RUHR

ECONOMIC PAPERS

Sylvi Rzepka

Labor Market Returns to College Education with Vocational Qualifications

RUHR UNIVERSITÄT BOCHUM RUB RWI #633

Imprint

Ruhr Economic Papers

Published by

Ruhr-Universität Bochum (RUB), Department of Economics
Universitätsstr. 150, 44801 Bochum, Germany

Technische Universität Dortmund, Department of Economic and Social Sciences
Vogelpothsweg 87, 44227 Dortmund, Germany

Universität Duisburg-Essen, Department of Economics
Universitätsstr. 12, 45117 Essen, Germany

Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI)
Hohenzollernstr. 1-3, 45128 Essen, Germany

Editors

Prof. Dr. Thomas K. Bauer
RUB, Department of Economics, Empirical Economics
Phone: +49 (0) 234/3 22 83 41, e-mail: thomas.bauer@rub.de

Prof. Dr. Wolfgang Leininger
Technische Universität Dortmund, Department of Economic and Social Sciences
Economics – Microeconomics
Phone: +49 (0) 231/7 55-3297, e-mail: W.Leininger@tu-dortmund.de

Prof. Dr. Volker Clausen
University of Duisburg-Essen, Department of Economics
International Economics
Phone: +49 (0) 201/1 83-3655, e-mail: vclausen@vwl.uni-due.de

Prof. Dr. Roland Döhrn, Prof. Dr. Manuel Frondel, Prof. Dr. Jochen Kluve
RWI, Phone: +49 (0) 201/81 49-213, e-mail: presse@rwi-essen.de

Editorial Office

Sabine Weiler
RWI, Phone: +49 (0) 201/81 49-213, e-mail: sabine.weiler@rwi-essen.de

Ruhr Economic Papers #633

Responsible Editor: Thomas K. Bauer

ISSN 1864-4872 (online) – ISBN 978-3-86788-737-3

Ruhr Economic Papers #633

Sylvi Rzepka

Labor Market Returns to College Education with Vocational Qualifications

RUHR UNIVERSITÄT BOCHUM RUB

RWI

Bibliografische Informationen der Deutschen Nationalbibliothek

Die Deutsche Bibliothek verzeichnet diese Publikation in der deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über: *http://dnb.d-nb.de* abrufbar.

Das RWI wird vom Bund und vom Land Nordrhein-Westfalen gefördert.

http://dx.doi.org/10.4419/86788737
ISSN 1864-4872 (online)
ISBN 978-3-86788-737-3

Sylvi Rzepka[1]

Labor Market Returns to College Education with Vocational Qualifications

Abstract

In a context of demographic change, European governments seek ways to keep the skill set of the labor force flexible. One option to achieve this goal is widening access to college education to non-traditional students, such as those vocationally trained. Assessing whether this is a promising approach, I investigate what kind of labor market returns German non-traditional students can expect after enrolling in college rather than continuing with a vocational training-based career. Relying on the Adult Cohort of the National Educational Panel Study I use propensity score-adjusted regressions to estimate the average treatment effect on those that enroll in college based on vocational qualifications. The findings suggest high opportunity costs because treated individuals have an up to 67 percent lower employment probability while being enrolled. After this initial phase individuals exhibit a similar employment level and job stability as those that continue with a vocational training-based career. All treated individuals take up more prestigious jobs. Enrolling in college is on average associated with at most 43 percent higher life-time earnings compared to earnings when continuing with a vocational training-based career. However, recouping the opportunity costs of enrolling in college is a lengthy and risky process.

JEL Classification: I21, J24, J62

Keywords: Educational choice; vocational training; tertiary education; occupational mobility

August 2016

1 Sylvi Rzepka, RWI and RUB. – This study uses the weakly anonymous National Educational Panel Study (NEPS): Starting Cohort 6 - Adults (Adult Education and Lifelong Learning), doi: 10.5157/NEPS:SC6:5.1.0, linked to administrative data of the IAB (Years 1975-2012) by the German Record Linkage Center (GRLC). Data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and remote data access. The NEPS data was collected as part of the Framework Program for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF) from 2008 to 2013. As of 2014, NEPS is carried out by the Leibniz Institute for Educational Trajectories (LIfBi) at the University of Bamberg in cooperation with a nationwide network. I thank Dörte Heger, Ingo Isphording, Stepan Jurajda, Jochen Kluve, Marc Piopiunik, and Sandra Schaffner, Christoph M. Schmidt, Marcus Tamm and seminar participants at SPP1646 Colloquium (Bamberg), IAWEE 2015 (Cantanzaro), BIEN Jahrestagung 2015 (Berlin), BIBB-Conference 2015 (Bonn) for helpful comments and suggestions. I acknowledge financial support from the Deutsche Forschungsgemeinschaft (TA 829/2-2). – All correspondence to: Sylvi Rzepka, RWI, Hohenzollernstr. 1-3, 45128 Essen, Germany, e-mail: sylvi.rzepka@rwi-essen.de

1 Introduction

In aging populations, most employees of tomorrow are already in the workforce today. Since they might fail to meet future skill requirements, lifelong learning and profound skill upgrades at later stages in life become increasingly important. Germany's recent policy to loosen and harmonize college entrance requirements for individuals with vocational training in all federal states is aimed at facilitating this objective (KMK, 2009). Since this resolution by the Conference of the Ministers of Education in 2009, there has been an increase in college enrollment of non-traditional students - those with vocational qualifications: in 1993, 1,177 individuals enrolled based on vocational qualifications, while in 2013 this figure rose to 13,215 (Federal Statistical Office, 2015b). However, in relative terms this increase remains small, corresponding to 0.4 percent of all first semester students in 1993 and to 2.7 percent in 2013[1]. A key factor underlying the low relative take-up of this new pathway to college could be limited labor market returns. This paper attempts to test this hypothesis, by estimating labor market returns to college education based on vocational qualifications[2]. In particular, I analyze the effect of college enrollment on non-traditional student employment probability, job quality, and earnings.

This study is closely related to the literature on labor market effects of college education for non-traditional students, i.e. individuals that enter college based on vocational qualifications and further qualification, rather than the regular college entrance certificate (Schuetze & Slowey, 2002).To date, the economics literature has focused on the returns to studying for mature students, i.e. individuals that are older than the main student body. For example, a series of studies in Nordic countries compare the outcomes of mature students to individuals that never take up studies. Hällsten (2012) asks: "Is it ever too late to study?". Using Swedish administrative data, he finds large significant positive effects on the employment rate and income for those that enroll in tertiary education. Also using Swedish administrative data, Stenberg et al. (2014) find positive wage effects of taking school-level classes between ages 42-55 for women, but no wage effects for men. Finally, Böckerman et al. (2015), in a study most comparable, reveal significant positive returns to finishing a postsecondary vocational training degree in Finland.

In a broader sense, this study fits in the literature on the returns to life-long learning - such as the training literature, which focuses on the returns to short-term training interventions. For instance, contributions using a comparison group approach find insignificant wage returns

[1] For comparison, about 462000 individuals aged 20-30 were in the German labor market in 2013 that had completed a substantial further training and of whom many would therefore vocationally qualify for college studies (Federal Statistical Office, 2015a).

[2] College refers to all tertiary education institutions that traditionally require a form of the German high school leaving certificate, the so-called *Abitur*, i.e. universities, universities of applied sciences, and university of cooperative education.

to further training in the Netherlands (Leuven & Oosterbeek, 2008) and in Germany (Görlitz, 2011). This suggests that the overall empirical evidence on the returns to life-long learning is still mixed.

I contribute to the ongoing discussion of whether life-long learning renders significant labor market benefits to the individual. More specifically, I focus on vocationally qualified students: a group of non-traditional students who are not only older than traditional college students, but also face higher entry barriers to college education because they do not possess the formal entry requirement. This type of non-traditional student is discussed in the sociology and education literatures. Specifically, these disciplines examine college access possibilities for individuals with vocational training, how they change over time (Scholz, 1995; Dahm, Kamm, Kerst, Otto, & Wolter, 2013) and compare pathways across countries (Schuetze & Slowey, 2002). In addition, these fields provide qualitative evidence on the motivation of individuals who enroll or attempt to enroll in college based on vocational training (Wolter, 1991; Kamm & Otto, 2013). However, to the best of my knowledge, there has been no control group-based quantitative analysis aimed at determining the returns to college education for vocationally trained students.

Using the adult cohort of the National Educational Panel Study linked to administrative wage information, I employ a selection on observables design. I use propensity score adjusted regressions with different treatment and control group definitions. *Version 1* splits the control group into those with an average vocational training-based career and a subgroup of the former which have participated in substantial further vocational training. *Version 2* divides the treated into early enrollees, those who enroll in college within 3.5 years and late enrollees, who enroll any time after 3.5 years. These different definitions allow to control for the diverse levels of motivation of individuals to participate in life-long learning.

Findings suggest that there are large opportunity costs attached to enrolling in university based on vocational qualifications. Initially, individuals who enroll in college have a lower employment probability than individuals that do not enroll. For instance, treated individuals are up to 45 percent less likely to be employed 3.5 years after finishing vocational training than those that continue with a vocational training-based career. However, this difference is temporary, and disappears after about ten years when most treated individuals are no longer enrolled in college. Furthermore, the individuals that enroll soon after finishing their vocational training have similar job stability as those that continue with their vocational training-based career. After enrolling in college, individuals score on average 34 points higher on the Magnitude Prestige Scale, that spans from 20 to 186.8, than those who do not enroll. While all individuals experience higher daily wages on average after enrolling in college, treated individuals on average break-even 23 years after finishing vocational training. The exact increase in cumulative life-time earnings due to enrolling in college is varies vastly

across individuals. Hence, recouping the forgone earnings of enrolling in college is a lengthy and risky process.

The remainder of this paper is structured as follows: section 2 describes the institutional set-up and the data, section 3 discusses the empirical strategy, section 4 presents the results and section 5 concludes.

2 Foundations for the analysis

2.1 Institutional setting

In West Germany in the 1980s and 1990s, 20 percent to 29 percent of an age cohort were enrolled in tertiary education (Federal Statistical Office, 2015b). There are three different paths to enter college in Germany which are summarized in Figure 1. Passing the *Abitur*, Germany's school exit exam after higher secondary education, in continuous schooling is the most common way to enter college. About 91 percent of all first year students took this "first educational path" in 1993[3]. The second way to college is passing a form of *Abitur* discontinuously at an evening school or similar institution, which is done by about 5 percent of all first year students in 1993.

The "third educational path" enables students to access college based on vocational qualifications without any form of *Abitur* (Dahm et al., 2013; Teichler & Wolter, 2004). This access mode became more available in the 1970s and 1980s. Until 2009 the exact regulations varied by Bundesland. For instance, in Lower Saxony and North-Rhein Westphalia individuals needed to pass a college entry exam (Dahm et al., 2013; Freitag, 2012), while Bremen, Schleswig-Holstein, Berlin and Hamburg offered a trial study phase (Wolter, 1991). In 2009, the Conference of the Ministers of Education (KMK) passed a resolution to harmonize college entry requirements for vocationally trained in all Bundesländer (KMK, 2009).

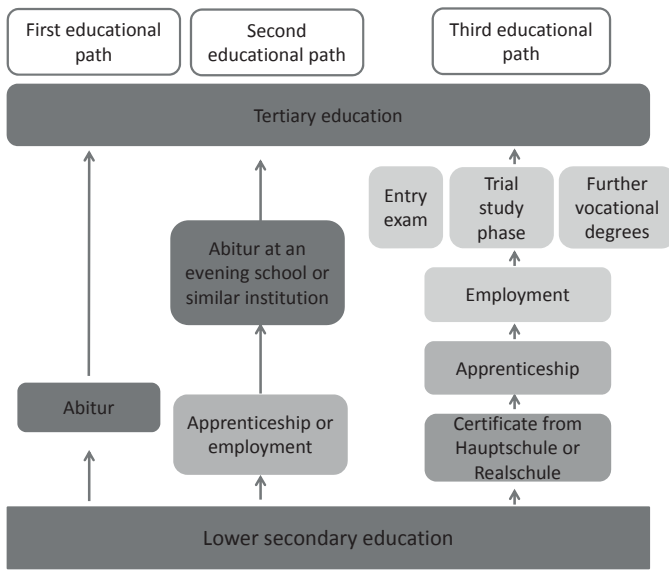
2.2 Data

The analysis uses the NEPS-SC6-ADIAB. This consists of the adult cohort of the National Education Panel Study (NEPS, Starting Cohort 6), which is a panel study on educational, occupational, and family formation processes (Blossfeld et al., 2011). The adult cohort covers detailed life course information from birth to adult life for 17,137 individuals born between 1944 and 1986. In addition, to the retrospective information the panel now consists of five waves covering current employment and educational activities.

The survey data are supplemented with administrative earnings data from the Sample of Integrated Labour Market Biographies (SIAB) which covers the time period 1975-2010

[3]These percentages are based on the Hochschulstatistik (H201) of the Federal Statistical Office (2015b) and are the earliest available. The definition of the third educational path is the same as Wolter et al. (2014) (p.18).

Figure 1: Educational paths to college in Germany



Source: Own illustration based on Kamm and Otto (2014).

for West Germany, if the survey participants agreed to record linkage and were identified in the data. 90 percent of all NEPS-Participants agreed to data-linkage and the records were retrievable in the SIAB. In total, 74 percent of all survey participants were linkable to the administrative data (Antoni & Eberle, 2015). Individuals that could not be linked either did not agree to record linkage, were not identifiable in the data with the record linkage variables (name, birthdate, gender and address), are self-employed or in public service and hence not registered with a social security number. The SIAB provides top-coded daily wages; therefore, I apply the routine suggested by Reichelt (2015) to impute the full daily earnings at the upper end of the distribution[4].

In line with the research question, the sample focuses on individuals who did not obtain a form of *Abitur*. Individuals that do not indicate a school degree, have inconsistencies in their educational path or that do not have a vocational education spell are omitted from the

[4]Reichelt (2015) proposes to predict wages above the top-coded income level based on interval regressions with the following covariates: schooling, age, sex, 3-digit occupations, job position, size of firm, as well as an East Germany indicator.

analysis[5]. I concentrate on West Germans since prior to the reunification the educational paths to tertiary education were different in East Germany (Lischka, 1991). The final sample has 5,774 observations. The treatment variable in its general form is defined as an individual that indicates enrolling in college based on vocational qualification or that is observed in the data as enrolling in college without having a form of Abitur. The sample includes 163 treated observations.

3 Preparing the Analysis

3.1 Method

I assess the effect of enrolling in college education based on vocational qualifications using propensity score-adjusted regressions and different control groups[6]. Thus, I rely on the potential outcomes framework (Rubin, 1974), where ideally, one compares the potential outcome of the treated when treated (y^T) and when not treated (y^C). However, individuals are not observable in both states. Therefore, in order to estimate the average treatment effect on the treated (ATT) I turn to a selection on observables design to construct an adequate control group: propensity score matching combined with regression models. I use the weights estimated by the best-performing matching algorithm to adjust the regression.

Formally the estimates for the average treatment effect on the treated read: $\beta^{=}(X'WX)^{-1}X'Wy$. Where the weight matrix W consists of the weights obtained from the propensity score matching for all control observations as the off-diagonal elements and of elements with the value 1 for all treated observations as the diagonal[7]. Standard errors are clustered at the Bundesland and vocational decade level since within these groups one can expect correlation[8]. All in all, this approach classifies as doubly-robust since any imbalances that remain after propensity score matching may be addressed by the covariates used in the regression model (Stuart, 2010; Bang & Robins, 2005).

I define different versions of the treatment and control group which are summarized in Table 1. In *version 1* the treated individuals enroll in college based on vocational qualifications some time after finishing their vocational training[9]. In version 1 there are 2 types

[5] The categories of inconsistencies are: being younger than 11 at a *Hauptschulabschluss* or higher, being younger than 12 at a *Mittlere Reife*, being younger than 14 when starting vocational training, being younger than 20 when obtaining a *Meister*, younger than 20 when finishing a college degree, enrolling in tertiary education 6 months before finishing secondary school or prior to finishing vocational education. Furthermore, I do not include individuals in the sample that are 40 years or older when starting a college degree since one cannot observe enough labor market episodes after the treatment.

[6] All studies on related aspects in Nordic countries mentioned in the introduction also rely on propensity score methods.

[7] This weighting approach is implemented in other recent applications which also make use of the propensity score: Schmitz and Westphal (2015) and Marcus (2014).

[8] There are 44 clusters.

[9] The way that individuals enter college may have been different over time and across Germany's federal states

of control groups. Control group 1 consists of individuals that have a vocational degree and never enroll in tertiary education; these represent the labor market outcomes of an average vocational training-based career. Control group 2, a subgroup of the former, includes individuals that have participated in substantial further vocational education e.g. by doing a master craftsman, a technician course or a course at the Chambre of Industry and Commerce (IHK). This group has demonstrated motivation to enhance their skills within the vocational track, and therefore are likely to resemble those that decide to enroll in college education more than the average worker that pursues a vocational training-based career. By comparing the treatment group to individuals who pursue a different but comparable further training strategy I implicitly control for motivation, a trait that is usually unobserved.

Version 2 adopts a dynamic perspective by stratifying the treatment into early enrollees, those that enroll within 3.5 years after finishing vocational training and late enrollees, those who enroll later than 3.5 years after their first vocational training. Early and late enrollees each constitute about half of the treatment group. The control group for the early and late enrollees corresponds to control group 1 of version 1, i.e. those that continue with an average vocational training-based career. The disaggregation of the treatment group in version 2 allows to implicitly capture motivation and determination of individuals, which is also an unobservable trait.

Table 1: Treatment and control group definitions

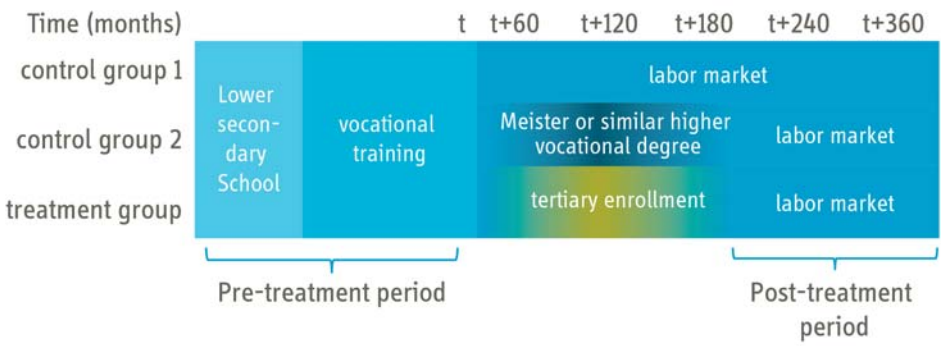
Version	Treatment definition	Control group definition
Version 1	Enrolling in college based on vocational qualifications after finishing vocational training	Control group 1: average vocational training-based career. Control group 2: completed additional vocational training (e.g. Master craftsman)
Version 2	Early and late enrollees (i.e. enrolling within 3.5 years after finishing vocational training or enrolling later)	Control group 1.

Propensity score matching assumes that the selection into treatment can be captured by observable characteristics. This is known as the conditional independence assumption (CIA). In addition, there must be overlap in the propensity scores of the treated and the control group (Caliendo & Kopeinig, 2008; Stuart, 2010). As illustrated in Figure 2, I match on pre-treatment and predetermined outcomes. Table 2 summarizes these variables. Matching only on variables in the pre-treatment period ensures that I rely on pre-determined

(Bundesländer). Prior to the KMK resolution in 2009 the college entry requirements for those without an Abitur were very diverse: ranging from having a vocational training degree and some work experience to passing a college entry exam. While I can control for the time aspect, I will not be able disentangle the different paths to college; however, I do include Bundesland fixed-effects.

characteristics. In version 1 and for the early enrollees of version 2 the pre-treatment period ends with finishing vocational training. For the late enrollees of version 2 the pre-treatment period extends until 3.5 years after completing vocational training, making it possible to include pre-treatment outcomes into the matching process. I then compare the outcomes (employment probability, job quality and stability, and life-time earnings) manifested in the post-treatment period, i.e. after a college enrollment of the treatment group and after the same time period elapsed for the control group. For example, I take the difference in the number of months spent in employment or self-employment 60 months after completing vocational training (t+60).

Figure 2: Empirical strategy



Source: Own illustration.

The conditional independence assumption requires a careful selection of the covariates (Caliendo & Kopeinig, 2008; Stuart, 2010). More specifically, one needs to observe all the factors that influence enrolling in college education and that could potentially also influence future labor market outcomes. In other words, it is important to understand what drives the self-selection into college education. In the following, I consider both theoretical considerations and previous empirical studies to guide my choice of covariates. Table 2 summarizes these aspects and lists the variables available in the data that capture them best.

First, the anticipated private returns may lead an individual to enrolling in college based on vocational credentials. These returns can depend on the occupational field in which the individual completed his/her apprenticeship. For instance, Hällsten (2012) notes that in Sweden mature students that enroll in college education have jobs of lower occupational status. Therefore, I include occupational segments (Matthes et al., 2008)[10].

[10]These occupational segments are characterized by easy mobility within an occupation segment and therefore represent more homogeneous occupation groups than alternative occupational classifications such as the ISCO code which specifies each occupation with different levels of detail. I further aggregate the occupational segments

Table 2: Selection into college education and variables available in the data

Potential confounder	**Variables available in the data**
Motivation	different control groups, age at vocational degree
Difference across cohorts	Decade of vocational training completion
Ability	Age (at finishing school degree), highest school level achieved, final school grade
Occupation	Occupation of apprenticeship
Difference by gender	Control for gender
Labor market experience prior to enrolling	Months spent in employment and unemployment, number of jobs (available for the late enrollees of version 2 only)
Aspiration	Difference to highest level of education of parents, migration background, gender
Socioeconomic background	ISEI of father & mother
Firm that motivates employee	Firm size of vocational training firm (if it was a dual apprenticeship)
Different access modes	Bundesland fixed effects
Labor demand side	Regional unemployment rate when individual finishes vocational degree

Besides the potential pay off, the individual also makes a personal judgment about effort and costs that accompanies enrolling in college education, which can be driven by unobservable factors such as motivation, ability and aspiration. I account for these factors with the help of the different control and treatment group definitions as specified above. In addition, I include the school type, age at completion of school and vocational training, as well as school leaving grades if available. Furthermore, the individual may also consider the local labor market conditions which is why I include the Bundesland unemployment rates at the time the individual finishes vocational training.

Qualitative and quantitative evidence from sociology and education research in Germany provide additional insights into what drives this self-selection. Kamm and Otto (2013) suggest that motivation differs across different cohorts: While up to the 1980s enrolling in college education is seen as a personal challenge, aspects such as the labor market conditions and the wish to advance professionally as well as achieving higher earnings levels gain more importance from the 1990s onwards. Thus, in order to capture these and other differences across cohorts I include indicator variables for the decade in which the individual finishes his/ her vocational training.

As in all education decisions, the socioeconomic background of individuals plays a role. For example, case studies of non-traditional students in Lower Saxony reveal that individ-

to nine different values: metal producer/processor, electronics, construction/interior construction, catering, sales, office/ management, care, medical occupations, others.

uals who enroll in tertiary education have a medium-level school degree and often did not continue with further schooling due to the family's limited academic background (Wolter, 1991; Kirchhoff, 1991). Conversely, evidence from Sweden suggests that mature college students come from more privileged social backgrounds than individuals that do not enroll in college (Hällsten, 2012). Furthermore, parental education or occupation may serve as a reference point for the individual (Black et al., 2009). Therefore, I include the International Socio-Economic Index of Occupational Status (ISEI) of both parents. The ISEI is constructed using both education and occupational information (Ganzeboom, de Graaf, & Treiman, 1992) which sets it apart from other constructed indexes, such as the Standard International Occupational Prestige Scale (SIOPS), that are solely based on the occupation. Moreover, I construct a variable that indicates whether the individual has so far attained a lower, equivalent or higher level of education than that of the highest educated parent.

An additional push factor could be the current firm incentivizing college education. To capture this and other firm-related factors I include firm size of the vocational training firm if the individual participated in a dual training. Further international empirical economic literature suggests that the probability to enroll in adult education varies by gender (Jepsen & Montgomery, 2012; Stenberg et al., 2014). For this reason I control for gender in all specifications.

3.2 Matching quality and descriptive statistics

All variables mentioned in Table 2 enter into the propensity score estimation. I also include interactions or higher order terms of these variables when it improves balance[11]. Since there is no consensus in the literature which matching algorithm performs best from a methodological point of view, I explore different algorithms to empirically determine the one that balances the covariates best. Notably, I run balancing tests on versions of nearest neighbor caliper matching, kernel matching and radius matching[12]. Caliper, radius or bandwidth vary between 0.25 and 0.05 of a standard deviation of the estimated propensity score. The results of this assessment are presented in Tables 3 to 6.

For each of my versions nearest neighbor matching is the best performing matching algorithm. I choose the number of nearest neighbors and the caliper which minimize the mean standardized difference, formally written as Mean Bias (after matching)$= 100 \frac{\bar{x}_1 - \bar{x}_0}{\sqrt{0.5(V_1(x)+V_0(x))}}$ (Caliendo & Kopeinig, 2008; Stuart, 2010). All standardized differences are below five percent, which is the required benchmark indicated in the literature (Caliendo & Kopeinig, 2008). Given the results of this assessment I use a 1:35 nearest neighbor matching with caliper .0064 for version 1, control group 1, a 1:35 nearest neighbor matching with caliper

[11] See Tables 11 to 12 in the appendix for the marginal effects of final specification for each of my versions.

[12] I also considered dynamic matching such as proposed by Fredriksson and Johansson (2008); however, due to the limited number of treated observations I did not implement this procedure.

.0463 for version 1, control group 2, a 1:30 nearest neighbor matching with caliper .0263 for the early enrollees of version 2 and a 1:40 nearest neighbor matching with caliper .0145 for the late enrollees of version 2.

Tables 7 and 10 report the before and after matching descriptive statistics for the different versions of the control and treatment group. Prior to matching the individuals of the control group differ substantially from the treated individuals. Except for control group 2 of version 1, individuals that enroll in college are much more likely to be male than their counterparts from the control group. Corroborating previous empirical research results, the socio-economic background of the treatment group is elevated: the parents of treated individuals dispose of higher education and a higher occupational status as measured by the ISEI. While individuals in the treatment group are much more likely to have a more advanced school degree, i.e. "Mittlere Reife" than individuals of the control group, they are less likely to have already attained the same level of education as their parents at the end of their vocational training.

Furthermore, a higher share of treated individuals receive vocational training in occupation segments such as metal producing, electronics, and construction than those of the control group. The treated individuals complete their vocational training in larger firms and in regions with lower unemployment rates than their counterparts from the control group. Furthermore, Table 10 indicates that late enrollees report fewer months in unemployment during the 3.5 years after vocational training and also show fewer job changes than the control group.

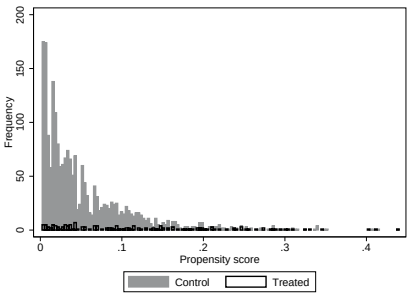
Most of the covariate imbalances can be eliminated by the propensity score matching and for most covariates the standardized difference also reaches levels below 5 percent. However, a few covariate imbalances remain. As noted above, the doubly-robust method, in which the weighted regression controls for the same covariates as used in the propensity score calculation, can deal with these imbalances.

Finally, overlap is sufficient as Figures 3 and 4 display. Even though the control group's propensity scores are left-skewed, there are still enough observations to match to the treatment group.

For a better understanding of the treatment I present some additional summary statistics. As explained in 3.1, I define treatment as enrolling in college some time after finishing vocational training in version 1 and as enrolling within or after 3.5 years after finishing vocational training. This means that the exact timing of treatment varies by individual. For version 1 the treatment period spans from immediately after finishing vocational training until 20.5 years after finishing vocational training. As Figure 5 illustrates 50 percent of the treated individuals enroll in college 43 months after finishing vocational training; 75 percent after 90 months. In the sample all individuals indicate that they finish their studies. The median vocationally qualified student completes his/her college education 84 months after

Figure 3: Overlap: version 1

(a) Control group 1



(b) Control group 2

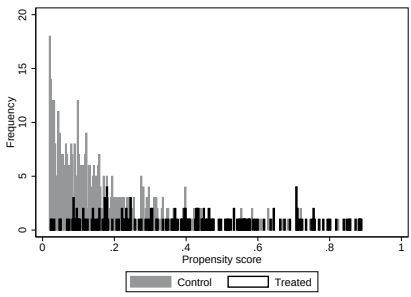
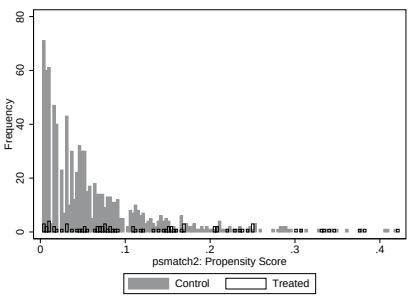


Figure 4: Overlap: version 2

(a) Early enrollees



(b) Late enrollees

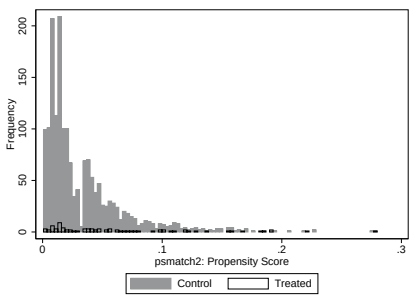
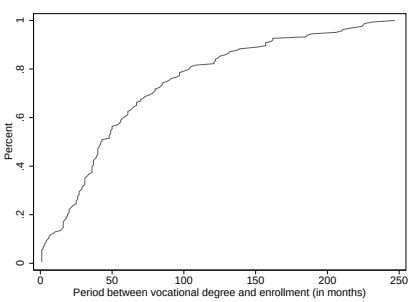


Figure 5: Cumulative distribution treatment timing

(a) Beginning of treatment



(b) End of treatment

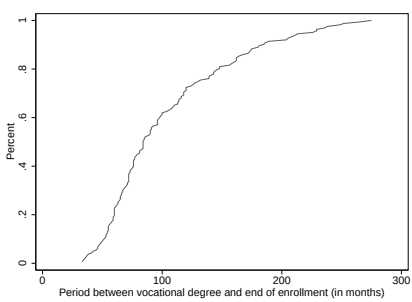
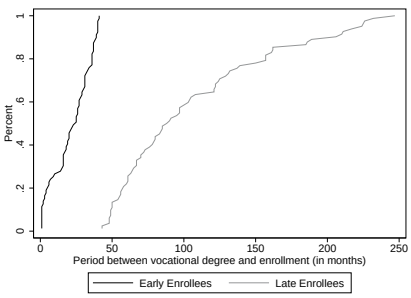
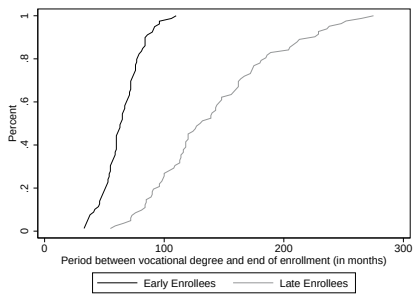


Figure 6: Cumulative distribution treatment timing

(a) Beginning of treatment



(b) End of treatment



finishing vocational training. After 132 months 75 percent have completed their college education.

Figure 6 provides the cumulative distributions of treatment timing for version 2, i.e. for early and late enrollees separately. Half of all early enrollees enroll within 25 months and terminate college studies within 64 months after finishing vocational training; 75 percent of the early enrollees begin within 34 months and end their college studies within 76 months after finishing vocational training. For late enrollees the treatment time period is more spread out: half enroll within 88 months and finish within 130; while 75 percent enroll within 137 months and finish their studies within 174 months after graduating from vocational training.

4 Results

I now discuss the estimated average treatment effects on the treated (ATT) for the employment probability and labor market experience as well as several outcome variables on job quality such as tenure, job stability, full-time status, job prestige, and earnings. The analysis uses a time-window of six months; this allows for some smoothing in the estimates while still regularly capturing changes in labor market status. The observation period covers 30 years after the month the individual finishes his/ her vocational training [13].

The ATT for the probability of being employed or self-employed displays a clear pattern. Comparing the treated to the control group 1 and 2 in the static set-up one observes some lock-in during the nine years after finishing vocational training of those who attend college (Figure 7). A large share of treated individuals withdraw from the labor market: after 3.5 years treated individuals are 45 percent less likely to be employed or self-employed than those

[13] Only for the 1950/60s and 1970s vocational training cohort, the oldest in the sample, could one observe the labor market outcomes for longer than 30 years. However, I am interested in an average effect; therefore, I limit the observation period to ensure a reasonable amount of treated and control group observations for each point in the labor market history time line.

who pursue an average vocational training-based career (control group 1) and 43 percent less likely to be employed or self-employed than individuals that engage in further training at the vocational level (control group 2).

After this initial phase, those who enroll in college are slightly more likely to be employed or self-employed than control group 1. However, they do not have higher employment probabilities compared to individuals of control group 2 since these point estimates only sporadically reach statistically significant levels. This suggests that college education results in similar employment levels as participating in further education on the vocational track, e.g. completing a master craftsman. The point estimates, when comparing the treated to control group 1, are slightly higher than compared to control group 2; yet, there are no statistical differences between the two treatment effects.

Early enrollees in version 2 (Figure 7) withdraw from the labor market even more strongly than the estimates of version 1 suggest. They are 67 percent less likely to be employed 3.5 years after finishing vocational training than the control group. However, they also re-enter the labor market more quickly. After about 7.5 years they are as likely to be employed as the control group. For the late enrollees the lock-in effect is delayed and longer, but much less profound. A finding, which may be influenced by the large variation in treatment timing of the late enrollees (see 6). In the pre-treatment period, they do not differ from the control group. 4.5 years after finishing vocational training they are 26 percent less likely to be employed or self-employed than their counterparts in the control group. After this period, there is no difference in the employment or self-employment probability between the late enrollees and the control group and between the two treatment groups. Overall, the results on the employment probability hint at large opportunity costs, since while the treated enroll in college the control group continues their vocational training-based career.

Labor market experience, tenure, and job changes are discussed in the wage growth literature since they facilitate on-the job and between job wage increases. For instance, Dustmann and Meghir (2005) find that for skilled workers experience and firm tenure often yield higher wages since firms value the general and firm-specific human capital which is likely to increase worker productivity. Job changes may indicate that the worker is searching for a better match. Altogether, experience, tenure and the number of job changes shed light on the job stability over a career.

After enrolling in college the treatment group has less labor market experience than any control group (Figure 8). For version 1, the labor market experience of the treated individuals drops almost linearly within ten years after finishing vocational training and only slowly increases at the end of the observation period. The gap of maximum 26 months amounts to approximately half of the time which individuals spent enrolled hinting at the opportunity costs of enrolling. This especially applies to the early enrollees, they have up

to 33 percent (33 months) lower labor market experience than the control group ten years after finishing vocational training. Towards the end of the observation period the difference in labor market experience between early enrollees and the control group decreases but still remains significantly negative. Note however, these are not complete careers; individuals may overcome this gap in labor market experience later in their career, for instance by retiring later.

While the treatment group displays a lower tenure than control group 1 starting five years after finishing vocational training, the point estimates compared to control group 2 hardly reach significant levels (Figure 9). This indicates that participating in college education does not cause lower tenure when comparing the treated to individuals that participate in a form of substantial further vocational education (control group 2). This indicates that the treated individuals and control group 2 have lower tenure than those that continue with an average career based on vocational training. The maximum difference between the two point estimates for the two control groups is about 20 months. At the same time, the share of job changes among the treatment group or control group 2 is not significantly higher (Figure 10). Therefore, the difference in the effect on tenure between the estimates for control group 1 and control group 2 most likely corresponds to the period in which the individuals are not available for the labor market, because they are enrolled in college or a further education scheme.

The pattern is slightly different when distinguishing between early and late enrollees. Early enrollees experience a drop in tenure in the period after treatment, but catch up to the control group in the course of 16 years after finishing vocational training. Late enrollees, on the other hand, fall back starting 8.5 years after vocational training and never again come close to the tenure levels of the control group during the observation period. As Figure 10 shows, late enrollees have a much lower job stability. Compared to the control group they have held 26 percent more jobs about 30 years after finishing vocational training and 11 percent more compared to the early enrollees, which do not significantly differ from the control group. In addition, late enrollees have lower tenure than the control group and the early enrollees because they change jobs more often. For instances, after 18.5 years after finishing vocational training they have 109 months (30 percent) less tenure than the control group.

In general, there are no strong effects of enrolling in college based on vocational qualifications with respect to the probability of being employed full-time conditional on being employed (Figure 11). Only briefly during the first five years after finishing vocational training do the treated have a lower probability of being employed full-time. For instance, the early enrollees are 26 percentage points more likely to be employed part-time if they are employed. This is a reasonable finding since during the treatment period individuals are likely

to combine part-time work with studying. However, after this initial phase no statistically significant differences remain between the early enrollees and the control group.

In addition to experience, tenure and job stability, I assess whether enrolling in college has an effect on job prestige, as measured by the Magnitude-Prestige-Scale (MPS)[14]. The MPS measures the reputation of an occupation in Germany and thus captures the degree of social status associated with a certain occupation. The MPS is constructed by a survey which asks individuals to indicate what reputation they associate with certain occupations listed in the International Standard Classification of Occupations (ISCO) (Wegener, 1988). It spans from 20, for construction and maintenance laborers, to 186.8, for judges, (Wegener, 1988). In 2004 the mean MPS for West Germany was 61.9 for men and 62.95 for women (Wirth & Frietsch, 2001).

After the initial lock-in phase, one observes a sharp increase in the job prestige. Ten years after finishing vocational training, treated individuals have between 24 and 31 points higher MPS scores than their counterparts in control group 1 and between 18 and 26 points than their counterparts control group 2 (Figure 12)[15]. This means that individuals who enroll in college education attain more prestigious jobs as measured by the MPS. Early enrollees mimic the development of the overall results albeit reaching higher prestigious occupations more quickly. Late enrollees also experience an increase in job quality as measured by the MPS compared to the control group; however, it is slower than that of early enrollees initially. Only 12.5 years after finishing vocational training do late enrollees reach about the same occupational prestige level as the early enrollees. This slower catching up to the level of the early enrollees may partly be due to the prolonged treatment timing of the late enrollees documented in Figure 6.

The average treatment effects on earnings are summarized in Figures 13 and 14[16]. During the lock-in phase discussed above the monthly earnings of the treated are up to 36 percent lower than those of the control group. This means, that during the time of enrollment individuals forgo earnings. However, after about 14 years they break even and after 28 years they earn about 990 Euros (50 percent) more per month than the control group[17]. The forgone earnings at the time of the enrollment are also visible in the cumulative life-time

[14] I use the MPS since this is a national measure and therefore captures the German occupational landscape, whereas other measures of occupational prestige such as the socioeconomic index of occupational status (SIOPS) are constructed using internationals scales (Christoph, 2005)

[15] In comparison, a 10 point difference corresponds to the prestige difference between mail carrier and sorting clerks (MPS of 45.1) and waiters, waitresses and bartenders (MPS of 55.4), a 20 point difference to electronics mechanics and servicers (MPS of 65.4) and a 30 point difference to companions and valets (MPS of 75.7) (Geis, 2011; Wegener, 1988).

[16] Note that for earnings I do not distinguish between control group 1 and 2. SIAB only records individuals that are employed and not self-employed which many individuals with further vocational degrees (control group 2) are. Therefore, the earnings recorded in SIAB for control group 2 would represent a very selected group biasing the ATT estimates.

[17] Earnings are deflated to 2015 prices using the consumer price index supplied by the Federal Statistical Office (2015c).

earnings. After about 23 years those who enrolled in college break even and recoup the opportunity costs (Figure 14). At the end of the observation period the treated have on average 43 percent higher cumulative life-time earnings. Given the wide confidence intervals the individual outcome may deviate considerably from this value.

There are differences according the timing of enrolling in college[18]. Initially, early enrollees experience a deep drop in monthly wages of up to 75 percent compared to those who continue with a vocational training-based career. This is inline with their large drop in the probability of being employed during the early phase of their career. As their career progresses they earn up to 58 percent more per month than the control group. The drop in monthly wages is lower for late enrollees. They earn up to 41 percent less than the control group while being enrolled and after enrolling in college they earn at most 37 percent more than those who did not enroll in college. Early enrollees (Figure 14) outperform the control group in terms of cumulative earnings after 24.5 years after finishing vocational training. Late enrollees, on the other hand, do not achieve a statistically significant surplus in cumulative life-time earnings due to college. This means that on average enrolling in college based on vocational qualifications does not pay off for late enrollees.

These results suggest that enrolling in college based on vocational training can pay off monetarily when enrolling soon after finishing vocational training. Note, however, that the confidence intervals on the cumulative earnings are particularly wide, hinting at a large variance in the individual outcome. Put differently, opportunity costs of enrolling in college based on vocational qualifications can be large and individuals face some risk in realizing higher earnings after the treatment.

However, for most individuals these do not represent complete labor market histories. For older cohorts this is because the observation period only spans over 30 years; for younger cohorts this may be because their career is still ongoing. Therefore, I consider the results as a momentary snapshot. For wages and earnings this means, that some individuals may still break even and may exceed the life-time earnings of the control groups after the observation period ends. The same applies to the other outcomes examined in this paper.

5 Conclusion

The key focus of this paper is to estimate labor market returns to college enrollment under vocational qualifications. Using the National Educational Panel Study, I identify individuals who took this path in the past and compare them to different control groups. In order to

[18]There is evidence that the early and late enrollees have different probabilities of being matched to the administrative earnings data. While early enrollees have a higher probability than the control group to have an entry for a particular month in SIAB, given that they indicate being employed in the NEPS, late enrollees have a lower probability of having a record in the SIAB for a month, for which they indicate employment in NEPS. This means that the ATT results can be biased upwards for the early enrollees and downward for the late enrollees.

calculate the associated labor market returns, I use propensity score adjusted regressions, each with different treatment and control group definitions. *Version 1* splits the control group into those with an average vocational training-based career (control group 1) and those who participate in substantial further vocational training (control group 2) - a subgroup of the former. *Version 2* divides the treated into early enrollees, those who enroll in college within 3.5 years, and late enrollees, who enroll any time after 3.5 years.

All in all, labor market returns vary over an individual career, tending to more positive results as the career progresses. During the first ten years after finishing vocational training, individuals who enroll in college experience lower employment probability; yet, in the long-run they exhibit similar employment levels as the control groups. Furthermore, labor market returns differ depending on the treatment and control group definition. While all treated individuals show lower labor market experience and tenure than the control groups within 30 years after finishing vocational training, only late enrollees have higher job instability than the control group. All treated individuals record higher job prestige scores than those in the control groups and all treated attain higher monthly wages some time after enrolling in college. Yet, their break-even point happens at different times: compared to those that remain in a vocational training-based career, individuals who enroll in college earn higher monthly wages on average after 14 years, with early enrollees reaching this differential after 12 years and late enrollees after 18 years. On average enrollees record positive returns in terms of cumulative life-time earnings 23 years after finishing vocational training, albeit with a high degree of uncertainty. This indicates that recouping the opportunity costs of enrolling in college is a lengthy and risky process.

These results suggest that opening colleges to the vocationally qualified, a group which usually does not have access to college in Germany but that policymakers now encourage to become college students, can provide labor market benefits to the individuals. However, these benefits are more likely to occur when individuals enroll during their early career; even then they materialize only late in a career and with a high degree of uncertainty.

References

Antoni, M., & Eberle, J. (2015). *Kurzdokumentation NEPS-SC6-ADIAB.*

Bang, H., & Robins, J. M. (2005). Doubly robust estimation in missing data and causal inference models. *Biometrics*, *61*(4), 962–973.

Black, S. E., Devereux, P. J., & Salvanes, K. G. (2009). Like father, like son? A note on the intergenerational transmission of IQ scores. *Economics Letters*, *105*(1), 138–140.

Blossfeld, H.-P., Roßbach, H.-G., & von Maurice, J. (Eds.). (2011). *Education as a Lifelong Process: The German National Educational Panel Study (NEPS)* (1st ed., Vol. 14). Wiesbaden: VS Verlag für Sozialwissenschaften.

Böckerman, P., Jepsen, C., & Haapen, M. (2015). Back to School? Labor-Market Returns to Vocational Postsecondary Education. *IZA Discussion Paper*(9079).

Caliendo, M., & Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*, *22*(1), 31–72.

Christoph, B. (2005). Zur Messung des Berufsprestiges: Aktualisierung der Magnitude-Prestigeskala auf die Berufsklassifikation ISCO88. *ZUMA-Nachrichten*, *29*(57), 79–127.

Dahm, G., Kamm, C., Kerst, C., Otto, A., & Wolter, A. (2013). Stille Revolution? Der Hochschulzugang für nicht-traditionelle Studierende im Umbruch. *Die Deutsche Schule*, *105*(4), 382–401.

Dustmann, C., & Meghir, C. (2005). Wages, Experience and Seniority. *Review of Economic Studies*, *72*(1), 77–108.

Federal Statistical Office. (2015a). *Beruf, Ausbildung und Arbeitsbedingungen der Erwerbstätigen in Deutschland: Fachserie 1 Reihe 4.1.2 - 2014.* Retrieved from `https://www.destatis.de/DE/Publikationen/Thematisch/Arbeitsmarkt/Erwerbstaetige/BerufArbeitsbedingungErwerbstaetigen.html`

Federal Statistical Office. (2015b). *Hochschulstatistik (H201).*

Federal Statistical Office. (2015c). *Verbraucherpreisindizes für Deutschland: Lange Reihe ab 1948.* Wiesbaden. Retrieved from `https://www.destatis.de/DE/Publikationen/Thematisch/Preise/Verbraucherpreise/VerbraucherpreisindexLangeReihen.html`

Fredriksson, P., & Johansson, P. (2008). Dynamic treatment assignment: the consequences for evaluations using observational data. *Journal of Business & Economic Statistics*, *26*(4), 435–445.

Freitag, W. K. (2012). Zweiter und Dritter Bildungsweg in die Hochschule. *Hans-Böckler-Stiftung Arbeitspapier 253*.

Ganzeboom, H. B., de Graaf, P. M., & Treiman, D. J. (1992). A standard international socio-economic index of occupational status. *Social Science Research*, *21*(1), 1–56.

Geis, A. (2011). *Handbuch für die Berufsvercodung.* Mannheim. Retrieved 2016/01/26, from `http://www.gesis.org/fileadmin/upload/dienstleistung/tools_standards/handbuch_der_berufscodierung_110304.pdf`

Görlitz, K. (2011). Continuous training and wages: An empirical analysis using a comparison-group approach. *Economics of Education Review*, *30*(4), 691–701.

Hällsten, M. (2012). Is it ever too late to study? The economic returns on late tertiary degrees in Sweden. *Economics of Education Review*, *31*(1), 179–194.

Jepsen, C., & Montgomery, M. (2012). Back to school: An application of human capital theory for mature workers. *Economics of Education Review*, *31*(1), 168–178. Retrieved from http://www.sciencedirect.com/science/article/pii/S0272775711001725

Kamm, C., & Otto, A. (2013). Studienentscheidungen und Studienmotive nicht-traditioneller Studierender. *ZBS*(2), 40–46.

Kamm, C., & Otto, A. (2014). *Studienentscheidungen und Studienmotive nicht-traditioneller Studierender,*. Göttingen. Retrieved from https://www.uni-goettingen.de/de/document/download/4953c386b1556c664caddd7862e0dd50.pdf/Vortrag_Kamm-Otto.pdf

Kirchhoff, E. (1991). Der Zugang zu einem Fachhochschulstudium für Erwachsene ohne Abitur. In A. Wolter (Ed.), *Die Öffnung des Hochschulzugangs für Berufstätige* (Vol. 48, pp. 147–157). Oldenburg: Bis.

KMK. (2009). *Hochschulzugang für beruflich qualifizierte Bewerber ohne schulische Hochschulzugangsberechtigung: Beschluss der Kultusministerkonferenz vom 06.03.2009.* Retrieved 12.2.2015, from http://www.kmk.org/fileadmin/veroeffentlichungen_beschluesse/2009/2009_03_06-Hochschulzugang-erful-qualifizierte-Bewerber.pdf

Leuven, E., & Oosterbeek, H. (2008). An alternative approach to estimate the wage returns to private-sector training. *Journal of Applied Econometrics*, *23*(4), 423–434.

Lischka, I. (1991). Hochschulvorbereitung und Hochschulzugang in der ehemaligen DDR: Nur Vergangenheitsbewältigung oder auch Zukunftsperspektive? In A. Wolter (Ed.), *Die Öffnung des Hochschulzugangs für Berufstätige* (Vol. 48, pp. 99–146). Oldenburg: Bis.

Marcus, J. (2014). Does Job Loss Make You Smoke and Gain Weight? *Economica*, *81*(324), 626–648.

Matthes, B., Burkert, C., & Biersack, W. (2008). Berufssegmente: Eine empirisch fundierte Neuabgrenzung vergleichbarer beruflicher Einheiten. *IAB Discussion paper*(3508). Retrieved from http://doku.iab.de/discussionpapers/2008/dp3508.pdf

Reichelt, M. (2015). Using longitudinal wage information in linked data sets. *FDZ-Methodenreport*. Retrieved from http://doku.iab.de/fdz/reporte/2015/MR_01-15_EN.pdf

Rubin, D. B. (1974). Estimating causal effects of treatments in randomized and nonrandomized studies. *Journal of educational Psychology*, *66*(5), 688.

Schmitz, H., & Westphal, M. (2015). Short- and medium-term effects of informal care provision on female caregivers' health. *Journal of health economics*, *42*, 174–185.

Scholz, W.-D. (1995). Studieren auch ohne Abitur. Möglichkeiten des Hochschulzugangs über den Beruf in Deutschland. *Bildung und Erziehung*, *48*(3).

Schuetze, H. G., & Slowey, M. (2002). Participation and exclusion: A comparative analysis of non-traditional students and lifelong learners in higher education. *Higher education*, *44*(3-4), 309–327.

Stenberg, A., de Luna, X., & Westerlund, O. (2014). Does Formal Education for Older Workers Increase Earnings? - Evidence Based on Rich Data and Long-term Follow-up. *Labour*, *28*(2), 163–189.

Stuart, E. A. (2010). Matching Methods for Causal Inference: A Review and a Look Forward. *Statistical Science*, *25*(1), 1–21.

Teichler, U., & Wolter, A. (2004). Zugangswege und Studienangebote für nicht-traditionelle Studierenden. *die hochschule*, *13*(2), 64–80.

Wegener, B. (1988). *Kritik des Prestiges.* Wiesbaden: VS Verlag für Sozialwissenschaften.

Wirth, H., & Frietsch, R. (2001). *Mean, Modus und Median der Magnitude-Prestigeskala_KldB-Verteilungen zwischen 1976 und 2004.* Retrieved 2016/01/26, from `http://www.gesis.org/missy/fileadmin/missy/klassifikationen/MPS_Wegener/MPS_SPSS/MPS_mean.pdf`

Wolter, A. (Ed.). (1991). *Die Öffnung des Hochschulzugangs für Berufstätige: Eine bildungspolitische Herausforderung* (Vol. 48). Oldenburg: Bis.

Wolter, A., Banscherus, U., Kamm, C., Otto, A., & Spexard, A. (2014). Durchlässigkeit zwischen beruflicher und akademischer Bildung als mehrstufiges Konzept: Bilanz und Perspektiven. *Beiträge zur Hochschulforschung*, *36*(4).

6 Appendix

Table 3: Matching quality for version 1 control group 1

Matching algorithm	Mean bias after matching	# treated	# controls
One-to-one matching	9.27	161	144
1:30 matching (caliper .01600)	3.07	161	1931
1:30 matching (caliper .01281)	2.80	161	1929
1:30 matching (caliper .0064)	2.69	158	1927
1:30 matching (caliper .0032)	3.09	154	1909
1:35 matching (caliper .01600)	2.88	161	2103
1:35 matching (caliper .01281)	2.65	161	2101
1:35 matching (caliper .0064)	2.53	158	2099
1:35 matching (caliper .0032)	2.96	154	2081
1:40 matching (caliper .01600)	2.88	161	2264
1:40 matching (caliper .01281)	2.65	161	2262
1:40 matching (caliper .0064)	2.57	158	2260
1:40 matching (caliper .0032)	3.02	154	2242
Kernel (bandwidth .01600)	3.95	161	5523
Kernel (bandwidth .01281)	3.67	161	5523
Kernel (bandwidth .0064)	3.16	161	5523
Kernel (bandwidth .0032)	3.19	161	5523
Radius (caliper .01600)	3.51	161	5521
Radius (caliper .01281)	3.01	161	5519
Radius (caliper .0064)	2.78	158	5517
Radius (caliper .0032)	3.10	154	5499

Notes: This table displays the matching quality for version 1 control group 1. Only observations with propensity scores in the overlap region are included.

Table 4: Matching quality version 1 control group 2

Matching algorithm	Mean bias after matching	# treated	# controls
One-to-one matching	8.00	153	101
1:30 matching (caliper .0578)	3.24	153	482
1:30 matching (caliper .0463)	3.33	153	482
1:30 matching (caliper .0231)	4.10	153	482
1:30 matching (caliper .0116)	4.68	150	482
1:35 matching (caliper .0578)	3.30	153	499
1:35 matching (caliper .0463)	3.31	153	499
1:35 matching (caliper .0231)	4.11	153	499
1:35 matching (caliper .0116)	4.71	150	499
1:40 matching (caliper .0578)	3.32	153	504
1:40 matching (caliper .0463)	3.35	153	504
1:40 matching (caliper .0231)	4.15	153	504
1:40 matching (caliper .0116)	4.71	150	504
Kernel (bandwidth .0578)	3.59	153	729
Kernel (bandwidth .0463)	3.48	153	729
Kernel (bandwidth .0231)	3.57	153	729
Kernel (bandwidth .0116)	4.13	153	729
Radius (caliper .0578)	3.54	153	729
Radius (caliper .0463)	3.53	153	729
Radius (caliper .0231)	4.19	153	729
Radius (caliper .0116)	4.69	150	557

Notes: This table displays the matching quality for version 1 control group 2. Only observations with propensity scores in the overlap region are included.

Table 5: Matching quality version 2, early enrollees

Matching algorithm	Mean bias after matching	# treated	# controls
One-to-one matching	11.79	79	68
1:30 matching (caliper .0263)	2.98	79	862
1:30 matching (caliper .0210)	3.21	79	860
1:30 matching (caliper .0105)	4.02	79	843
1:30 matching (caliper .0053)	4.93	79	826
1:35 matching (caliper .0263)	2.99	79	937
1:35 matching (caliper .0210)	3.11	79	935
1:35 matching (caliper .0105)	4.00	79	918
1:35 matching (caliper .0053)	4.83	79	899
1:40 matching (caliper .0263)	2.97	79	1012
1:40 matching (caliper .0210)	3.16	79	1010
1:40 matching (caliper .0105)	3.99	79	993
1:40 matching (caliper .0053)	4.88	79	972
Kernel (bandwidth .0263)	5.66	79	5021
Kernel (bandwidth .0210)	4.86	79	5021
Kernel (bandwidth .0105)	4.05	79	5021
Kernel (bandwidth .0053)	4.29	79	5021
Radius (caliper .0263)	3.86	79	5020
Radius (caliper .0210)	3.86	79	5018
Radius (caliper .0105)	4.28	79	5001
Radius (caliper .0053)	4.70	79	4980

Notes: This table displays the matching quality for version 2, the early enrollees. Only observations with propensity scores in the overlap region are included.

Table 6: Matching quality version 2, late enrollees

Matching algorithm	Mean bias after matching	# treated	# controls
One-to-one matching	7.78	81	79
1:30 matching (caliper .0145)	3.04	81	1446
1:30 matching (caliper .0116)	3.34	81	1445
1:30 matching (caliper .0058)	3.61	81	1437
1:30 matching (caliper .0029)	3.60	81	1399
1:35 matching (caliper .0145)	2.87	81	1585
1:35 matching (caliper .0116)	3.18	81	1584
1:35 matching (caliper .0058)	3.54	81	1577
1:35 matching (caliper .0029)	3.50	81	1537
1:40 matching (caliper .0145)	2.82	81	1708
1:40 matching (caliper .0116)	3.09	81	1707
1:40 matching (caliper .0058)	3.41	81	1700
1:40 matching (caliper .0029)	3.40	81	1660
Kernel (bandwidth .0145)	5.28	81	5429
Kernel (bandwidth .0116)	4.58	81	5429
Kernel (bandwidth .0058)	3.71	81	5429
Kernel (bandwidth .0029)	3.55	81	5429
Radius (caliper .0145)	4.06	81	5425
Radius (caliper .0116)	3.81	81	5424
Radius (caliper .0058)	3.70	81	5417
Radius (caliper .0029)	3.52	81	5377

Notes: This table displays the matching quality for version 2, the late enrollees. Only observations with propensity scores in the overlap region are included.

Table 7: Descriptive statistics before and after matching (Version 1, control group 1)

Variables	Treated		Unmatched Controls		Matched Controls		Standardized Bias	
	Mean	SD	Mean	SD	Mean	SD	unmatched	matched
Male	0.82	0.39	0.49	0.50	0.81	0.39	74.00	1.74
Migration background	0.10	0.30	0.15	0.36	0.10	0.30	-14.60	-0.41
Type of school degree								
Haupt-/ Volksschulabschluss	0.14	0.35	0.46	0.50	0.15	0.35	-74.16	-1.70
Mittlere Reife	0.86	0.35	0.54	0.50	0.85	0.35	74.16	1.70
Age at school degree	16.39	2.20	15.95	2.39	16.41	2.43	19.16	-1.22
Overall school grade								
1-1.9	0.02	0.14	0.01	0.12	0.02	0.15	3.81	-4.25
2-2.9	0.35	0.48	0.25	0.43	0.37	0.48	22.22	-4.77
3-3.4	0.25	0.43	0.22	0.41	0.22	0.42	6.56	6.15
3.5-5.0	0.04	0.19	0.05	0.21	0.04	0.19	-5.18	-0.59
Missing school grade	0.34	0.47	0.45	0.50	0.32	0.47	-23.90	2.76
Did not repeat a school year	0.25	0.43	0.21	0.41	0.24	0.43	8.32	0.50
Repeated a school year	0.74	0.44	0.77	0.42	0.75	0.44	-6.82	-1.29
Decade of vocational training								
1950s/ 60s	0.44	0.50	0.23	0.42	0.43	0.50	45.00	1.20
1970s	0.26	0.44	0.30	0.46	0.26	0.44	-8.27	0.74
1980s	0.20	0.40	0.29	0.45	0.20	0.40	-21.70	-0.67
1990s/ 2000s	0.11	0.31	0.19	0.39	0.11	0.32	-22.06	-1.69
Age at vocational degree attainment	18.91	1.53	19.15	2.75	18.91	1.74	-11.02	-0.42
Vocational occupation segment								
Metal producer/ processor	0.20	0.40	0.17	0.37	0.18	0.38	7.87	4.35
Electronics	0.14	0.35	0.07	0.26	0.13	0.34	21.40	1.79
(interior) construction	0.08	0.28	0.06	0.24	0.07	0.26	7.49	4.77
Catering	0.02	0.14	0.07	0.25	0.03	0.16	-23.88	-3.80
Sales	0.15	0.35	0.21	0.40	0.15	0.36	-15.87	-1.88
Office/ management	0.15	0.36	0.15	0.36	0.16	0.37	-0.46	-3.59
Care	0.03	0.18	0.04	0.19	0.04	0.21	-3.76	-6.58
Medical	0.04	0.19	0.09	0.29	0.04	0.21	-22.20	-2.67
Other	0.17	0.38	0.13	0.33	0.15	0.36	12.51	4.82
Occupational sector missing	0.03	0.16	0.01	0.12	0.03	0.17	8.34	-3.86
Firm size of apprenticeship								
below 10 employees	0.13	0.34	0.26	0.44	0.13	0.34	-31.28	0.30

10-100 employees	0.24	0.43	0.30	0.46	0.25	0.43	-14.08	-1.11
100-2000 employees	0.31	0.46	0.22	0.42	0.29	0.46	19.75	3.78
2000 and more employees	0.16	0.37	0.07	0.26	0.14	0.35	26.65	4.96
Missing firm size	0.16	0.37	0.15	0.35	0.19	0.39	3.67	-7.99
Bundesland of vocational training								
Schleswig-Holstein	0.04	0.19	0.01	0.11	0.03	0.17	16.55	5.64
Hamburg	0.04	0.19	0.02	0.15	0.03	0.18	9.06	2.64
Lower Saxony	0.11	0.31	0.10	0.30	0.10	0.30	1.43	2.46
Bremen	0.01	0.08	0.00	0.07	0.00	0.07	1.93	2.08
North Rhine-Westphalia	0.18	0.38	0.19	0.39	0.19	0.39	-3.46	-3.76
Hesse	0.08	0.27	0.06	0.24	0.07	0.26	5.83	1.78
Rhineland-Palatinate	0.04	0.19	0.04	0.20	0.04	0.19	-2.32	0.78
Baden-Wuerttemberg	0.14	0.35	0.10	0.30	0.15	0.36	11.39	-2.42
Bavaria	0.09	0.29	0.15	0.35	0.09	0.29	-15.85	0.05
Saarland	0.02	0.14	0.02	0.13	0.03	0.16	1.34	-5.23
Missing Bundesland	0.27	0.44	0.30	0.46	0.27	0.44	-6.95	0.17
Regional unemployment rate								
up to 2.3	0.34	0.47	0.21	0.41	0.34	0.47	28.84	-0.84
between 2.5-6.5	0.16	0.37	0.21	0.41	0.17	0.37	-13.24	-2.40
more than 6.5	0.13	0.34	0.22	0.41	0.13	0.34	-22.22	0.09
Rate missing	0.36	0.48	0.36	0.48	0.36	0.48	-0.58	0.64
ISEI of parents								
Mother	14.66	19.89	10.42	17.93	15.25	20.27	22.40	-3.11
Father	25.82	24.23	18.24	20.90	26.64	24.72	33.47	-3.62
ISEI father missing	0.39	0.49	0.50	0.50	0.38	0.49	-22.71	2.60
ISEI mother missing	0.59	0.49	0.71	0.45	0.58	0.49	-23.72	2.60
Comparison to parents' education								
Lower than that of parents	0.30	0.46	0.20	0.40	0.32	0.47	23.34	-3.88
Same as that of parents	0.58	0.49	0.63	0.48	0.55	0.50	-9.56	5.82
Higher than that of parents	0.11	0.32	0.16	0.36	0.12	0.32	-12.14	-0.47
Number of observations	158		5523		2099			

Notes: This table displays the summary statistics for the treatment and control group separately before and after matching for version 1, control group 1. Mean Bias (before or after matching)= $100\frac{\bar{x}_1-\bar{x}_0}{\sqrt{0.5(V_1(x)+V0(x)}}$

Table 8: Descriptive statistics before and after matching (Version 1, control group 2)

Variables	Treated		Unmatched Controls		Matched Controls		Standardized Bias	
	Mean	SD	Mean	SD	Mean	SD	unmatched	matched
Male	0.83	0.38	0.84	0.36	0.81	0.40	-5.39	4.34
Migration background	0.09	0.29	0.11	0.31	0.08	0.27	-2.10	8.91
Type of school degree								
Haupt-/ Volksschulabschluss	0.15	0.36	0.47	0.50	0.15	0.36	-76.69	-3.77
Mittlere Reife	0.85	0.36	0.53	0.50	0.85	0.36	76.69	3.77
Age at school degree	16.39	2.23	16.32	3.43	16.41	2.11	1.83	-1.51
Overall school grade								
1-1.9	0.02	0.14	0.01	0.10	0.01	0.09	7.02	10.09
2-2.9	0.34	0.47	0.26	0.44	0.36	0.48	23.13	2.22
3-3.4	0.23	0.42	0.19	0.39	0.22	0.41	7.26	0.05
3.5-5.0	0.03	0.18	0.05	0.22	0.05	0.22	-5.56	-4.75
Missing school grade	0.37	0.48	0.48	0.50	0.34	0.48	-27.35	1.03
Did not repeat a school year	0.23	0.42	0.22	0.41	0.22	0.41	4.43	4.81
Repeated a school year	0.76	0.43	0.75	0.43	0.76	0.43	-0.65	-2.64
Decade of vocational training								
1950s/ 60s	0.40	0.49	0.25	0.43	0.40	0.49	41.33	6.80
1970s	0.28	0.45	0.29	0.45	0.26	0.44	-7.75	-0.33
1980s	0.20	0.40	0.33	0.47	0.23	0.42	-28.01	-5.61
1990s/ 2000s	0.11	0.32	0.14	0.35	0.11	0.32	-10.79	-2.92
Age at vocational degree attainment	18.95	1.46	18.87	2.01	18.73	1.40	-1.51	7.81
Vocational occupation segment								
Metal producer/ processor	0.19	0.40	0.36	0.48	0.19	0.40	-34.78	2.00
Electronics	0.15	0.36	0.17	0.38	0.13	0.34	-6.47	4.85
(interior) construction	0.09	0.28	0.08	0.28	0.09	0.29	0.96	-1.44
Catering	0.01	0.12	0.08	0.28	0.02	0.14	-29.22	-0.28
Sales	0.13	0.33	0.07	0.25	0.13	0.34	20.81	-0.13
Office/ management	0.14	0.35	0.03	0.18	0.17	0.38	42.51	-3.95
Care	0.04	0.20	0.02	0.13	0.02	0.15	1.31	-1.43
Medical	0.03	0.18	0.02	0.12	0.04	0.19	7.77	-7.16
Other	0.19	0.39	0.16	0.37	0.18	0.38	6.33	1.28
Occupational segment missing	0.03	0.16	0.01	0.09	0.02	0.15	13.78	2.87
Firm size of apprenticeship								
below 10 employees	0.14	0.35	0.26	0.44	0.12	0.33	-31.23	4.62

10-100 employees	0.24	0.43	0.29	0.45	0.24	0.43	-9.26	1.24
100-2000 employees	0.30	0.46	0.26	0.44	0.32	0.47	12.04	-0.93
2000 and more employees	0.17	0.37	0.13	0.33	0.15	0.36	10.15	3.32
Missing firm size	0.15	0.36	0.06	0.24	0.17	0.37	24.83	-7.98
Bundesland of vocational training								
Schleswig-Holstein	0.01	0.12	0.01	0.09	0.02	0.13	13.78	6.32
Hamburg	0.03	0.16	0.02	0.13	0.04	0.19	12.84	1.01
Lower Saxony	0.11	0.31	0.08	0.28	0.11	0.32	9.24	0.02
Bremen	0.00	0.00	0.00	0.05	0.01	0.10	5.57	-4.03
North Rhine-Westphalia	0.19	0.39	0.19	0.40	0.17	0.38	-4.36	0.79
Hesse	0.09	0.28	0.06	0.24	0.05	0.23	7.10	9.98
Rhineland-Palatinate	0.05	0.21	0.04	0.19	0.04	0.20	0.42	-1.91
Baden-Wuerttemberg	0.15	0.36	0.14	0.34	0.19	0.39	1.90	-11.51
Bavaria	0.09	0.29	0.15	0.35	0.09	0.29	-14.50	3.23
Saarland	0.02	0.14	0.01	0.10	0.01	0.10	7.02	7.81
Missing Bundesland	0.26	0.44	0.30	0.46	0.27	0.44	-8.96	-1.73
Regional unemployment rate								
up to 2.3	0.32	0.47	0.22	0.42	0.33	0.47	26.68	1.82
between 2.5-6.5	0.18	0.39	0.22	0.41	0.17	0.38	-13.60	-1.44
more than 6.5	0.14	0.35	0.19	0.39	0.15	0.36	-16.70	-6.02
Rate missing	0.34	0.48	0.37	0.48	0.35	0.48	-3.05	0.99
ISEI of parents								
Mother	14.29	19.63	9.72	17.94	14.63	20.36	27.20	1.37
Father	24.74	23.56	17.22	20.85	24.70	23.82	35.82	2.19
ISEI father missing	0.41	0.49	0.53	0.50	0.41	0.49	-26.13	-1.58
ISEI mother missing	0.60	0.49	0.73	0.44	0.60	0.49	-29.72	-0.25
Comparison to parents' education								
Lower than that of parents	0.31	0.46	0.27	0.44	0.34	0.47	7.34	-8.18
Same as that of parents	0.58	0.50	0.60	0.49	0.54	0.50	-3.88	8.15
Higher than that of parents	0.11	0.32	0.12	0.33	0.12	0.32	-1.36	0.34
Number of Observations	153		729		499			

Notes: This table displays the summary statistics for the treatment and control group separately before and after matching for version 1, control group 2. Mean Bias (before or after matching)= $100\frac{\bar{x}_1-\bar{x}_0}{\sqrt{0.5(V_1(x)+V0(x)}}$

Table 9: Descriptive statistics before and after matching (Version 2, early enrollees)

Variables	Treated		Unmatched Controls		Matched Controls		Standardized Bias	
	Mean	SD	Mean	SD	Mean	SD	unmatched	matched
Male	0.86	0.35	0.49	0.50	0.85	0.36	85.82	3.23
Migration background	0.11	0.32	0.14	0.35	0.13	0.34	-8.45	-4.90
Type of school degree								
Haupt-/ Volksschulabschluss	0.04	0.19	0.46	0.50	0.04	0.19	-111.97	0.11
Mittlere Reife	0.96	0.19	0.54	0.50	0.96	0.19	111.97	-0.11
Age at school degree	16.19	1.54	15.88	2.35	16.21	1.87	15.59	-0.80
Overall school grade								
1-1.9	0.01	0.11	0.00	0.06	0.01	0.12	10.07	-1.22
2-2.9	0.30	0.46	0.28	0.45	0.31	0.47	5.17	-1.84
3-3.4	0.27	0.44	0.16	0.37	0.25	0.44	25.23	3.26
3.5-5.0	0.03	0.16	0.03	0.18	0.02	0.14	-4.81	3.99
Missing school grade	0.39	0.49	0.50	0.50	0.39	0.49	-21.28	1.13
Age at vocational degree attainment	19.03	1.44	18.99	2.49	18.97	1.64	1.66	2.80
Vocational occupation segment								
Metal producer/ processor	0.16	0.37	0.17	0.37	0.18	0.38	-1.16	-2.81
Electronics	0.18	0.38	0.07	0.26	0.17	0.38	31.14	0.70
(interior) construction	0.11	0.32	0.06	0.24	0.12	0.32	18.04	-0.91
Catering	0.03	0.16	0.07	0.25	0.02	0.15	-19.21	1.08
Sales	0.10	0.30	0.21	0.40	0.12	0.32	-29.32	-4.25
Office/ management	0.13	0.33	0.16	0.37	0.12	0.33	-9.07	0.70
Care	0.04	0.19	0.04	0.18	0.03	0.18	1.34	2.99
Medical	0.01	0.11	0.09	0.29	0.01	0.08	-36.30	2.88
Other	0.22	0.41	0.12	0.33	0.21	0.41	24.24	2.46
Occupational segment missing	0.03	0.16	0.01	0.11	0.03	0.16	10.03	0.08
Firm size of apprenticeship								
below 10 employees	0.14	0.35	0.25	0.43	0.14	0.35	-28.72	-1.42
10-100 employees	0.25	0.44	0.30	0.46	0.24	0.43	-10.92	1.94
100-2000 employees	0.30	0.46	0.23	0.42	0.31	0.46	16.49	-0.31
2000 and more employees	0.15	0.36	0.08	0.27	0.16	0.37	23.86	-1.42
Missing firm size	0.15	0.36	0.14	0.35	0.15	0.36	3.81	0.79
Bundesland of vocational training								
Schleswig-Holstein	0.01	0.11	0.02	0.15	0.01	0.09	-7.48	3.21
Hamburg	0.05	0.22	0.02	0.14	0.06	0.24	16.37	-5.51

Lower Saxony	0.10	0.30	0.10	0.30	0.12	0.32	0.36	-4.93
Bremen	0.01	0.11	0.01	0.09	0.01	0.10	4.41	2.07
North Rhine-Westphalia	0.22	0.41	0.17	0.38	0.19	0.39	10.26	6.70
Hesse	0.09	0.29	0.06	0.23	0.10	0.30	11.49	-4.06
Rhineland-Palatinate	0.06	0.25	0.04	0.20	0.09	0.28	10.58	-10.36
Baden-Wuerttemberg	0.10	0.30	0.10	0.30	0.10	0.30	0.43	0.58
Bavaria	0.05	0.22	0.14	0.35	0.05	0.21	-31.12	1.87
Saarland	0.03	0.16	0.02	0.13	0.02	0.13	6.27	5.30
Missing Bundesland	0.28	0.45	0.32	0.47	0.27	0.45	-8.68	2.40
Decade of vocational training								
1950s/ 60s	0.49	0.50	0.26	0.44	0.47	0.50	50.62	4.08
1970s	0.25	0.44	0.33	0.47	0.28	0.45	-17.34	-6.46
1980s	0.15	0.36	0.25	0.44	0.16	0.36	-25.65	-0.94
1990s/ 2000s	0.10	0.30	0.16	0.36	0.09	0.28	-16.94	4.15
Regional unemployment rate								
Up to 2.3	0.42	0.50	0.23	0.42	0.42	0.50	41.42	0.42
Between 2.5-6.5	0.15	0.36	0.21	0.41	0.17	0.38	-16.04	-4.58
More than 6.5	0.08	0.27	0.17	0.38	0.07	0.26	-29.05	1.16
Rate missing	0.33	0.47	0.39	0.49	0.34	0.48	-11.85	-1.86
ISEI of parents								
Mother	11.59	19.15	9.22	17.04	10.29	18.26	13.11	7.19
Father	26.47	26.05	17.09	20.78	25.81	25.73	39.80	2.81
ISEI father missing	0.42	0.50	0.54	0.50	0.42	0.50	-23.88	-1.25
ISEI mother missing	0.68	0.47	0.74	0.44	0.72	0.45	-11.47	-7.12
Comparison to parents' education								
Lower than that of parents	0.38	0.49	0.21	0.41	0.40	0.49	37.96	-3.87
Higher than that of parents	0.11	0.32	0.16	0.37	0.11	0.32	-13.86	0.28
Number of Observations	79		5021		862			

Notes: This table displays the summary statistics for the treatment and control group separately before and after matching for version 2, early enrollees. Mean Bias (before or after matching)= $100\frac{\bar{x}_1-\bar{x}_0}{\sqrt{0.5(V_1(x)+V0(x)}}$

Table 10: Descriptive statistics before and after matching (Version 2, late enrollees)

Male	0.78	0.42	0.49	0.50	0.77	0.43	63.29	2.39

Migration background	0.07	0.26	0.15	0.35	0.06	0.25	-22.85	3.34
Type of school degree								
Haupt-/ Volksschulabschluss	0.21	0.41	0.47	0.50	0.21	0.41	-55.99	0.42
Mittlere Reife	0.79	0.41	0.53	0.50	0.79	0.41	55.99	-0.42
Age at school degree (smallest)	16.53	2.71	15.92	2.37	16.61	3.24	23.86	-3.22
Overall school grade								
1-1.9	0.02	0.16	0.01	0.12	0.03	0.16	7.89	-0.35
2-2.9	0.38	0.49	0.25	0.43	0.39	0.49	29.13	-2.44
3-3.4	0.23	0.43	0.22	0.42	0.22	0.42	3.04	3.85
3.5-5.0	0.05	0.22	0.05	0.21	0.05	0.22	0.61	-0.47
Missing school grade	0.28	0.45	0.45	0.50	0.27	0.45	-34.53	2.37
Age at vocational degree attainment	18.80	1.53	19.08	2.62	18.90	1.73	-12.93	-4.45
Vocational occupation segment								
Metal producer/ processor	0.21	0.41	0.17	0.37	0.20	0.41	10.78	1.64
Electronics	0.10	0.30	0.07	0.26	0.10	0.30	8.84	1.22
(interior) construction	0.05	0.22	0.06	0.24	0.05	0.22	-5.90	-0.49
Catering	0.01	0.11	0.07	0.25	0.02	0.14	-28.00	-3.20
Sales	0.19	0.39	0.21	0.40	0.18	0.39	-5.31	1.77
Office/ management	0.19	0.39	0.15	0.36	0.20	0.40	8.65	-3.21
Care	0.04	0.19	0.04	0.19	0.04	0.19	-0.38	-0.18
Medical	0.06	0.24	0.09	0.29	0.07	0.25	-11.58	-2.21
Other	0.14	0.34	0.13	0.33	0.13	0.34	2.79	1.44
Occupational sector of vocational training	0.02	0.16	0.01	0.12	0.02	0.14	8.20	2.76
Firm size of apprenticeship								
below 10 employees	0.12	0.33	0.26	0.44	0.12	0.33	-34.86	0.42
10-100 employees	0.22	0.42	0.30	0.46	0.22	0.42	-18.62	-0.62
100-2000 employees	0.33	0.47	0.22	0.42	0.34	0.48	24.71	-1.50
2000 and more employees	0.16	0.37	0.07	0.26	0.14	0.34	27.27	7.91
Missing firm size	0.16	0.37	0.14	0.35	0.18	0.38	5.51	-4.89
Bundesland of vocational training								
Schleswig-Holstein	0.05	0.22	0.02	0.15	0.04	0.20	13.85	3.48
Hamburg	0.02	0.16	0.02	0.15	0.01	0.12	1.83	7.54
Lower Saxony	0.11	0.32	0.10	0.30	0.11	0.31	2.63	1.45
Bremen	0.00	0.00	0.00	0.00	0.00	0.00	.	.
North Rhine-Westphalia	0.16	0.37	0.19	0.39	0.16	0.37	-7.20	1.02
Hesse	0.07	0.26	0.06	0.24	0.07	0.26	5.67	1.85
Rhineland-Palatinate	0.01	0.11	0.04	0.20	0.01	0.12	-18.20	-1.14

Baden-Wuerttemberg	0.17	0.38	0.10	0.30	0.20	0.41	20.95	-9.27
Bavaria	0.14	0.34	0.15	0.35	0.14	0.34	-3.41	0.08
Saarland	0.01	0.11	0.02	0.13	0.02	0.14	-4.24	-5.94
Missing Bundesland	0.25	0.43	0.30	0.46	0.24	0.43		
Decade of vocational training							-11.02	2.16
1950s/ 60s	0.40	0.49	0.23	0.42	0.38	0.49	35.38	3.64
1970s	0.26	0.44	0.30	0.46	0.26	0.44	-9.11	-0.37
1980s	0.23	0.43	0.29	0.45	0.24	0.43	-12.53	-1.82
1990s/ 2000s	0.11	0.32	0.18	0.38	0.12	0.32		
Regional unemployment rate							-18.85	-2.00
Up to 2.3	0.28	0.45	0.21	0.41	0.28	0.45	17.07	0.41
Between 2.5-6.5	0.16	0.37	0.21	0.41	0.17	0.38	-12.32	-1.93
More than 6.5	0.19	0.39	0.21	0.41	0.19	0.40	-7.42	-1.60
Missing	0.37	0.49	0.36	0.48	0.36	0.48		
ISEI of parents							1.21	2.96
Mother	19.28	20.94	10.54	17.97	20.37	21.77	44.79	-5.54
Father	26.38	22.62	18.38	20.86	28.08	23.89	36.80	-7.81
ISEI father missing	0.35	0.48	0.50	0.50	0.33	0.47	-31.40	2.58
ISEI mother missing	0.48	0.50	0.70	0.46	0.47	0.50	-46.08	2.34
Comparison to parents' education								
Lower than that of parents	0.23	0.43	0.20	0.40	0.26	0.44	7.80	-6.61
Same as that of parents	0.67	0.47	0.64	0.48	0.65	0.48	5.80	3.02
Higher than that of parents	0.10	0.30	0.16	0.37	0.09	0.28	-17.94	3.87
Months employed 3.5 years after vocational training	29.05	14.25	33.24	11.61	29.37	13.98	-32.22	-2.48
Months unemployed 3.5 years after vocational training	0.27	1.12	1.28	4.21	0.30	1.19	-32.80	-0.77
Number of job changes 3.5 years after vocational training	1.33	0.74	1.57	0.83	1.34	0.71	-29.98	-1.36
Number of job segment changes 3.5 years after vocational training	1.11	0.55	1.19	0.55	1.10	0.51	-14.78	2.57
Number of Observations	81		5429		1708			

Notes: This table displays the summary statistics for the treatment and control group separately before and after matching for version 2, late enrollees. Mean Bias (before or after matching)= $100\frac{\bar{x}_1-\bar{x}_0}{\sqrt{0.5(V_1(x)+V0(x)}}$

Table 11: Marginal effects of propensity score estimation for version 1

	(1) Version 1, control group 1	(2) Version 1, control group 2
Gender	0.703***	2.968***
	(3.60)	(2.63)
Migration background	-0.0790	0.254
	(-0.61)	(1.21)
Haupt-/ Volksschulabschluss	-3.685***	-6.650***
	(-2.96)	(-2.67)
Age at school degree	-0.0487**	-0.0814***
	(-2.44)	(-2.81)
Age at school degree (quadr.)	0.141*	0.364**
	(1.74)	(2.18)
Overall school grade		
1-1.9	0.466	0.357
	(1.53)	(0.45)
3-3.4	-0.114	0.173
	(-1.01)	(0.84)
3.5-5.0	-0.256	-0.471
	(-1.14)	(-1.14)
Missing school grade	0.0193	0.420
	(0.13)	(1.53)
Repeated a school year	-0.0266	0.0466
	(-0.26)	(0.30)
Decade of vocational training		
1950s/ 60s	0.492***	0.704**
	(3.01)	(2.38)
1980s	-0.206	-0.478**
	(-1.62)	(-2.42)
1990s/ 2000s	-0.291*	-0.398*
	(-1.87)	(-1.66)
Age at vocational degree attainment	-0.0657**	-0.0638
	(-2.27)	(-1.41)
Segment of vocational training		
Metal producer/ processor	0.533	-0.958
	(1.07)	(-1.25)
Electronics	-4.350	-1.183***
	(-0.01)	(-3.59)
Construction/interior construction	-4.281	-5.269
	(-0.02)	(-0.03)
Catering	0.0462	-1.218**
	(0.15)	(-2.39)
Sales	-0.224	-1.448***
	(-1.00)	(-2.78)
Care	-0.141	-1.195**
	(-0.47)	(-2.12)
Medical	-0.209	-0.979*
	(-0.89)	(-1.91)
Other	-0.334	-1.976**
	(-0.95)	(-2.21)
Missing occupational segment	-4.132	-0.756
	(-0.01)	(-1.36)

Size of vocational training firm		
below 10 employees	-0.298**	-0.325
	(-2.28)	(-1.62)
10-100 employees	-0.187*	-0.102
	(-1.70)	(-0.59)
2000 and more employees	0.0417	0.251
	(0.31)	(1.28)
Missing vocational training	0.132	0.590**
firm size	(0.86)	(2.20)
Bundesland of vocational training		
Schleswig-Holstein	0.0742	0.256
	(0.27)	(0.53)
Hamburg	-0.0283	0.374
	(-0.10)	(0.77)
Lower Saxony	-0.0635	0.210
	(-0.37)	(0.77)
Bremen	-0.161	0.532
	(-0.31)	(0.66)
Hesse	-0.0472	0.197
	(-0.24)	(0.60)
Rhineland-Palatinate	-0.244	-0.145
	(-0.88)	(-0.35)
Baden-Wuerttemberg	-0.0238	-0.188
	(-0.14)	(-0.74)
Bavaria	-0.210	-0.481*
	(-1.17)	(-1.65)
Saarland	0.164	0.437
	(0.41)	(0.49)
Missing Bundesland	-0.0899	-0.0360
	(-0.39)	(-0.09)
Regional unemployment rate		
between 2.5-6.5	0.00348	0.293
	(0.02)	(0.93)
more than 6.5	-0.0716	0.194
	(-0.35)	(0.55)
missing	0.0249	0.231
	(0.14)	(0.77)
ISEI of parents		
ISEI of mother	-0.00414	0.00818
	(-0.85)	(0.47)
ISEI of father	0.00953**	0.0611***
	(2.54)	(3.45)
Missing ISEI father	0.355*	2.357***
	(1.75)	(2.63)
Missing ISEI mother	-0.376*	-0.144
	(-1.83)	(-0.18)
Comparison to parents' highest education		
Lower than that of parents	0.191**	0.0977
	(2.00)	(0.68)
Higher than that of parents	-0.0387	-0.0244
	(-0.29)	(-0.11)
o.Haupt-/ Volksschulabschluss x Schleswig-Holstein	–	–
Interaction between school type and Bundesland of vocational training		
Haupt-/ Volksschulabschluss x Hamburg	0.563	-0.0894
	(0.92)	(-0.10)

Haupt-/ Volksschulabschluss x Lower Saxony	0.176		-0.0214	
	(0.36)		(-0.03)	
o.Haupt-/ Volksschulabschluss x Bremen		–		–
Haupt-/ Volksschulabschluss x Hesse	0.288		-0.465	
	(0.56)		(-0.57)	
Haupt-/ Volksschulabschluss x Rhineland-Palatinate	0.944*		0.624	
	(1.93)		(0.84)	
Haupt-/ Volksschulabschluss x Baden-Wuerttemberg	0.690*		0.968*	
	(1.82)		(1.78)	
Haupt-/ Volksschulabschluss x Bavaria	0.357		0.664	
	(0.86)		(1.13)	
Haupt-/ Volksschulabschluss x Saarland	0.491		0.151	
	(0.76)		(0.13)	
Haupt-/ Volksschulabschluss x Missing Bundesland	0.750**		0.707	
	(2.20)		(1.29)	
Interaction between occupation segment and gender				
Metal producer/ processor x male	-0.572		-0.405	
	(-1.08)		(-0.49)	
Electronics x male	4.455			–
	(0.01)			
Construction/interior construction x male	4.586		4.502	
	(0.02)		(0.03)	
Catering x male	-0.693		-0.773	
	(-1.20)		(-0.93)	
Sales x male	0.105		1.387**	
	(0.36)		(2.15)	
Care x male	1.199**			–
	(2.26)			
Medical x male	0.0389			–
	(0.07)			
Other x male	0.514		1.139	
	(1.31)		(1.20)	
Missing occupational segment x male	4.456			–
	(0.01)			
Interaction school type and grade				
1-1.9 x Haupt-/Volksschulabschluss			0.633	
			(0.58)	
3-3.4 x Haupt-/Volksschulabschluss			-1.063**	
			(-2.27)	
3.5-5.0 x Haupt-/Volksschulabschluss			0.459	
			(0.66)	
Missing school grade x Haupt-/Volksschulabschluss			-0.878**	
			(-1.99)	
Interaction gender parents' ISEI				
Male x ISEI of mother			-0.0152	
			(-0.79)	
Male x ISEI of father			-0.0549***	
			(-2.91)	
Male x Missing ISEI father			-2.257**	
			(-2.42)	
Male x Missing ISEI mother			-0.461	
			(-0.54)	
Constant	0.0557		-0.122	
	(0.08)		(-0.08)	

ll_0	-739.6	-417.3
ll	-570.2	-287.8
chi2	338.8	259.1
Observations	5686	888

Marginal effects of propensity score estimation; t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Marginal effects of propensity score estimation for version 2

	(1) Version 2, early enrollees	(2) Version 2, late enrollees
Gender	1.031***	0.731***
	(4.52)	(5.21)
Migration background	0.103	-0.245
	(0.57)	(-1.34)
Haupt-/ Volksschulabschluss	-1.959***	-0.576***
	(-7.43)	(-4.14)
Age at school degree	-0.0988***	-0.00586
	(-2.80)	(-0.30)
Overall school grade		
1-1.9	1.066*	0.391
	(1.86)	(1.13)
3-3.4	-0.773*	-0.112
	(-1.92)	(-0.83)
3.5-5.0	-4.983	-0.111
	(-0.01)	(-0.44)
Missing school grade	-0.0175	-0.0710
	(-0.06)	(-0.38)
o.Moved region for vocational training	–	–
Age at vocational degree attainment	-0.0373	-0.0372
	(-0.96)	(-1.10)
Segment of vocational training		
Metal producer/ processor	0.0865	-0.233
	(0.39)	(-1.29)
Electronics	0.340	-0.332
	(1.49)	(-1.55)
Construction/interior construction	0.561**	-0.269
	(2.25)	(-1.04)
Catering	0.217	-0.577
	(0.58)	(-1.55)
Sales	-0.331	-0.105
	(-1.42)	(-0.61)
Care	0.304	0.0450
	(0.81)	(0.14)
Medical	-0.804	0.00796
	(-1.56)	(0.03)
Other	0.261	-0.187
	(1.21)	(-0.98)
Missing occupational segment	0.229	-0.180
	(0.51)	(-0.49)
Size of vocational training firm		
below 10 employees	-0.195	-0.284*
	(-1.03)	(-1.76)
10-100 employees	-0.0877	-0.242*
	(-0.54)	(-1.75)
2000 and more employees	-0.0192	0.0881
	(-0.10)	(0.53)
Missing vocational training firm size	0.354	-0.0148
	(1.54)	(-0.08)

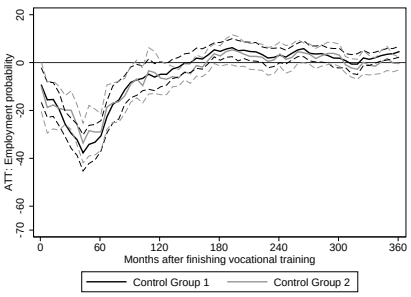
Bundesland of vocational training			
Schleswig-Holstein	-0.495	0.229	
	(-0.93)	(0.79)	
Hamburg	0.516	-0.264	
	(1.60)	(-0.70)	
Lower Saxony	-0.143	-0.0645	
	(-0.60)	(-0.32)	
Bremen	0.120		–
	(0.20)		
Hesse	-0.0281	0.0466	
	(-0.11)	(0.21)	
Rhineland-Palatinate	0.463	-0.738*	
	(1.63)	(-1.73)	
Baden-Wuerttemberg	-0.257	0.330*	
	(-1.07)	(1.81)	
Bavaria	-0.572**	0.00392	
	(-2.04)	(0.02)	
Saarland	0.757*	-0.225	
	(1.79)	(-0.50)	
Missing Bundesland	-0.0275	-0.103	
	(-0.07)	(-0.39)	
Decade of vocational training			
1950s/ 60s	0.0876	0.355*	
	(0.29)	(1.78)	
1980s	-4.357	-0.200	
	(-0.02)	(-1.29)	
1990s/ 2000s	-0.777	-0.268	
	(-1.58)	(-1.36)	
Interaction between school grade and vocational decade			
o.1-1.9 x 1950s/ 60s		–	–
o.1-1.9 x 1980s		–	–
3-3.4 x 1950s/ 60s	1.030**		
	(2.29)		
o.3-3.4 x 1980s		–	–
3.5-5.0 x 1950s/ 60s	4.588		
	(0.01)		
o.3.5-5.0 x 1980s		–	–
Missing school grade x 1950s/60s	-0.0743		
	(-0.14)		
Missing school grade x 1980s	4.381		
	(0.02)		
o.1-1.9 x 1990s/ 2000s		–	–
o.3-3.4 x 1990s/ 2000s		–	–
o.3.5-5.0 x 1990s/ 2000s		–	–
Missing school grade x 1990s/2000s	0.717		
	(1.36)		
Regional unemployment rate			
between 2.5-6.5	-0.211	0.180	
	(-0.79)	(0.81)	

more than 6.5	-0.691**	0.409*
	(-2.07)	(1.65)
missing	-0.489	0.515**
	(-1.64)	(2.37)
ISEI of parents		
ISEI of mother	-0.00805	0.000378
	(-0.99)	(0.07)
ISEI of father	0.0120**	0.00395
	(2.15)	(0.86)
Missing ISEI father	0.293	0.136
	(0.90)	(0.56)
Missing ISEI mother	-0.284	-0.353
	(-0.85)	(-1.47)
Comparison to parents' highest education		
Lower than that of parents	0.494*	0.0426
	(1.88)	(0.35)
Higher than that of parents	-3.774	-0.176
	(-0.02)	(-1.01)
o.Missing difference to parental education	–	–
Lower than that of parents x Male	-0.225	–
	(-0.75)	
Higher than that of parents x Male	3.834	–
	(0.02)	
o.Missing difference to parental education x Male	–	–
Months employed	–	-0.00882**
3.5 years after finishing vocational training		(-2.11)
Months unemployed during	–	-0.0586
the 3.5 years after finishing vocational training		(-1.57)
Number of job changes	–	-0.117
3.5 years after finishing vocational training		(-1.47)
Number of job segment changes	–	-0.0341
3.5 years after finishing vocational		(-0.30)
Constant	-0.0957	-1.010
	(-0.10)	(-1.29)
ll_0	-407.6	-426.4
ll	-271.7	-350.1
chi2	271.9	152.6
Observations	5100	5511

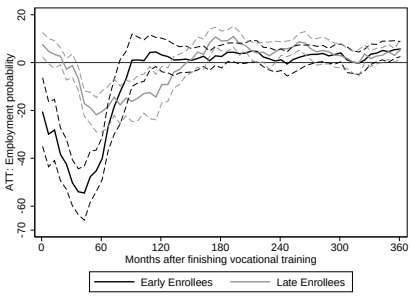
Marginal effects of the propensity score estimation.; t statistics in parentheses
(d) for discrete change of dummy variable from 0 to 1
* p< 0.1, ** p< 0.05, *** p< 0.01

Figure 7: ATT for the probability of being employed

(a) Version 1



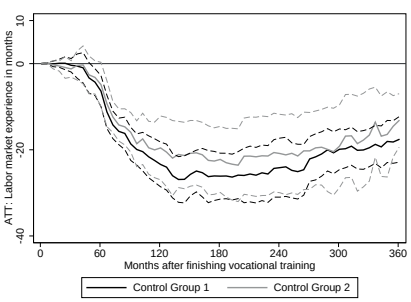
(b) Version 2



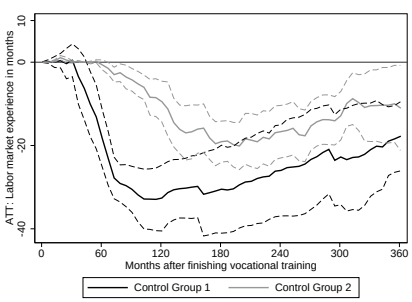
Notes: This figure displays the ATT for the employment probability measured in percentage point differences for both version 1 and 2. I use a six month time window. The ATT is calculated using propensity score adjusted regression based on nearest neighbor matching. The standard errors are clustered at the Bundesland and vocational decade level. The dashed lines indicate the 95 percent confidence interval.

Figure 8: ATT for labor market experience

(a) Version 1



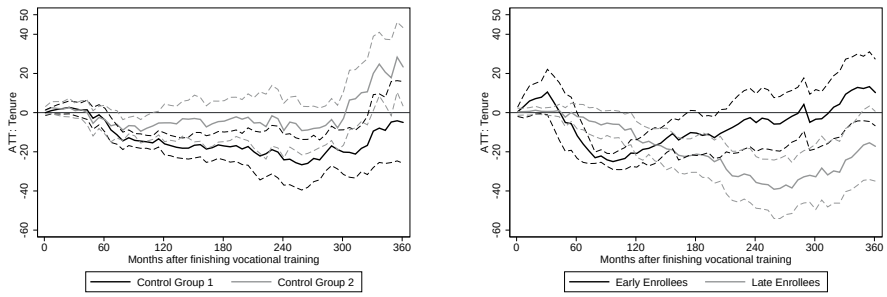
(b) Version 2



Notes: This figure displays the ATT on labor market experience in months for both version 1 and 2. I use a six month time window. The ATT is calculated using propensity score-adjusted regressions based on nearest neighbor matching. The standard errors are clustered at the Bundesland and vocational decade level The gray lines indicate the 95 percent confidence interval.

Figure 9: ATT for tenure

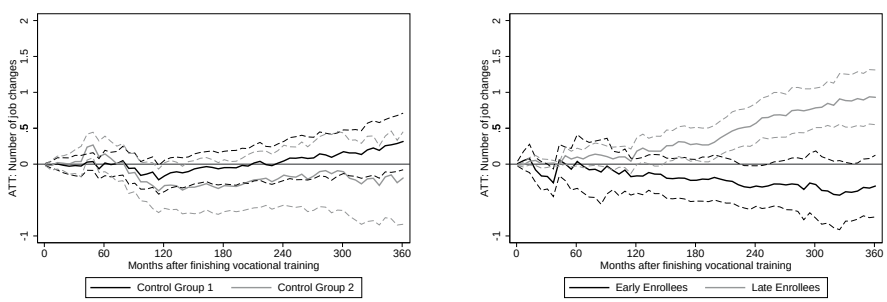
(a) Version 1 (b) Version 2



Notes: This figure displays the ATT on tenure in months for both version 1 and 2. I use a six month time window. The ATT is calculated using propensity score-adjusted regressions based on nearest neighbor matching. The standard errors are clustered at the Bundesland and vocational decade level The gray lines indicate the 95 percent confidence interval.

Figure 10: ATT for the number of job changes

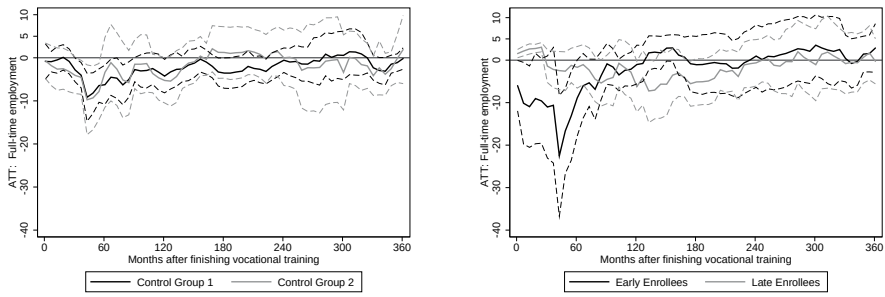
(a) Version 1 (b) Version 2



Notes: This figure displays the ATT for the number of job changes for both version 1 and 2. I use a six month time window. The ATT is calculated using propensity score-adjusted regressions based on nearest neighbor matching. The standard errors are clustered at the Bundesland and vocational decade level The gray lines indicate the 95 percent confidence interval.

Figure 11: ATT for the probability of full-time employment

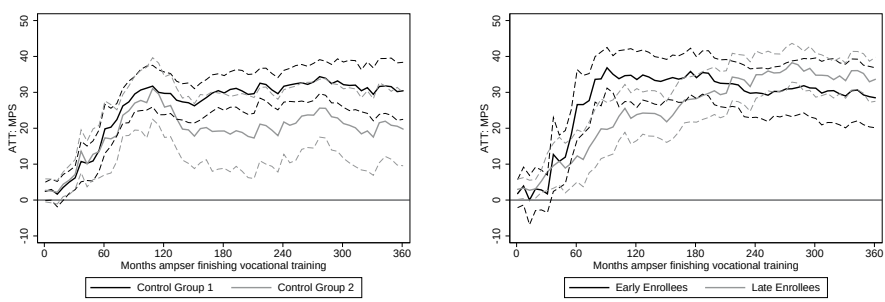
(a) Version 1 (b) Version 2



Notes: This figure displays the ATT for the probability of being employed full-time for both version 1 and 2. I use a six month time window. The ATT is calculated using propensity score-adjusted regressions based on nearest neighbor matching. The standard errors are clustered at the Bundesland and vocational decade level. The gray lines indicate the 95 percent confidence interval.

Figure 12: ATT for the job prestige (MPS)

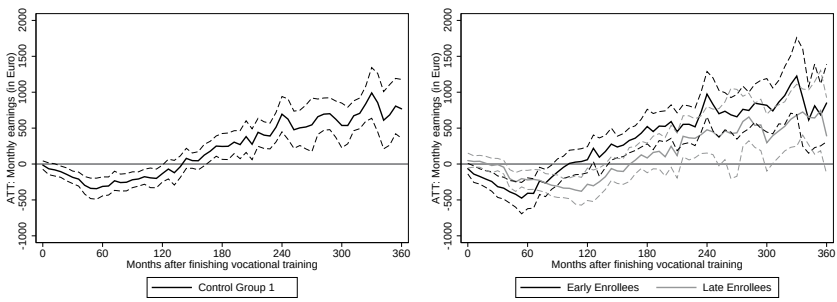
(a) Version 1 (b) Version 2



Notes: This figure displays the ATT for job quality measured by MPS for version 1 and 2. The ATT is calculated using propensity score-adjusted regressions based on nearest neighbor matching. The standard errors are clustered at the Bundesland and vocational decade level. I use a six month time window. The dashed lines indicate the 95 percent confidence interval.

Figure 13: Average treatment effect on monthly earnings

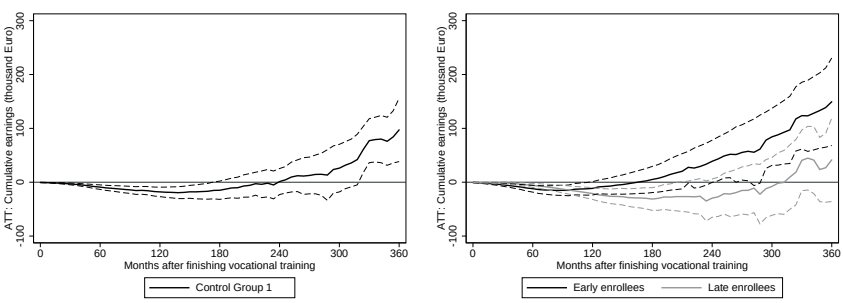
(a) Version 1 (b) Version 2



Notes: This figure displays the ATT for monthly earnings for version 1 and 2. I use a six month time window. The ATT is calculated using nearest neighbor matching and linear regressions. The standard errors are clustered at the Bundesland and vocational decade level. The dashed lines indicate the 95 percent confidence interval. The Euros are deflated to 2015.

Figure 14: Average treatment effect on cumulative earnings

(a) Version 1 (b) Version 2



Notes: This figure displays the ATT for cumulative earnings for version 1 and 2. I use a six month time window. The ATT is calculated using nearest neighbor matching and linear regressions. The standard errors are clustered at the Bundesland and vocational decade level. The dashed lines indicate the 95 percent confidence interval.