the focus of students aged 35 and under. The focus on those who have prior working experience is particularly policy-relevant in the aftermath of the global economic crisis, because many unemployed youth have to decide whether to pursue additional schooling or not and the government has to decide whether to invest more resources in postsecondary education. Third, we look at returns over several years rather than studying the returns one or two years after graduation. Fourth, we have registry data on all permanent residents of Finland between 1987 and 2012, whereas previous work used a 50 percent sample of Finnish high-school and vocational school graduates between 1990 and 2000.

3. Vocational Polytechnic Education in Finland

Vocational colleges were a diverse group of schools at the beginning of 1990s. The entry requirements and the length of education varied between schools. Some took most students directly from comprehensive schools and provided them with two or three years of vocational education. In some vocational colleges most students had completed high school (upper secondary schooling) before entering vocational college.³

The purpose of the polytechnic education reform was to raise the general educational standard and training of the population and to diversify higher education (OECD 2003). Other objectives included pooling resources into larger units and making the Finnish education system more comparable to educational systems in other European countries.

The first 22 polytechnics were established under a temporary licence in 1991. These polytechnics were created by gradually merging 215 vocational colleges and vocational

³ Finnish children enter school at the age of seven and comprehensive schooling lasts for nine years. After comprehensive schooling 50% of the pupils continue their studies in the high school. It lasts for three years and ends with a compulsory matriculation examination. Typically students graduate from high school at age 19 (or age 20).

schools, often operating at several locations. Seven new temporary licences were granted during the 1990s. The experimental phase was judged to be successful and since 1996 the temporary polytechnics gradually became permanent. Currently there are 24 polytechnics.

Polytechnic degrees are Bachelor-level higher education degrees with a vocational emphasis. These degrees are quite similar to the Bachelor of Arts (Hons) or Bachelor of Science (Hons) Degrees in the UK, the French Licence, the German Diplom Fachhochschule and the Dutch HBO Diploma. In Finland, the polytechnic degrees take 3.5 to 4 years to complete. The three largest fields are business and administration, social and health care (typically nursing), and technology and transport (typically engineers). Each year, between eighty and ninety percent of all polytechnic degrees are awarded in these three fields.

As a consequence of the polytechnic education reform, the higher education system comprises two parallel sectors, which are universities and vocationally-oriented polytechnics. Polytechnic schools are not engaged in academic research like universities.

4. Data

The basic individual-level data come from the Longitudinal Census File and the Longitudinal Employment Statistics File constructed by Statistics Finland. These two administrative data sets were updated on five-year intervals from 1970 to 1985 and annually from 1987 to 2012. The data constitute all under 70-year-old individuals in Finland during this period. The data are further merged with the Registry of Completed Degrees, which holds information on completed degrees since 1970, and the Registry of Student Population, which contains information e.g. on presence or absence at degree-leading educational programs since 1995.⁴ Because individuals are matched based on their unique personal identifiers across time periods and data sources, these panel data sets provide a variety of reliable, register-based information on all the residents of Finland.

⁴ Information on the completed degrees and student population is available at ISCED level 3 and higher in Finland.

In contrast to surveys, for example, the comprehensive, register-based data contain only a minimal amount of measurement error (Malamud and Wozniak, 2012). Furthermore, register data on spouses and the region of residence are linked to the individual records. Through longitudinal linkages of the data, we are able to know, for example, spouse's employment status and unemployment rate in the region of residence.

The regression sample consists of individuals who are aged 22 to 50 when they initially enroll in polytechnics. We exclude individuals who have graduated from (or enrolled in) another education program within two-years prior to the entry to polytechnic. These age and education restrictions are in order to capture students who have meaningful measures of pre- and post-schooling earnings.

We also exclude individuals who transfer to universities after their polytechnic studies, move abroad, or die during the sample period as well as individuals attending polytechnics in the Åland Islands, a small isolated region with many differences such as language from the rest of Finland. The preferred sample is 36,646 individuals who enter polytechnics between 1997 and 2004, and graduate by 2009 or dropout. Hence, dropouts are defined as students who enter polytechnics in 1997–2004 but do not graduate by 2012. Of the individuals who enter polytechnics, 25,845 (71%) receive polytechnic bachelor's degrees and 10,801 (29%) do not. The individuals are followed backward until 1987, the year they turn 18 or the year after graduation from prior education⁵ (whichever comes first) and forward until 2012.

5. Method

5.1 Person Fixed Effects Model

⁵ In terms of previous qualification, most polytechnic students in our working sample had graduated from vocational college (44%) or vocational school (33%). Around 16% of the students had graduated from high school and 4% from university. In contrast, 54% of the overall sample polytechnic students (i.e. including people under 23 at enrollment, etc.) have ever graduated from high school.

Because we have a detailed panel data set with pre- and post-schooling earnings data, we use these data to estimate the change in earnings and employment associated with polytechnic bachelor's degrees. Specifically, we compare the post-education earnings with the pre-education earnings for two groups, those who receive polytechnic bachelor's degrees and those who do not. The major difference between the two groups is the polytechnic bachelor's degree. In terms of program evaluation, our estimation technique resembles a treatment-on-the-treated model. This model has been used extensively to study the returns to U.S. community colleges (Jacobson, LaLonde, and Sullivan, 2005a, 2005b; Jepsen, Troske, and Coomes, 2014; Stevens, Kurlaender, and Grosz, 2015).

Equation (1) contains the person fixed effects model:

$$(1) \quad Y_{it} = \alpha + \beta POLYBA_{it} + \gamma ATTEND_{it} + \delta DEMOG_{it} + \eta_i + \tau_t + \varepsilon_{it}$$

In this equation, i denotes a person and t denotes a year.

The dependent variables (Y_{it}) are annual measures of earnings, total income, employment, and unemployment. Specifically, we have information on annual earnings as well as total annual taxable income obtained from the Finnish tax authorities. Total annual taxable income is a broad income concept, which includes annual wage and salary earnings, self-employment income and capital income (dividends, capital gains). It also includes income transfers and social security benefits, such as unemployment and parental leave benefits, which often are proportional to past wage and salary earnings. Annual earnings and income are deflated to 2012 euros by using the consumer price index. Employment (unemployment) is measured as a dichotomous variable equal to one for individuals who are employed (unemployed) during the last week of each year. For brevity we have only reported results on earnings and employment. Descriptive results are also given for taxable income and unemployment.

$POLYBA$ is a dichotomous variable for possessing a polytechnic bachelor's degree in

the beginning of the year t . For example, a person who received a degree in 2002 will have values of 0 from 1987 to 2002 and values of 1 from 2003 on. Of course, individuals who never receive a degree will have values of 0 in all periods. Separate effects are estimated for the year when the degree was obtained (see *ATTEND* variables below).

DEMOG is a set of time-variant person-specific demographics. Specifically, we include two interaction terms: (1) a time trend interacted with a dummy variable for female and (2) a time trend interacted with age at polytechnic entry.⁶ See Jepsen, Troske, and Coomes (2012) for additional motivation for including time trends such as these. We also include the unemployment rate at the NUTS-4 level as an additional, time-varying control.

ATTEND contains four dichotomous attendance variables. The first is equal to one when the individual is attending polytechnics and zero otherwise. This variable accounts for the opportunity cost (in terms of earnings and employment) for students while they attend polytechnics. The second variable is equal to one after the individual has finished attending polytechnics. This variable accounts for any increase in earnings resulting from polytechnic school attendance regardless of degree received. In other words, this *post-schooling* variable equals one for all individuals, dropouts and completers, in post-schooling periods. The third variable is equal to one for polytechnic bachelor's degree recipients in the year that they receive the degree and is zero for other years (and in all years for dropouts). The returns to a degree are likely to be lower in the year of degree receipt, relative to future years, because individuals spent part of the year enrolled in polytechnics. The fourth variable is equal to one for year in which all students, not just completers, exit polytechnics. Using the same logic as the previous variable, the returns to polytechnics attendance (with or without a degree) are

⁶ In unreported results, we also estimated models where we included controls for marital status, employment status of partner (equal to zero for individuals without partners), and the presence of children under seven. Because these variables have little within-person variation in the data, the labor-market returns are not sensitive to the inclusion or exclusion of these control variables. Because getting a degree or not may also affect the likelihood of getting married and/or having children, these variables may be endogenous. Therefore, we exclude these variables in our preferred analysis.

likely to be lower in the year of exiting because individuals spent part of the year enrolled in polytechnics.

The key feature of the model is the inclusion of the person fixed effects (η) to control for time-invariant measures of ability and other factors such as personality traits that affect earnings and are correlated with polytechnic schooling. The fixed effects model uses variation between individuals as well as variation over time within individuals to estimate the value of the coefficients. Although each source of variation has their weaknesses, together they provide a compelling technique for estimating the causal effect of education on earnings and employment.

The fixed effects approach assumes that the pre-schooling and post-schooling earnings and employment patterns are similar between students who received an award and students who did not receive an award. If a student receives a positive or negative shock that affects degree receipt and earnings patterns, the fixed effects model will not produce valid estimates. However, we believe that, on average, the impact of such shocks is likely to be small. Furthermore, this criticism is also true of nearly all the previous studies of vocational postsecondary education returns, particularly for U.S. community colleges.

The model also contains indicator variables for each calendar year and for the number of years since entering polytechnics, and we denote these two sets of time effects as τ . The inclusion of both sets of indicator variables controls for differences in macroeconomic conditions such as business cycles as well as for differences in age-schooling profiles. The last component (ε) is the unobservable component of earnings and employment. There are up to 26 years for each individual, from 1987 to 2012. Standard errors are clustered at the person level to account for unobservable, within-person variation in outcomes.

5.2 Alternate Specifications

Jacobson, LaLonde, and Sullivan (2005a) include two parameters to model short-run deviations from long-run effects on labor-market outcomes. The first parameter is *post-schooling* * $1/k$, where k is the number of time periods after the individual has left schooling. This variable equals 1 for the first period after the person left school, $\frac{1}{2}$ for the second, and so on until the variable goes to zero in the limit. For example, a person exiting polytechnics in 2003 would have a value of 1 for 2004 (the year after leaving), a value of $\frac{1}{2}$ for 2005, etc. Hence, these parameters show the temporal patterns in the effect of polytechnic attendance. The second parameter is an interaction between the first parameter and a measure of human capital, which in their case is the number of community college credits. We adapt this variable to our case and measure it as *post-schooling* * *POLYBA* * $1/k$, where *POLYBA* is the dummy variable for degree receipt as defined previously. This interaction variable allows us to study temporal patterns in the effect of polytechnic degree. In some specifications, we include these two variables (*post-schooling* * $1/k$ and *post-schooling* * *POLYBA* * $1/k$) to follow more closely the specifications of Jacobson, LaLonde, and Sullivan (2005a); note that we include these variables in addition to all the other variables discussed above (incl. *post-schooling* and *POLYBA*).

Carruthers and Sanford (2015) argue that, for their sample of Tennessee community and technical college students, the person fixed-effects model does not adequately control for differences in trends in labor market prospects between graduates and dropouts. Specifically, they estimate the following equation (equation (4) in their paper) on all pre-enrollment time periods:

$$(2) \quad Y_{it} = \alpha + \beta \text{EverAward}_i * \text{trend} + \delta \text{DEMOG}_{it} + \eta_i + \tau_t + \varepsilon_{it}$$

In addition to being estimated for pre-enrollment time periods only rather than all time periods, this equation includes one additional variable to the previous analysis. The variable

is an interaction between a dummy variable for the student ever receiving a bachelor's degree in the future (*EverAward*) and a time trend for the number of periods before enrollment (*trend*). For example, the trend variable equals one for the year before entering polytechnics. Carruthers and Sanford (2015) find statistically significant (although not always positive) effects of this interaction term, showing that graduates and dropouts have different pre-enrollment earnings trends. When we estimate this model, the coefficient on the interaction term (β) is statistically insignificant. Thus, we cannot reject the hypothesis that completers and dropouts have similar pre-enrollment earnings trends. Importantly, these results do not violate the underlying assumptions of the preferred fixed effects model presented in equation (1).

5.3 Matching Estimators

The person fixed-effects model presented above compares students who complete polytechnics with students who drop out. In this section, we consider an alternate model where we compare polytechnic entrants to similar individuals who did not attend postsecondary education (polytechnics or university) as of 2012. This technique is also used in Carruthers and Sanford (2015) for U.S. community colleges. It allows us to investigate the possibility that earnings and employment trends differ between individuals with or without any polytechnic education.

For each entrant and non-entrant, we calculate the propensity of entering a polytechnic as follows:

$$(3) \quad Prob(POLYBA_i) = f(DEMOG_{i,t-1}, Y_{i,t-j}), \quad j = 1, 2, 3,$$

where $Prob(POLYBA)$ denotes the probability of entry (i.e. the propensity score), $DEMOG$ denotes the demographics (as shown in Appendix Table 1) prior to entry, and Y denotes earnings and employment in the three years j before enrollment decision. Squared prior

earnings are also used to capture non-linearities in the probability of entry. We estimate the function f as a probit.

To illustrate the matching algorithm more closely, consider a polytechnic entrant who started polytechnics in 2000. For this individual, the demographics are from 1999 and the earnings and employment information are from 1997 to 1999. We also calculate the corresponding entry probabilities in 2000 for individuals with no postsecondary attendance based on the prior demographic and labor-market information. The yearly data on each non-entrant can constitute up to eight different control observations (one for each entry year 1997 to 2004). Hence, in total we have over 6.3 million non-entry observations. However, to reduce the computation burden, we will find the best matches for the entrants from a ten percent random sample of the control observations.⁷

We use propensity score matching based on the two nearest neighbors. Using the example from the previous paragraph, we compare the entrant in 2000 with the two control individuals with the most similar entry probabilities based on the prior demographic (from 1999) and labor-market information (from 1997–1999). We match with replacement, so that an individual with no postsecondary attendance can be matched with more than one entrant. After matching we compare the average earnings and employment development among entrant and non-entrant groups from three years before up to eight years after the entry decision.

The matching algorithm assumes that the differences between polytechnic entrants and individuals with no postsecondary attendance are captured by the propensity score. In other words, the selection is a function of observable characteristics. The validity of this assumption is strengthened by the inclusion of prior earnings and employment among the

⁷ The matching results are similar when we use all control observation (available on request). Results are based on a ten percent sample because the calculation of Abadie and Imbens (2012) robust standard errors is in practice impossible with the full data (i.e. the computational burden is too large).

observable characteristics. Matching estimators based on prior earnings are common in studies of job-training; for example, see Mueser, Troske, and Goriaslavsky (2007).

Matching estimators use data on a large sample of individuals with no postsecondary attendance. However, rather than comparing polytechnics to the entire sample of individuals, we instead use the subset of individuals who are similar with respect to the likelihood of entering a polytechnic bachelor's program. However, the main observable difference is that one group has entered the program and the other group has not.

In sum, the matching technique, like the person fixed-effects model, is only valid under certain assumptions, but these assumptions differ from those for the fixed-effects model. Consequently, the matching estimators are a useful complement for the preferred fixed-effects results.

6. Results

6.1 Descriptive Statistics

Table 1 contains the descriptive statistics for the sample. The table reports results for the full sample as well as separately for dropouts and completers. The unit of analysis in the table is an individual. The top panel of the table contains the post-schooling outcomes, the middle panel contains the pre-schooling outcomes, and the bottom panel contains demographic information.

The average post-schooling earnings (measured in years 6 to 8 after initial enrollment) is around €28,600 (in 2012 euro) for dropouts, and graduates have higher earnings of nearly €3,000. Total taxable income is slightly higher, and the gap between dropouts and graduates is slightly smaller. On average, dropouts also have higher unemployment rates and lower employment rates than completers.

The next panel provides information on outcomes measured one to three years before initial enrollment, in order to illustrate whether there are concerns with the fixed effects

strategy of comparing dropouts and completers. Although dropouts have slightly better pre-schooling earnings and income than completers, the differences are modest. Similarly, the unemployment rate of dropouts is slightly higher than the unemployment rate for completers. Employment rates prior to enrollment are very alike.

The bottom panel provides demographic information on the sample, where all characteristics are measured prior to initial polytechnic enrollment. Individuals are on average 33 years of age when they enter polytechnics. Thirty percent of individuals attended polytechnics in the Helsinki metropolitan area. The NUTS-4 regional unemployment rate is 14 percent, clearly illustrating the deep recession of the early 1990s. The pre-enrollment unemployment rate is actually higher for completers than for dropouts. About two-thirds of the sample are women, and women have higher completion rates of more than 20 percentage points compared to men. Two-thirds of the individuals are married, and approximately half have a partner who is employed. One third of the students have at least one child under age seven. About 96 percent speak Finnish as their native language. Matriculation exam results are around four on a six-point scale, and completers have similar exam results to dropouts.⁸

The descriptive statistics suggest that dropouts and completers have comparable outcomes in the years before they attend polytechnics. Figure 1 provides more detailed information on the timing of annual earnings for dropouts and completers, where the x-axis shows the number of years relative to initial polytechnic enrollment. Year 0 is the year when the individual enrolls. Year -1 is the year prior to enrollment, and year 1 is the year after enrollment. The figure shows that average annual earnings are indistinguishable between the two groups in the eight years before enrollment. Completers have noticeably higher earnings starting five years after enrollment, about the time after they graduate with their degrees. The

⁸ The matriculation examination is a national compulsory final exam taken by all students who graduate from high school. The answers in each test are first graded by teachers and then reviewed by associate members of the Matriculation Examination Board outside the schools. The exam scores are standardized so that their distribution is the same every year. The range of the matriculation exam scores is 1–6. Matriculation exam results are available for 1971–2000, excluding years 72, 76 and 78–81.

gap persists, slightly increasing over time. Unlike quarterly data from the U.S., annual data from Finland show no evidence of an “Ashenfelter dip” in earnings in the years immediately prior to enrollment.

Figure 2 illustrates the pattern for employment. The figures show that the dropouts and completers have similar employment rates in the years just before enrollment, but completers have slightly higher employment three to eight years before they attend polytechnics.

Figure 1 shows that pre-schooling earnings are quite similar between dropouts and completers, but earnings during attendance are noticeably lower for the completers.⁹ Post-schooling earnings is higher for graduates. Figure 2 shows that graduates’ employment is lower during attendance. Post-schooling, the advantage in employment for graduates is higher. Taken together, the figures suggest that dropouts and completers have comparable labor-market outcomes before enrollment, but completers have substantially better long-run labor-market outcomes after enrollment. Because these figures are simple differences in means and provide no controls, Appendix Table 1 reports regression results for an OLS regression (i.e. a regression of equation (1) without person fixed effects) to illustrate a similar pattern. Next, we estimate fixed effects regressions to provide more causal evidence.

6.2 Fixed Effects Regression Results

The preferred fixed effects results are in Table 2. The table contains two outcomes, annual earnings and annual employment. Although employment is dichotomous, it is estimated with linear probability models. Linear models for employment are common in the returns to schooling literature, as they are less sensitive to distributional assumptions (Wooldridge, 2001). For each outcome, the first specification (columns (1) and (3)) is the basic specification, whereas the second specification (columns (2) and (4)) includes short-run

⁹ The corresponding figure is very similar for total annual taxable income instead of annual earnings. It is available on request from the authors.

deviations for attendance as well as degree receipt, as in Jacobson, LaLonde, and Sullivan (2005a). Although not shown, we have also estimated models that include short-run deviations for attendance and degree receipt separately. Those results, available upon request from the authors, are quite similar to the results from the basic specification.

A polytechnic bachelor's degree is associated with increased earnings of €5,100 in the basic specification and €6,300 in the full specification. In percentage terms, the returns are 27 to 33 percent of the average pre-schooling earnings of €19,140 (Table 1). For comparison, Jepsen, Troske, and Coomes (2014) find earnings increases of 56 percent for women and 24 percent for men for U.S. community college degrees requiring two years of full-time study. If we assume an average degree completion of four years for polytechnics, then the returns are around 8 percent per year in Finland and 20 percent per year in the U.S. (for an average of males and females).

The employment returns for a polytechnic bachelor's degree are 7.5 percentage points in the basic model and 8.5 percent in the full specification. In contrast, the employment returns for U.S. community colleges are around 12 percentage points for men and 20 percentage points for women (Jepsen, Troske, and Coomes, 2014).

The coefficients for the short-run deviations are significant for three out of the four coefficients.¹⁰ Due to this general significance, as well as the flexibility of the model, our preferred model is the specification that includes these deviations. In this specification, the earnings coefficient should be interpreted as a long-run return, when the short-run deviations are approaching zero (due to large values of k).

Other results in the table are as expected. Students have lower earnings and employment while enrolled. The increase in earnings and employment is lower in the year of exit than in later years. Dropouts and completers also receive sizable returns after polytechnic

¹⁰ Unless otherwise stated, all discussions of statistical significance refer to being statistically different from zero at the ten-percent level for a two-sided test.

enrollment. The post-schooling earnings increase is €1,800, and the post-schooling employment increase is 3.9 percentage points.

6.3 Sensitivity Analysis

This section explores the robustness of the main results to differences in model and sample. A concern with the results in Table 2 is that individuals have relatively low levels of pre-schooling earnings, as illustrated in Table 1. Therefore, in Table 3 we restrict the sample to individuals with different earnings and employment thresholds. In columns (1) and (3), the sample only includes individuals who were in the top 75 percent of the earnings distribution (for the population of polytechnic attendees) in the year before they enrolled in polytechnics. In columns (2) and (4), the sample only includes individuals who earned at least €9,438 (€8,409 in 2000 euros), the minimum earnings level used by Statistics Finland (2000) to classify a worker as being a full-time work for the year, in the year before attendance. This earnings threshold is also used in Böckerman, Hämäläinen, and Uusitalo (2009).

When we exclude the bottom quartile of the earnings distribution of our sample of polytechnic attendees, the returns to polytechnic degree fall from €6,300 to €5,600. When we restrict the sample to people earning the minimum earnings level for full-time work, the returns are slightly lower still, at €5,300 (all significant at the 1% level). This pattern of results is consistent with the highest returns occurring for individuals with the weakest labor-force attachment prior to entering polytechnics. However, this finding should be interpreted with caution, as we cannot distinguish whether these higher earnings returns are causal or not. In other words, the estimates may overstate the true returns to polytechnics for individuals with low pre-schooling earnings if these earnings are below their earnings potential because they are just “killing time” until polytechnic entry.

The employment results, shown in Columns (3) and (4), display a similar pattern of higher returns for individuals with the weakest pre-attendance labor-force attachment.

6.4 Returns by Demographic Groups

Table 4 shows the earnings returns to polytechnic bachelor's degrees by demographic groups. The first two columns divide the sample by sex, the middle three divide the sample by age at entry to polytechnic studies, and the final two columns divide the sample by region. The returns for men are more than fifty percent larger than the return for women: €8,100 versus €5,200. One possible explanation is that many more men than women receive degrees in technology, and – as shown in the next section (Table 5) – technology has the highest returns of any degree subject. This pattern of results is in contrast with the higher returns for women in U.S. community colleges (Jepsen, Troske, and Coomes, 2014; Carruthers and Sanford, 2015).

For age, younger students have higher returns than older students, consistent with U.S. research. For students ages 22 to 24 at entry, the returns are €9,100, compared to returns of €5,900 for ages 25 to 29 and €6,100 for students entering polytechnics after age 29. However, the results for the youngest age group should be interpreted with caution because – as mentioned previously – the pre-schooling earnings of 22 to 24 year-olds may not be accurate measures of their earnings potential if they are “settling” for low-paid jobs temporarily because they are waiting until they are admitted to postsecondary education.

The final two columns compares results between students who attended polytechnics in the Helsinki metropolitan area (using NUTS 3 as the level of region) and the rest of Finland. Region of schooling is chosen in an attempt to reduce the potential endogeneity of migration, but the results still make the potentially strong assumption that the location of polytechnics is exogenous. Completers who attend polytechnics outside the Helsinki metropolitan area have noticeably higher returns of €6,800 compared to returns of €5,300 for completers in Helsinki. A plausible explanation for this difference is better earnings

opportunities even without completing a degree in Helsinki than in other parts of Finland (cf. larger post-schooling dummy for Helsinki).

Appendix Table 2 shows the results for annual employment. Contrary to earnings effects, the employment returns for men (8.0 percentage points) are slightly smaller than the returns for women (8.7 percentage points). Employment returns decrease with age: youngest students have the highest returns (10.5 percentage points), followed by the aged 25–29 students (9.3 percentage points) and the oldest students (8.1 percentage points). Students attending in Helsinki have much smaller returns (6.3 percentage points) than students studying elsewhere in Finland (9.5 percentage points).

6.5 Returns by Field of Study

In Table 5, we present the returns to polytechnic bachelor's degrees by the field of study. Fields of study are divided into four areas: business, technology, health, and all other fields such as culture, tourism, catering and domestic services. Health is the most popular subject area, with 10,369 students. Business, administration, and social sciences have nearly as many (10,039). Of the polytechnic entrants, 9,369 study in the field of technology and transport and 6,873 study all other subjects. The dependent variable is earnings in the first four columns and employment in the remaining columns. As always, each column is from a separate regression.

The earnings and employment returns vary substantially by field of study. In the field of technology, polytechnic bachelor's degrees are associated with earnings increases of €9,000 and employment increases of 7.1 percentage points. Although health degrees correspond with higher employment of 10.4 percentage points, the earnings returns for health degrees are only €5,600. In the field of business, earnings and employment returns are considerably lower (€5,100 and 6.3 percentage points) than in the field of technology. Studies in all other subjects have average earnings returns of €5,700 and employment returns of 5.6

percentage points. Thus, the highest earnings returns are for technology, whereas the highest employment returns are for health.

6.6 Returns for Matching Estimators

Finally, we look at the results for the matching estimators, where the comparison group for entrants is the subset of individuals who have the most similar propensity to enter a polytechnic but have no postsecondary attendance. All covariates are balanced between the matched entrants and the non-entrants (based on the standardized differences in means and the variance ratios; results available from authors upon request).¹¹ In other words, the matched sample is similar with respect to observable characteristics as well as with respect to the propensity to enter a polytechnic in a particular year.

Figure 3 presents the difference in the earning development between the matched polytechnic entrants and non-entrants. Appendix Table 3 contains the coefficients and standard errors. Prior to the entry year, the earnings difference is minimal. During their studies, entrants earn considerable less than the non-entrants. Similarly to the descriptive Figure 1 for the completers and dropouts, five years after the match the earnings returns to a polytechnic entry are (€2,100) higher than not attending postsecondary education. The returns increase to €2,800 for six years, and €3,800 for eight years. For comparison, the preferred fixed effects result in Table 2 (column 2) is €6,300 for degree completion (*POLYBA*) and €1,800 for having attended polytechnics regardless of degree completion (*post-schooling*). As expected, our long-run matching estimates, which are a combination of the returns to attendance and the returns to completion, fall in between.

¹¹ The reported matching results are estimated using the teffects algorithm in Stata 14. To decrease the computation burden, we only use a 10% random sample of control observations and exclude individuals with a university degree from the matching analysis (a small subgroup in the polytechnic entrants). We only include individuals whom we observe labor market information for the full period before and after entry decision (-3, -2, ..., 7, 8). We utilize Abadie and Imbens (2012) robust standard errors that take into account that propensity scores are estimated.

The corresponding employment returns are shown in Figure 4. The pattern is also similar to the earnings development. Employment returns to polytechnic entry vary from 2.6 to 4.1 percentage points between years 5 and 8. The preferred fixed-effects return to employment is 8.5 percentage points for completion and 3.9 percentage points for attendance. As with earnings, the employment returns from the matching estimator are consistent with the returns from the preferred fixed-effects estimator.

7. Discussion

For mature students, polytechnic bachelor's degrees in Finland are associated with annual earnings gains of €6,300 and employment gains of 8.5 percentage points. The preferred model is person fixed effects, as earnings patterns show no systematic pre-schooling differences between future dropouts and completers.¹²

The gains appear to be strongest for younger individuals and for individuals with weak labor-force attachment in the years immediately prior to enrolling in polytechnics. However, these higher returns may not be causal if these individuals' pre-schooling labor-market outcomes are not representative of their potential labor-market outcomes in the absence of polytechnics attendance.

The gains differ substantially across demographics and fields of study. In contrast to the U.S., men have noticeably higher earnings returns than women. But employment returns are higher for women. Individuals who studied in the Helsinki metropolitan area have lower returns than individuals who studied elsewhere in Finland. Technology students have by far the highest earnings returns, whereas health has the highest employment returns. Business graduates have the smallest, but still significant, earnings and employment returns (of the three fields).

¹² To increase the representativeness, our analysis has focused on individuals entering polytechnics at relatively high age (22 or older).

This paper provides much-needed information on the labor-market returns to postsecondary vocational education in Europe. The overwhelming majority of evidence comes from U.S. community colleges, but the U.S. system is much different than the system in many European countries. Although our paper focuses on one country, the postsecondary vocational system in Finland is representative of many European countries. Students earn polytechnic bachelor's degrees after approximately three and a half to four years of full-time attendance, as in other countries such as Norway and the HBO diploma from universities of applied science in the Netherlands. Given the dire labor-market prospects for individuals with no postsecondary education in Europe, particularly among younger individuals, a better understanding of the labor-market returns to postsecondary education is needed (Bell and Blanchflower, 2011). Results from the U.S. are not particularly informative given the pronounced differences in education systems and labor markets. More research on Europe and elsewhere is warranted.

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Table 1: Descriptive Statistics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All		Dropouts		Completers		Diff.
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	(3) - (5)
<i>Post-Schooling Outcomes</i>							
Earnings (000s)	30.70	17.02	28.60	19.21	31.56	15.95	-2.97
Taxable income (000s)	34.61	18.44	33.44	21.47	35.10	17.01	-1.66
Employed	0.88	0.27	0.83	0.32	0.91	0.24	-0.07
Unemployed	0.06	0.17	0.08	0.20	0.05	0.16	0.03
<i>Pre-Schooling Outcomes</i>							
Earnings (000s)	19.14	13.13	19.74	14.07	18.89	12.70	0.85
Taxable income (000s)	22.51	12.70	23.25	14.06	22.20	12.07	1.05
Employed	0.75	0.35	0.75	0.35	0.76	0.35	-0.01
Unemployed	0.12	0.24	0.14	0.25	0.12	0.23	0.02
<i>Demographics</i>							
Completed degree	0.71	0.46					
Age at entry	32.92	7.40	32.90	7.45	32.92	7.38	-0.02
Helsinki region	0.31	0.46	0.32	0.47	0.31	0.46	0.01
Unemployment rate	13.95	4.68	13.78	4.68	14.02	4.67	-0.24
Female	0.61	0.49	0.47	0.50	0.67	0.47	-0.20
Finnish language	0.96	0.21	0.94	0.23	0.96	0.19	-0.02
Swedish language	0.03	0.16	0.04	0.19	0.02	0.15	0.02
Married or cohabiting	0.67	0.47	0.63	0.48	0.69	0.46	-0.06
Employed spouse	0.51	0.50	0.46	0.50	0.53	0.50	-0.08
Has kids under 7	0.30	0.46	0.28	0.45	0.31	0.46	-0.03
High school	0.54	0.50	0.50	0.50	0.56	0.50	-0.07
Matricul. exam results	3.80	1.21	3.83	1.24	3.79	1.19	0.04
Exam results missing	0.14	0.35	0.14	0.35	0.15	0.35	-0.01
Number of individuals	36,646		10,801		25,845		
Pre-schooling	292,003		84,821		207,182		
Post-schooling	451,860		131,849		320,011		
Number of observations	743,863		216,670		527,193		

Notes: Post-schooling outcomes are measured in years 6 to 8 after initial polytechnic enrollment. Pre-schooling outcomes are measured in the three years prior to initial polytechnic enrollment. All earnings and income measures are deflated using the consumer price index (base year 2012). Demographics are measured at the individual level in the year prior to initial polytechnic enrollment.

Table 2: Main Fixed-Effects Results for Earnings and Employment

	Earnings		Employment	
	(1)	(2)	(3)	(4)
POLYBA	5.10*** (0.17)	6.30*** (0.22)	0.075*** (0.004)	0.085*** (0.004)
POLYBA * 1/k		-3.22*** (0.25)		-0.029*** (0.006)
Post-schooling	1.32*** (0.18)	1.80*** (0.27)	0.041*** (0.005)	0.039*** (0.006)
Post-schooling * 1/k		0.35 (0.25)		0.011* (0.006)
Polytechnic student this year	-2.36*** (0.10)	-2.32*** (0.10)	-0.049*** (0.003)	-0.049*** (0.003)
Student exits polytechnic	2.61*** (0.13)	2.68*** (0.12)	0.061*** (0.004)	0.061*** (0.004)
Polytechnic degree this year	-1.03*** (0.18)	-1.01*** (0.18)	0.003 (0.005)	0.003 (0.005)
Unemployment rate (NUTS4)	-0.39*** (0.02)	-0.39*** (0.02)	-0.015*** (0.000)	-0.015*** (0.000)
Observations	743,863	743,863	743,863	743,863
Adj. R-squared	0.622	0.622	0.318	0.318
No. of individuals	36,646	36,646	36,646	36,646
F-test for absorbed effect	25.23***	25.24***	8.623***	8.620***

Notes: Standard errors clustered at the individual level are in parentheses. Statistical significance in two-sided tests are denoted by * for the ten-percent level, ** for the five-percent level, and *** for the one-percent level. All models also include calendar year fixed effects, year relative to initial enrollment fixed effects, person fixed effects, a time trend interacted with age at initial enrollment, and a time trend interacted with female gender.

Table 3: Earnings and Employment Results by Pre-Enrollment Earnings Levels

	Earnings		Employment	
	(1) top 75%	(2) > min wage	(3) top 75%	(4) > min wage
POLYBA	5.56*** (0.26)	5.34*** (0.27)	0.062*** (0.004)	0.056*** (0.004)
POLYBA * 1/k	-3.36*** (0.30)	-3.33*** (0.31)	-0.032*** (0.006)	-0.034*** (0.006)
Post-schooling	1.84*** (0.32)	1.92*** (0.33)	0.033*** (0.007)	0.033*** (0.007)
Post-schooling * 1/k	0.78*** (0.30)	0.82*** (0.305)	0.017*** (0.006)	0.021*** (0.006)
Student this year	-2.43*** (0.12)	-2.40*** (0.17)	-0.044*** (0.003)	-0.040*** (0.004)
Student exits polytechnic	3.15*** (0.14)	3.23*** (0.15)	0.055*** (0.004)	0.054*** (0.004)
Degree this year	-1.52*** (0.22)	-1.59*** (0.23)	0.001 (0.006)	-0.001 (0.006)
Unemployment rate (NUTS4)	-0.36*** (0.02)	-0.36*** (0.02)	-0.013*** (0.000)	-0.012*** (0.000)
Observations	562,249	531,701	562,249	531,701
Adj. R-squared	0.600	0.597	0.241	0.230
No. of individuals	27,484	25,916	27,484	25,916
Minimum prior earnings	7,876	9,438	7,876	9,438

Notes: Standard errors clustered at the individual level are in parentheses. Statistical significance in two-sided tests are denoted by * for the ten-percent level, ** for the five-percent level, and *** for the one-percent level. All models also include calendar year fixed effects, year relative to initial enrollment fixed effects, person fixed effects, a time trend interacted with age at initial enrollment, and a time trend interacted with female gender. The minimum earnings limit is used by Statistics Finland (2000) to classify a person as a full-time full-year worker, based on annual data.

Table 4: Earnings Results by Gender, Age, and Region of Study

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Males	Females	Age 22–24	Age 25–29	Age 30–50	Helsinki	Not Helsinki
POLYBA	8.13*** (0.37)	5.18*** (0.27)	9.12*** (0.53)	5.92*** (0.46)	6.11*** (0.28)	5.30*** (0.439)	6.85*** (0.25)
POLYBA * 1/k	-5.53*** (0.42)	-1.82*** (0.32)	-4.23*** (0.62)	-1.75*** (0.53)	-3.84*** (0.33)	-3.19*** (0.50)	-3.24*** (0.29)
Post-schooling	2.83*** (0.44)	1.18*** (0.33)	3.08*** (0.58)	1.80*** (0.50)	1.25*** (0.37)	2.45*** (0.53)	1.35*** (0.31)
Post-schooling * 1/k	-0.32 (0.39)	0.53 (0.33)	-0.57 (0.58)	-0.03 (0.49)	0.72** (0.34)	1.10** (0.49)	0.06 (0.29)
Student this year	-2.37*** (0.16)	-2.28*** (0.12)	-2.46*** (0.21)	-2.20*** (0.16)	-2.28*** (0.14)	-1.96*** (0.22)	-2.53*** (0.10)
Student exits polytechnic	2.86*** (0.19)	2.62*** (0.17)	2.07*** (0.26)	2.45*** (0.23)	2.75*** (0.17)	3.26*** (0.24)	2.35*** (0.14)
Degree this year	-0.97*** (0.28)	-1.25*** (0.23)	0.61* (0.35)	-0.17 (0.30)	-1.81*** (0.25)	-0.74* (0.41)	-1.07*** (0.18)
Unemployment rate (NUTS 4)	-0.36*** (0.03)	-0.38*** (0.02)	-0.40*** (0.04)	-0.39*** (0.03)	-0.36*** (0.02)	-0.70*** (0.04)	-0.34*** (0.02)
Observations	283,912	459,951	91,465	150,689	501,709	229,128	514,735
Adj. R-squared	0.652	0.579	0.639	0.607	0.620	0.607	0.625
No. of individuals	14,250	22,396	5,757	8,490	22,399	11,467	25,179

Notes: Standard errors clustered at the individual level are in parentheses. Statistical significance in two-sided tests are denoted by * for the ten-percent level, ** for the five-percent level, and *** for the one-percent level. All models also include calendar year fixed effects, year relative to initial enrollment fixed effects, person fixed effects, a time trend interacted with age at initial enrollment, and a time trend interacted with female gender.

Table 5: Earnings and Employment Results by the Field of Study

	Earnings				Employment			
	(1) Business	(2) Technology	(3) Health	(4) Other	(5) Business	(6) Technology	(7) Health	(8) Other
POLYBA	5.07*** (0.43)	9.03*** (0.45)	5.63*** (0.42)	5.73*** (0.47)	0.063*** (0.008)	0.071*** (0.008)	0.104*** (0.010)	0.056*** (0.010)
POLYBA * 1/k	-4.09*** (0.49)	-5.37*** (0.51)	-0.35 (0.49)	-3.22*** (0.55)	-0.026** (0.010)	-0.039*** (0.010)	0.011 (0.014)	-0.031** (0.013)
Post-schooling	1.37** (0.55)	3.37*** (0.53)	2.03*** (0.50)	1.67*** (0.56)	0.034*** (0.012)	0.069*** (0.012)	0.043*** (0.015)	0.015 (0.015)
Post-schooling * 1/k	0.95* (0.49)	-0.83* (0.48)	0.28 (0.50)	0.20 (0.54)	0.009 (0.011)	0.007 (0.011)	0.005 (0.015)	0.035*** (0.013)
Student this year	-1.31*** (0.24)	-1.89*** (0.21)	-3.85*** (0.14)	-1.49*** (0.19)	-0.018*** (0.006)	-0.059*** (0.006)	-0.090*** (0.006)	-0.017** (0.007)
Student exits polytechnic	2.36*** (0.23)	2.34*** (0.23)	3.60*** (0.27)	1.85*** (0.26)	0.053*** (0.007)	0.079*** (0.007)	0.074*** (0.011)	0.029*** (0.009)
Unemployment rate (NUTS 4)	-0.68 (0.43)	0.44 (0.36)	-1.57*** (0.32)	0.05 (0.35)	-0.011 (0.009)	0.013 (0.010)	0.020 (0.012)	0.011 (0.012)
Observations	206,644	191,295	209,138	136,786	206,644	191,295	209,138	136,786
Adj. R-squared	0.610	0.642	0.572	0.625	0.314	0.344	0.302	0.330
No. of individuals	10,039	9,369	10,365	6,873	10,039	9,369	10,365	6,873

Notes: Standard errors clustered at the individual level are in parentheses. Statistical significance in two-sided tests are denoted by * for the ten-percent level, ** for the five-percent level, and *** for the one-percent level. All models also include calendar year fixed effects, year relative to initial enrollment fixed effects, person fixed effects, a time trend interacted with age at initial enrollment, and a time trend interacted with female gender. The field has been measured at the beginning of the studies.

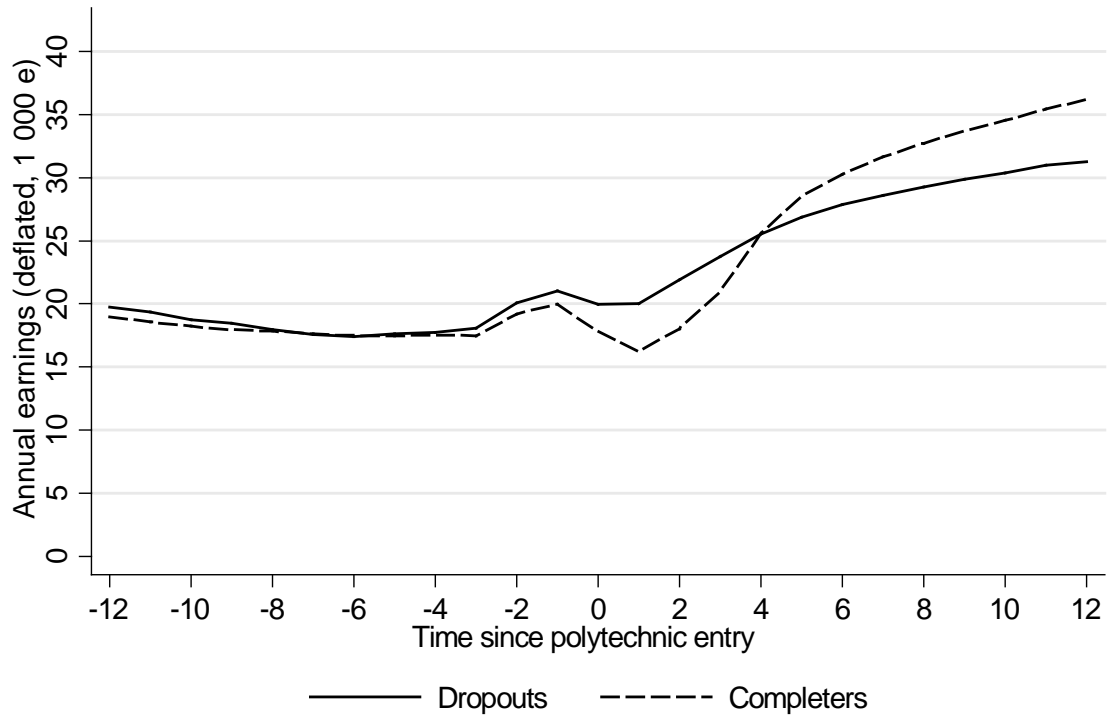


Figure 1: Annual Earnings by Completion Status, Years since Polytechnic Entry

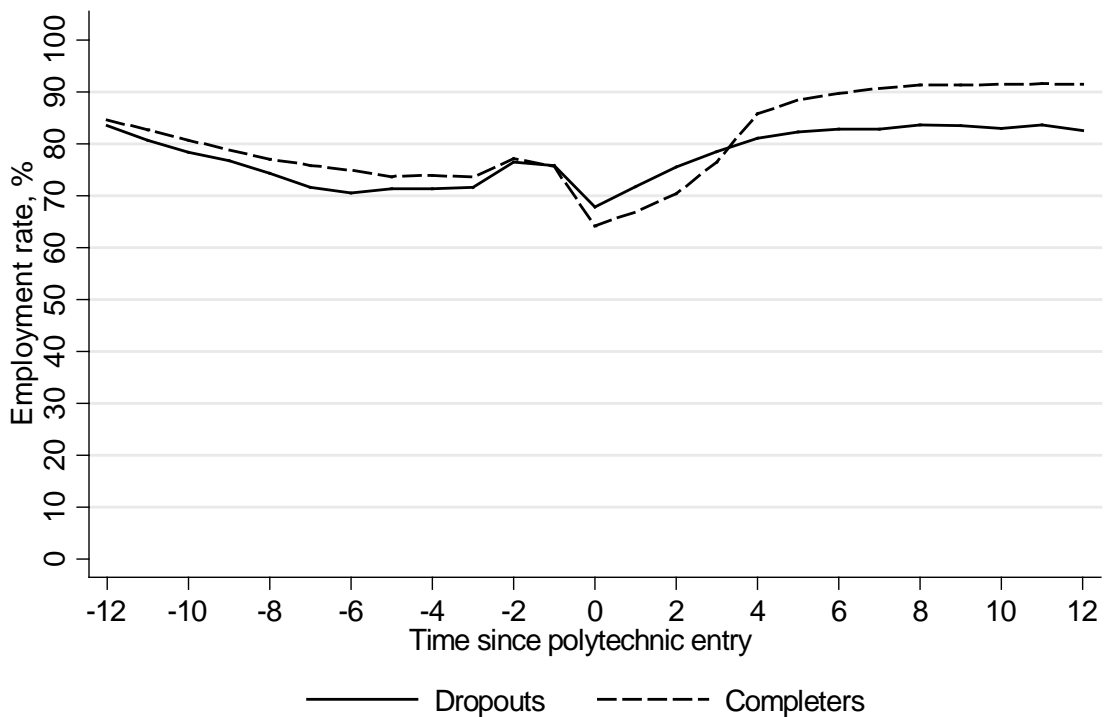


Figure 2: Annual Employment by Completion Status, Years since Polytechnic Entry

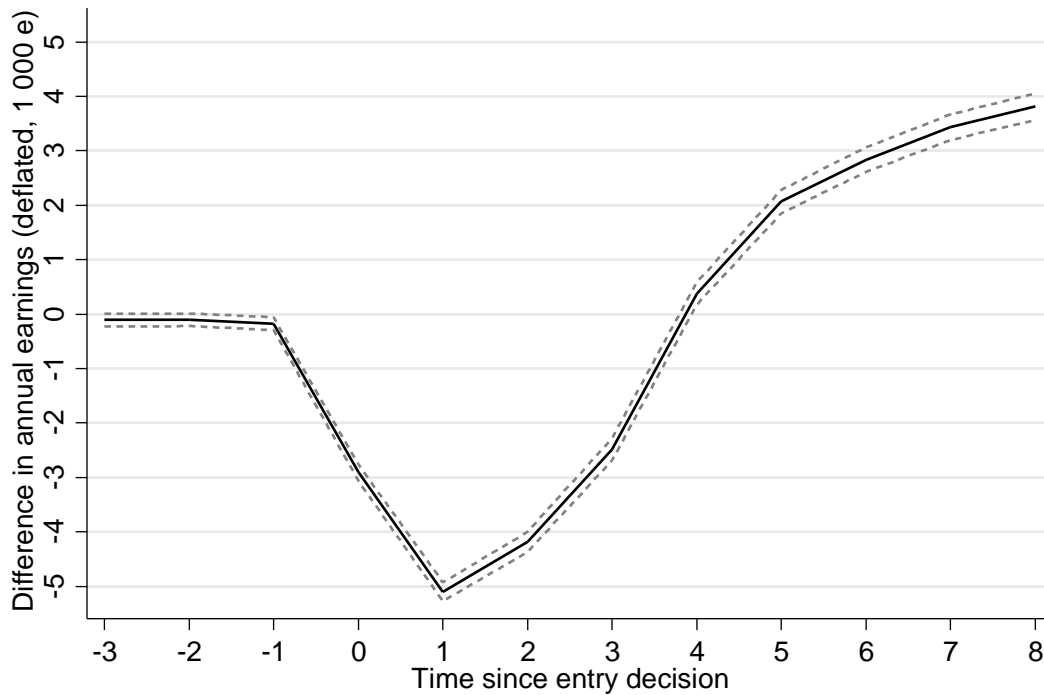


Figure 3: Difference in Earning Development between the Matched Polytechnic Entrants and Non-Entrants, Years since Polytechnic Entry Decision (Notes: Treatment effect on the treated is reported. Dashed lines indicate 95% confidence intervals based on Abadie and Imbens (2012) robust standard errors.)

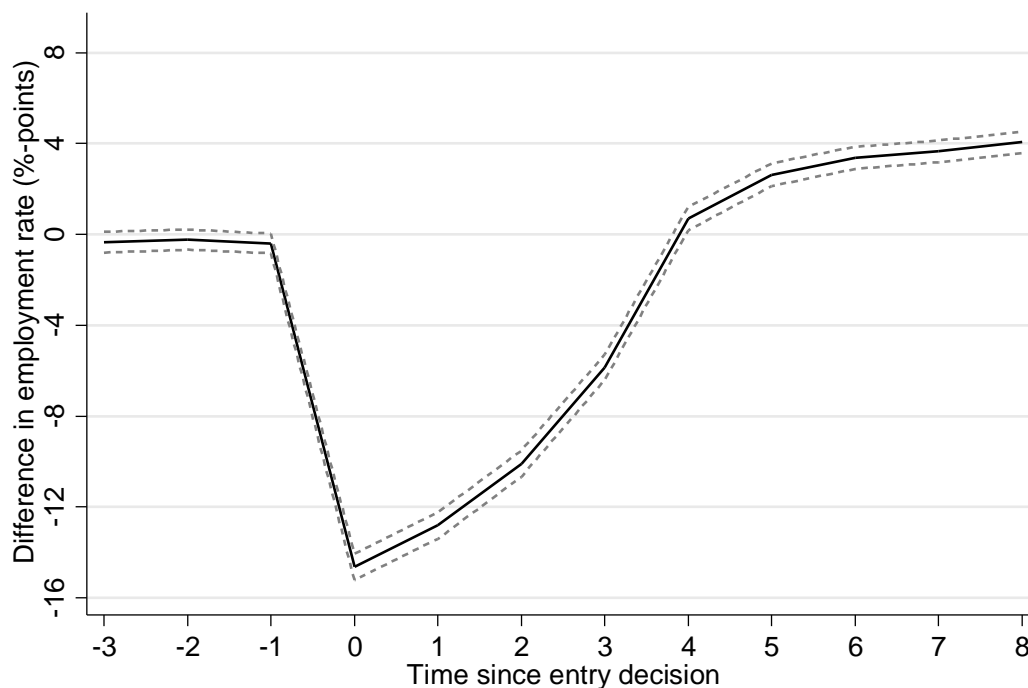


Figure 4: Difference in Employment Development between the Matched Polytechnic Entrants and Non-Entrants, Years since Polytechnic Entry Decision (Notes: Treatment effect on the treated is reported. Dashed lines indicate 95% confidence intervals based on Abadie and Imbens (2012) robust standard errors.)

Appendix Table 1: OLS Results for Earnings and Employment

	Earnings		Employment	
	(1) Coeff.	(2) Std. Err.	(3) Coeff.	(4) Std. Err.
POLYBA	6.07***	0.24	0.083***	0.004
POLYBA * 1/k	-3.04***	0.29	-0.031***	0.006
Post-schooling	1.15***	0.36	0.026***	0.007
Post-schooling * 1/k	0.43	0.34	0.018***	0.006
Polytechnic student this year	-2.69***	0.13	-0.052***	0.004
Student exits polytechnic	2.48***	0.15	0.057***	0.004
Degree this year	-1.28***	0.21	-0.001	0.006
Age in years	2.14***	0.07	0.048***	0.001
Age squared	-0.02***	0.001	-0.001***	0.000
Female	12.69***	1.19	0.171***	0.025
Female * Age	-0.73***	0.08	-0.008***	0.001
Female * Age squared	0.01***	0.001	0.000***	0.000
Swedish (ref. Finnish)	-1.35***	0.37	-0.007	0.007
Other language	-8.89***	0.67	-0.181***	0.015
Male * Married	4.30***	0.22	0.087***	0.004
Female * Married	0.50***	0.16	-0.001	0.004
Male * Has kids under 7	0.87***	0.17	0.015***	0.003
Female * Has kids under 7	-7.58***	0.09	-0.139***	0.002
Male * Spouse employed	2.96***	0.20	0.056***	0.003
Female * Spouse employed	0.77***	0.12	0.056***	0.003
High school graduate	-0.45	0.29	0.007	0.005
Matricul. exam results	0.11	0.07	-0.002	0.001
Exam results missing	0.52*	0.30	-0.005	0.005
Previous degree (ref. vocational college)				
- University	2.12***	0.40	-0.026***	0.006
- High school	-6.09***	0.19	-0.107***	0.004
- Vocational school	-3.52***	0.13	-0.038***	0.002
- Unknown	-5.79***	0.32	-0.116***	0.007
Unemployment rate (NUTS4)	-0.40***	0.02	-0.010***	0.000
Observations		743,863		743,863
Adj. R-squared		0.335		0.138

Notes: Standard errors clustered at the individual level are in parentheses. Statistical significance in two-sided tests are denoted by * for the ten-percent level, ** for the five-percent level, and *** for the one-percent level. All models also include birth and study region (NUTS3) fixed effects, calendar year fixed effects and year relative to initial enrollment fixed effects.

Appendix Table 2: Employment Results by Gender, Age, and Region of Study

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Males	Females	Age 22–24	Age 25–29	Age 30–50	Helsinki	Not Helsinki
POLYBA	0.080*** (0.006)	0.087*** (0.006)	0.105*** (0.012)	0.093*** (0.009)	0.081*** (0.005)	0.063*** (0.007)	0.095*** (0.005)
POLYBA * 1/k	-0.046*** (0.008)	-0.008 (0.008)	-0.043*** (0.016)	-0.011 (0.012)	-0.032*** (0.007)	-0.028*** (0.009)	-0.030*** (0.007)
Post-schooling	0.039*** (0.009)	0.041*** (0.009)	0.063*** (0.018)	0.050*** (0.014)	0.037*** (0.008)	0.026** (0.011)	0.045*** (0.008)
Post-schooling * 1/k	0.012 (0.008)	0.001 (0.009)	-0.004 (0.017)	0.007 (0.013)	0.003 (0.007)	0.031*** (0.010)	0.002 (0.007)
Student this year	-0.066*** (0.005)	-0.039*** (0.004)	-0.093*** (0.009)	-0.042*** (0.007)	-0.042*** (0.004)	-0.024*** (0.005)	-0.059*** (0.004)
Student exits polytechnic	0.076*** (0.006)	0.049*** (0.006)	0.065*** (0.012)	0.064*** (0.009)	0.056*** (0.005)	0.044*** (0.007)	0.068*** (0.005)
Degree this year	-0.015* (0.008)	0.016** (0.007)	0.014 (0.015)	0.027** (0.012)	-0.013** (0.006)	0.021** (0.009)	-0.004 (0.007)
Unemployment rate (NUTS 4)	-0.015*** (0.001)	-0.015*** (0.001)	-0.020*** (0.001)	-0.019*** (0.001)	-0.011*** (0.001)	-0.020*** (0.001)	-0.012*** (0.001)
Observations	283,912	459,951	91,465	150,689	501,709	229,128	514,735
Adj. R-squared	0.354	0.299	0.351	0.321	0.299	0.288	0.326
No. of individuals	14,250	22,396	5,757	8,490	22,399	11,467	25,179

Notes: Standard errors clustered at the individual level are in parentheses. Statistical significance in two-sided tests are denoted by * for the ten-percent level, ** for the five-percent level, and *** for the one-percent level. All models also include calendar year fixed effects, year relative to initial enrollment fixed effects, person fixed effects, a time trend interacted with age at initial enrollment, and a time trend interacted with female gender.

Appendix Table 3: Earnings and Employment Results for Matching Estimators (Entrants vs. Non-Entrants)

Number of Years after Match (i.e. after Polytechnic Entry Decision)	Earnings		Employment	
	(1) Diff.	(2) Std. Err.	(3) Diff.	(4) Std. Err.
-3 years	-0.106*	0.060	-0.003	0.002
	[-0.225, 0.012]		[-0.008, 0.001]	
-2 years	-0.103*	0.059	-0.002	0.002
	[-0.218, 0.012]		[-0.007, 0.002]	
-1 year	-0.173***	0.060	-0.004*	0.002
	[-0.292, -0.055]		[-0.008, 0.000]	
Year of Entry Decision	-2.909***	0.076	-0.146***	0.003
	[-3.058, -2.759]		[-0.152, -0.141]	
1 year	-5.103***	0.088	-0.128***	0.003
	[-5.276, -4.929]		[-0.134, -0.122]	
2 years	-4.186***	0.094	-0.101***	0.003
	[-4.371, -4.001]		[-0.107, -0.095]	
3 years	-2.484***	0.104	-0.059***	0.003
	[-2.689, -2.280]		[-0.064, -0.053]	
4 years	0.379***	0.105	0.007***	0.003
	[0.173, 0.585]		[0.002, 0.012]	
5 years	2.067***	0.109	0.026***	0.003
	[1.853, 2.282]		[0.021, 0.031]	
6 years	2.839***	0.115	0.034***	0.002
	[2.613, 3.064]		[0.029, 0.039]	
7 years	3.434***	0.120	0.037***	0.002
	[3.199, 3.669]		[0.032, 0.041]	
8 years	3.813***	0.125	0.041***	0.002
	[3.568, 4.057]		[0.036, 0.045]	

Notes: Number of observations is 671,737 (number of entrants is 34,963 and number of non-entrants is 636,774). Average treatment effects on the treated are reported. The results are based on propensity score matching on two nearest neighbors on common support. A probit model is used to estimate the propensity scores (the results are available on request). Abadie and Imbens (2012) robust standard errors on two matches are used that take into account that propensity scores are estimated. Statistical significance in two-sided tests are denoted by * for the ten-percent level, ** for the five-percent level, and *** for the one-percent level. 95 percent confidence intervals are given in square brackets.