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Keep It Up Switzerland! Four Empirical Studies on Dual Vocational Education and Training

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Keep It Up Switzerland!
Four Empirical Studies on Dual Vocational Education and Training

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‘Pleasure in the job puts perfection in the work.’
— Aristotle, Greek philosopher

With gratitude and love to my family,

Maria Esther, Edwin, Alexandra, Lorenz, Rafael & Tobias

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Maria Esther Oswald-Egg, Winterthur, February 2021

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Abstract

In Switzerland, dual vocational education and training (VET) is the main pathway in upper-secondary education. Because of concerns about the benefits of dual VET, Switzerland must provide evidence to justify its policy of strengthening dual VET. This thesis adds empirical evidence to the growing literature on dual VET by examining four challenges around dual VET in Switzerland.

The first chapter examines lower-secondary education students' occupational choices upon entering dual VET. I show that it is possible to provide those students with low-cost personalised information that expands the set of occupations they consider. The information intervention increases the number of occupations in which students apply for work shadowing by 0.3 occupations. Providing information on occupations matching students' work preferences increases the number of occupations in which they apply for work shadowing by six occupations.

The second chapter examines whether having done dual VET as a first career step is beneficial for higher education graduates entering the labour market. Our findings indicate that dual VET leads to higher wages by 7% to 19% one year after graduation and lowers search time by two month. We find no effect on the probability of doing an internship. However, the positive effects of dual VET do not persist five years after graduation as we find no significant effects on wages, unemployment or employment position. The channels through which the effect operates are human capital (specific and general), screening and signalling, not social network.

The third chapter examines how a reduction in firms' hiring costs – through a supply shock of skilled workers on the labour market – influences firms' provision of apprenticeship positions. Our findings show that firms hire more skilled workers, but that at least ten new hires are necessary to cancel one apprenticeship position. The shock has no effect on the probability of offering apprenticeship positions. However, firms' motivation to train for saving hiring costs or attracting skilled workers become less important.

The fourth chapter examines whether young people in countries with dual VET pathways have a smoother transition onto the labour market. Specifically, we focus on the relation between different upper-secondary education programmes (general education, school-based VET and dual VET) and labour market outcomes for 20- to 24-year-olds.

We find that mixed education systems that include both general education and VET are best. Depending on the circumstances, dual VET is preferable over school-based VET.

To sum up, neither of the findings puts dual VET in Switzerland into question. On the contrary, the evidence in this thesis supports the Swiss approach of strengthening dual VET in its education system. It also provides new knowledge for Swiss policymakers to use as they implement evidence-based policies.

Zusammenfassung

Die duale Berufsbildung ist in der Schweiz der Königsweg auf Sekundarstufe II. Aufgrund von Bedenken hinsichtlich des Nutzens dieser Bildungsprogramme muss die Schweiz ihre Politik zur Stärkung immer wieder unter Beweis stellen. Die vorliegende Arbeit ergänzt die steigende Zahl von Publikationen zur dualen Berufsbildung um empirische Belege, indem sie vier Herausforderungen untersucht, denen die Schweiz gegenüber steht.

Das erste Kapitel untersucht die Berufswahl von Schülern der Sekundarstufe I vor dem Übertritt in die duale Berufsbildung. Ich zeige, dass Schüler kostengünstige, personalisierte Informationen nutzen, um ihr Spektrum in Frage kommender Berufe zu erweitern. Die Einführung der Informationsintervention erhöht die Anzahl der Berufe, in denen sich Schüler für Schnupperlehren bewerben, um 0.3 Berufe. Erhalten die Schüler Informationen über Berufe, die ihren Arbeitspräferenzen entsprechen, bewerben sie sich in sechs weiteren Berufen für eine Schnupperlehre.

Das zweite Kapitel untersucht, ob Hochschulabsolventen, die in den Arbeitsmarkt eintreten, von einer dualen Berufsbildung als Erstausbildung profitieren. Unsere Ergebnisse zeigen, dass eine duale Berufsbildung ein Jahr nach dem Abschluss den Lohn um 7 bis 19 Prozent erhöht und die Suchzeit für eine Anstellung um zwei Monate verkürzt. Wir finden keinen Effekt auf die Wahrscheinlichkeit, dass die Absolventen ein Praktikum absolvieren. Die positiven Effekte der dualen Berufsbildung bleiben jedoch langfristig nicht bestehen. Wir finden keine signifikanten Effekte auf den Lohn, die Arbeitslosigkeit oder die Beschäftigungsposition fünf Jahre nach dem Abschluss. Die Kanäle, über die der Effekt der dualen Berufsbildung wirkt, sind Humankapital (spezifisch und allgemein), Screening und Signaling, nicht aber das soziale Netzwerk.

Das dritte Kapitel untersucht, wie das Senken der Einstellungskosten – durch einen Angebotsschock von Fachkräften auf dem Arbeitsmarkt – die Entscheidung der Unternehmen beeinflusst Ausbildungsplätze für Berufslernende bereitzustellen. Unsere Ergebnisse zeigen, dass Unternehmen mehr Fachkräfte einstellen, dass aber mindestens zehn Neueinstellungen notwendig sind, um eine Lehrstelle zu streichen. Der Schock hat keinen Einfluss auf die Entscheidung Lehrstellen anzubieten. Die Motivation der Unternehmen

Berufslernende auszubilden, um Einstellungskosten zu sparen oder Fachkräfte zu gewinnen, verliert jedoch an Bedeutung.

Das vierte Kapitel untersucht, ob Jugendliche in Ländern mit dualem Berufsbildungsweg einen reibungsloseren Übergang in den Arbeitsmarkt erfahren. Konkret konzentrieren wir uns auf die Beziehung unterschiedlicher Bildungsprogramme auf der Sekundarstufe II (allgemeine Bildung, schulische Berufsbildung und duale Berufsbildung) mit der Arbeitsmarktlage der 20- bis 24-Jährigen. Wir stellen fest, dass gemischte Bildungssysteme, die sowohl Allgemeinbildung als auch Berufsbildung beinhalten, die Jugendlichen am erfolgreichsten in den Arbeitsmarkt integrieren. Unter gewissen Umständen ist die duale Berufsbildung der schulischen Berufsbildung vorzuziehen.

Zusammenfassend kann ich festhalten, dass keines der Ergebnisse die duale Berufsbildung in der Schweiz in Frage stellt. Im Gegenteil, die Erkenntnisse in dieser Arbeit unterstützen den Schweizer Ansatz, die duale Berufsbildung in ihrem Bildungssystem zu stärken. Diese Arbeit liefert auch neue Erkenntnisse, welche Schweizer Politiker zur Umsetzung evidenzbasierter Politik nutzen können.

Introduction

The education system in Switzerland provides students with two main pathways for upper-secondary education: general education and vocational education and training (VET).[1] Every year, roughly two thirds of a cohort start with VET, most of them in dual profiles[2,3] (SERI, 2020). One possible explanation for the popularity of dual VET is its combination of learning at vocational schools (1-2 days per week) with working at training firms (3-4 days per week; SERI, 2020), which is ideal for individuals with school fatigue (Eichhorst et al., 2015). Furthermore, dual VET provides a double degree, enabling graduates to enter the labour market and to continue with higher education. Moreover, the transmission of hard and soft skills (OECD, 2010) provides a solid educational foundation for life-long learning (Cedefop, 2012) and matches the needs of the 21^{st} century labour market (Salvisberg, 2010). For Switzerland, these positive aspects of dual VET are reflected in low youth unemployment rates (Dubs, 2006) and high innovation (Backes-Gellner & Pfister, 2019; Rupietta & Backes-Gellner, 2019; Rupietta et al., 2021).

Backes-Gellner et al. (2020) and the references therein provide a broad review of published and upcoming studies around dual VET in Switzerland and other countries. However, there is also criticism of dual VET (Ryan, 2001). One argument against dual VET is that there is a trade-off between short-run benefits and long-term limitations (e.g. Forster et al., 2016; Hanushek et al., 2017). For example, Hanushek et al. (2017) argue that general education should be superior to VET for individuals because general

[1] This thesis is all about vocational education and training on upper-secondary education level, which some sources call initial vocational education and training (Cedefop, 2014).

[2] There are some regional differences with an average of 96% of students following dual VET in the German-speaking part compared to 76% of students in the French-speaking part and 70% in the Italian-speaking part (SERI, 2020).

[3] The OECD differentiates between two types of VET: school-based VET and combined school- and work-based VET. In school-based VET more than 75% of the curriculum is provided at a vocational school whereas in combined school- and work-based VET 25-90% of the curriculum is provided at a training firm (OECD, 2018a). For simplicity, I will use the term 'dual VET' for combined school- and work-based VET throughout this thesis. The one exception is when referring to dual VET from the firms' perspective (in Chapter 3) for which I use apprenticeships for dual VET and apprentices for dual VET students instead.

education provides individuals with transferable skills that make them more adaptable to technological change. The results in that study support their argument for all countries except Switzerland, where they find the opposite trend – dual VET is superior to general education. An explanation for this finding might be that Switzerland has strengthened dual VET over the last 25 years to confront upcoming challenges whereas other countries famous for dual VET have not – Germany has shifted dual VET towards academic education, and Austria has diversified it by enlarging school-based VET (Cedefop, 2020). Thus, the effects of dual VET might depend on the country under analysis. Moreover, findings depend on the research method (Wolter & Ryan, 2011).

To address concerns about dual VET in Switzerland, this thesis examines four contemporary challenges affecting dual VET. The first chapter explores whether it is possible to provide lower-secondary school students with low-cost personalised information to support them in their initial occupational choices before entering dual VET. The second chapter explores whether dual VET is beneficial or harmful for individuals entering the labour market after graduating from higher education. The third chapter explores whether an increase in skilled labour affects firms' provision of apprenticeship positions. The fourth chapter explores whether and to what extent having VET in the education system improves the situation of young people in the labour market, thereby differentiating between school-based VET and dual VET.

The overall aim of this thesis is to add to the evidence on dual VET in Switzerland. The findings presented here should either reinforce Swiss policymakers' choice to strengthen dual VET or point out weaknesses that policymakers need to address. The first specific issue I address is students' choice of occupation before starting dual VET. Swiss teenagers choose among 240 occupations, which can become overwhelming and increasingly result in students opting for bridge solutions or gap years before transitioning to upper-secondary education (see SKBF, 2018). Hence, chapter 1 assesses one effort to improve information flow and broaden students' occupational choice set. A second challenge is that dual VET is still seen as inferior to general education regarding social status (Wolter et al., 2014). The specific aim of chapter 2 is to show that dual VET is not a second-best solution, but is instead a benefit for those graduating from higher education. Dual VET is especially an asset in times where graduates from higher education need work experience to enter the labour market (see Billett, 2014).

A third challenge is that dual VET depends on firms' provision of training positions. The specific aim of chapter 3 is to learn whether immigration reduces firms' willingness to train, thereby threatening dual VET. A fourth challenge is that some stakeholders see the Swiss education system as needlessly complex due to its multiple pathways and transition mechanisms. The specific aim of chapter 4 is to find whether countries benefit from having mixed education systems that include VET, especially dual VET, and not only general education.

To achieve these goals, each chapter of this thesis contains empirical analyses based on identification strategies to provide the best-possible causal evidence given available data. The data in chapter 1 is Swiss cross-sectional data on individuals, which allows for a regression discontinuity design. The data in chapter 2 is also Swiss cross-sectional data on individuals, but it is pooled over a few years and we use an instrumental variable approach to identification. The data in chapter 3 is Swiss panel data at the establishment level and Swiss pooled cross-sectional data on the firm level, allowing for a difference-in-difference approach. The data in chapter 4 is international panel data at the country level including Switzerland, which enables us to use a generalised method of moments approach. Moreover, chapter 3 also extends Stevens' (1994) theoretical model, which models the two opposite effects of an increase in the availability of skilled workers. The following four paragraphs each provide a compact overview of the chapters' contents.

Chapter 1 analyses the effect of a low-cost, personalised online information intervention on the number of occupations to which lower-secondary education students apply for work shadowing. I use data from Yousty AG, one of the largest online platforms in Switzerland where students find dual VET positions. I exploit their introduction of an occupation finder – a tool for suggesting occupations matching student's stated preferences – with a regression discontinuity design. My findings show that the introduction of the occupation finder broadens the set of occupations to which students apply by roughly 0.3 occupations and using the occupation finder results in students applying to six additional occupations. Subgroup analysis shows that the introduction of the occupation finder especially affects students living in urban areas. Thus, it is possible to provide low-cost tailored information to students to broaden their occupational interests in a VET system where dual VET positions are allocated via an apprenticeship market and not via regulated criteria.

Chapter 2, co-authored with Ursula Renold, analyses how work experience from dual VET affects labour market outcomes after higher education. To account for selection into dual VET, we use the regional enrolment rate as an instrument for upper-secondary VET. Results suggest that work experience gained during dual VET leads to significantly higher wages of 7% to 19% one year after graduation from higher education and two months less search time for the first employment but does not significantly lower the probability of an internship in the post-graduation year. However, these positive effects do not persist: the effect is no longer robustly significant for wages, unemployment or employment position after five years. The effect operates through the human capital (specific and general), screening and signalling channels, not the social network channel. Our results suggest that upper-secondary VET is an equivalent pathway to academic education, not merely the second-best, for individuals planning on higher education.

Chapter 3, co-authored with Michael Siegenthaler, formalises how an increased supply of skilled workers affects firms' motives to train. We study how a Swiss reform

that gradually opened Swiss borders to EU cross-border workers in the early 2000s affected firms' provision of apprenticeships, or dual VET positions at firms. Our firm-level difference-in-differences design exploits the stronger effect on firms near the border from the agreement on the free movement of persons (free movement policy). We find that the policy substantially increased the employment of foreign workers in firms that train apprentices. Depending on regression specifications, each foreign worker hired by highly treated firms reduced the number of apprenticeships by 0 to 0.1 positions. We find no effect of the free movement policy on the probability that firms offer apprenticeships. Consistently with the theoretical model, the policy reduced firms' motives to train for saving hiring costs and to attract skilled workers.

Chapter 4, co-authored with Thomas Bolli and Ladina Rageth, investigates how enrolment rates in upper-secondary education programmes – general education, school-based VET and dual VET – affect ten youth labour market indicators on integration and job quality. We run first-difference generalized method of moments regressions on panel data of 36 countries for 2004 through 2014. We complement the existing literature by dealing with unobserved heterogeneity across time and reverse causality and by analysing non-linear effects that might arise due to general equilibrium effects. Our findings show that school-based VET and dual VET have different effects: school-based VET's effect on labour market integration depends on the outcome indicator and country, whereas dual VET overall improves both labour market integration and job quality. Depending on the labour market indicator, we find evidence for both linear and non-linear effects. In educational reforms, policymakers should therefore consider the non-linear and heterogeneous effects of VET.

My involvement in the co-authored chapters was as follows. For chapter 2, my co-author Ursula Renold and I developed the research idea, upon which I created a draft version. For chapter 3, I was in charge of writing a draft version based on my co-author Michael Siegenthaler's idea and suggested identification strategy. I was also responsible for developing the theoretical model and for carrying out the analysis of the firm-level data under his supervision. For chapter 4, I did the analysis under the supervision of my co-author Thomas Bolli, wrote the methodology and results sections, and contributed to the abstract, introduction and conclusion.

The contribution of this thesis is by and large empirical, with a theoretical contribution in chapter 3. This work adds add two studies on the individual level (Ch. 1 & Ch. 2), one study on the firm level (Ch. 3) and one study on the system level (Ch. 4) to the literature on dual VET. In addition, the findings add to the empirical literature in two related areas. I contribute to the economics of education in the areas of college choice (Ch. 1), work experience gained during education (Ch. 2) and transitions from education to the labour market (Ch. 4). I contribute to labour economics in the areas of job search (Ch. 1), training provision by firms (Ch. 3) and immigration (Ch. 3). The overall findings show positive

or null effects for dual VET, thereby providing knowledge for evidence-based policies in Switzerland. Furthermore, this thesis supports the current path of Swiss policymakers strengthening dual VET within the Swiss education system.

However, I do not advise transferring these results to other countries or using them to criticise Germany or Austria for their alternative approaches. Cultural and institutional differences in other countries call for their own research (Chatzichristou et al., 2014). Thus, the external validity of these findings is limited. The research presented here provides evidence that it is possible to have an effective education system that includes dual VET. Also, although I apply the latest empirical methods, causality is still limited due to unobservable variables and because, due to data restriction, it is not possible to control for all influences. However, the only better approach is a randomized control trial, which has not yet been used for analyses of dual VET in Switzerland as it is difficult to apply with regards to ethical issues. Finally, although these four chapters take up current issues, new issues around dual VET are emerging – such as increasing international mobility – and putting pressure on Switzerland and its dual VET program (see for example Widmer, 2014; Deissinger, 2019). This leaves room for much more research on dual VET to come.

Chapter 1

New information, new interests? The effect of an occupation finder for dual vocational education and training on students' occupational choice

1.1 Introduction

Given that people spend thousands and thousands of hours at work, choosing an occupation as a first career step is a far-reaching life decision. Ideally, the chosen occupation fits an individual's aptitudes and interests (Möser et al., 2019). However, finding a suitable occupation among the great number of options available at the start of a career path is challenging especially for 14-year old teenagers. The wide variety of options might so overwhelm students that they end up choosing an unsuitable occupation (Lavecchia et al., 2016). However, suitable occupational choices are crucial for high satisfaction, high productivity and low probability of unemployment (Müller & Schweri, 2009). Moreover, individuals' not reaching their full potential is societally costly in terms of unemployment and unemployment benefits (Bonin et al., 2016). Thus making an informed decision about one's intended occupation is critical for both individuals and society.

A vast literature discusses the effect of providing information on educational choices like continuing with education or not, choosing a type of university, and selecting a field of study (e.g. Lavecchia et al., 2016; Huntington-Klein, 2017; Baker et al., 2018; Mulhern, 2021). The aim is to improve match quality through the provision of information, thereby reducing school-leaving. Some evidence suggests that information interventions help jobseekers re-enter the labour market (Altmann et al., 2018; Belot et al., 2019; Briscese

et al., 2020). The overall findings show that providing information works only if i) it is personalised and ii) it is inexpensive enough to reach a lot of people.

Jaik and Wolter's (2019) study is thus far the only one that analyses the effect of an information intervention on occupation choice for dual vocational education and training[1] (dual VET) students. Their study closes the gap between studies in education economics and those in labour economics, because it focuses on 13- and 14-year-old students considering their first occupations. Jaik & Wolter (2019) analyse whether these students adjust their preferred dual VET occupation after they receive mandatory career guidance including information on labour market imbalances. Thus far, however, no evidence exists on the effect of low-cost personalised information interventions on occupational choices in dual VET. Moreover, although Baker et al. (2018) show that not only students' beliefs about labour market outcomes are important but also students' preferences for certain occupations, studies thus far, provide solely information on external factors such as labour market situation. However, with the exception of Berkes et al. (2019), studies on information interventions overlook internal factors such as clarifying preferences.

This chapter analyses the effect of the introduction and take-up of a low-cost information intervention – tailored to each student's work preferences – on the number of occupations to which students apply. I consider the overall effect and examine its heterogeneity by further analysing whether the effect differs for male and female students or students living in urban and intermediate or rural areas. Demonstrating whether a low-cost information intervention can influence occupation choice is a necessary step towards establishing a method to reduce the number of students using bridge solutions or gap years (e.g 13% of lower-secondary education graduates in Switzerland; Golder et al., 2018). It can also help prevent dual VET contracts from being dissolved (e.g. in Switzerland 20-25%[2] of dual VET contracts; Kriesi et al., 2016) despite extensive career guidance (Golder et al., 2018). Moreover, the results of these analyses are crucial for teachers, career guidance centres, policymakers and others offering (or planning to offer) guidance on occupational decisions and providing advice for information interventions.

My data stem from Yousty AG (henceforth Yousty), one of the largest online platforms in Switzerland for dual VET positions.[3] The dataset contains cross-sectional observations on 12,019 students. Students in the sample enrolled on the platform between January 1, 2016, and January 14, 2019 and applied for work shadowing, where they would follow

[1] Dual vocational education and training, in some studies also called 'apprenticeships', is an upper-secondary education programme combining formal education at school with practical training in a firm (for details, see, e.g. Wolter & Ryan, 2011 or Backes-Gellner et al., 2020).

[2] Between 50-77% of the students dissolving their contract continue their education in a new firm or new occupation within the next three years (Kriesi et al., 2016).

[3] In Switzerland about two thirds of students in lower-secondary education opt for an upper-secondary VET programme, 90% of whom choose dual VET (SERI, 2020).

a worker for a short period like one day, observing his or her work routine (Gordon & Parkes, 1997). The data also contain information on students and their applications.

On August 1, 2018, Yousty introduced an occupation finder, which suggests occupations to students according to their stated occupational preferences. Using a regression discontinuity design, I identify the causal effect of introducing the occupation finder (ITT) and using the occupation finder (provision of information; LATE) on the number of occupations to which each student applies. This quasi-experimental design exploits the introduction of the occupation finder by comparing students who signed up for Yousty in the period immediately following the introduction of the occupation finder (treatment group) to students who signed up before it was introduced (control group). The variable of interest is the number of occupations in which students apply for work shadowing. In Switzerland, 99% of each cohort has at least one experience of work shadowing, and 81% have more than one (Golder et al., 2018). Neuenschwander et al. (2018) find that exposure to work situations through work shadowing is essential for making occupational choices.

The advantage of having data on applications for work shadowing – over data on applications for dual VET or the actual final dual VET occupation – is that they capture the effect of the intervention better. The reason is that external influences such as parents or training firms (Neuenschwander & Hartmann, 2011; Salvisberg & Sacchi, 2014) are not very strong yet. For example parents might be more open to experimenting in the early stages, requirements for entering vocational schools are not yet binding, training firms are still considering potential apprentices, and labour market demand is not yet crucial.

This chapter contains two main findings. First, low-cost information interventions can nudge individuals into expanding their set of choices. I find that providing students with advice on occupations matching their preferences significantly increases the number of occupations to which they apply. The ITT is about 0.3, indicating that three out of ten students consider an additional occupation after the introduction of the occupation finder. The LATE is roughly six, which means that students sticking to their assigned treatment status apply to six additional occupations when treated (using the occupation finder). Second, there is weak evidence for heterogeneous effects as students living in urban areas are affected significantly more by the introduction of the occupation finder. For the subgroup analysis on gender, I find no differences between female and male students due to the occupation finder. Hence this chapter provides initial evidence on how a low-cost tailored online information intervention affects students' occupational choices when applying to dual VET programmes. The findings also show that students living in urban areas and students living in intermediate or rural areas might react differently to information.

This chapter contributes to the rapidly growing literature on information interventions for students and job-seekers by showing that personalised low-cost interventions on work preferences affect their choices. It is related to Mulhern (2021) on students' college choice and Belot et al. (2019) on online information provision for job-seekers. It also contributes

to the literature on nudging students by providing them information about returns of different colleges (e.g. Barone et al., 2019). This chapter also contributes to the literature on internet-based job search and occupational choice (see e.g. Marinescu & Rathelot, 2018), which are now the predominant methods for job search according to Kuhn & Mansour (2014).

Additionally, by showing that RDD is feasible with a time threshold in cross-sectional data, this chapter adds to the literature about RDD in time (for an overview see Hausman & Rapson, 2018) and to the literature that uses (fuzzy) RDD to examine interventions in education (e.g. Hurwitz & Howell, 2014; Jepsen et al., 2017; Pistolesi, 2017) and on the labour market (e.g. Lalive, 2007; Cockx & Dejemeppe, 2012; Bratti et al., 2018). This design differs from that of studies providing information interventions through randomised control trials (see for an overview Oreopoulos & Dunn, 2013), which are mostly smaller in scale. Moreover, the findings contribute to the literature on the gender-specific choice of occupation in dual VET (e.g.Heiniger & Imdorf, 2018; Kuhn & Wolter, 2020).

This chapter is organised as follows. Section 1.2 discusses and summarises the literature on information interventions and states my hypotheses. Section 1.3 presents my data and estimation methods. Section 1.4 shows the results of the analyses and provides robustness tests. Section 1.5 discusses potential interpretations of my results and concludes.

1.2 Literature review and hypotheses

Choosing an occupation is a very demanding task for individuals because they have to gather information on numerous occupations, evaluate them to find those best matching their preferences and abilities, and form expectations about each option's future labour market prospects (Babcock et al., 2012; Fitzenberger et al., 2019; Saniter et al., 2019). For most individuals, this task is very difficult because they are not very good at processing large amounts of complex information or at making choices under uncertainty (Tversky & Kahneman, 1974; Tversky & Shafir, 1992). Indeed, behavioural economics studies analysing occupational choice find that people are not the fully informed rational actors that neoclassical economic models assume they are (Babcock et al., 2012; Bonin et al., 2016). Moreover, Bonin et al. (2016) argue that most individuals are not even secure about their own abilities or preferences. Indeed, the helplessness people feel when dealing with such an enormous task may lead some to make the wrong choice, simply because they stick to a well-known and presumably safe option (Lavecchia et al., 2016).

To alleviate the difficulty of the task, some individuals turn to their families or peers for guidance (Neuenschwander & Hartmann, 2011; Hofer et al., 2020). Another more objective source is external guidance from such places as career guidance centres or mentors, each providing individualised advice (Hofer et al., 2020). According to Borghans

et al. (2015) study counsellors improve a student's choice of field of study. Fitzenberger & Lickleder er (2017) analyse additional career assistance and find heterogeneous effects. According to Saniter et al. (2019) students profit from visiting career guidance centres by making a smoother transition to the labour market. Moreover, Sanders et al. (2019) find that obtaining help from career guidance centres is advantageous, as reflected in shorter unemployment spells. However, the drawback of one-to-one career counselling through guidance centres is that it is costly (McNally, 2016).

In the search for less costly alternatives, recent studies on career guidance for students analyse how the effect of low-cost information interventions affect students' higher education choice, university choice and choice of field of study (Wiswall & Zafar, 2013; Wiswall & Zafar, 2015; Barone et al., 2017; Pistolesi, 2017; Baker et al., 2018; Bonilla-Mejía et al., 2019; Kerr et al., 2020; Mulhern, 2021).[4] For providing extensive information at low costs, more recent studies use web-based interventions (Huntington-Klein, 2017; Berkes et al., 2019). Huntington-Klein (2017) analysing the provision of web-based college scorecards (i.e. graphic information designs for each college), find small effects on the number of searches. Berkes et al. (2019) use an online survey that also provides information on pecuniary and non-pecuniary labour market returns, finding only small effects of the intervention.

All these studies, which use untailored interventions that give students general information, find that although students revise their beliefs, these non-personalised interventions have small to no effect on actual choice. In contrast, studies providing personalised information show that such interventions improve the intervention's effectiveness (McNally, 2016). As disseminating information through the internet generates low cost (Belot et al., 2019), online solutions are key for low-cost interventions. The one study providing personalised information – on admission – through a low-cost online solution finds that the interventions significantly and largely changed college choices (Mulhern, 2021).

The literature on advising job-seekers finds that low-cost interventions providing personalised information supports job-seekers in finding employment (Altmann et al., 2018; Belot et al., 2019; Briscese et al., 2020). Altmann et al. (2018) give job-seekers an information brochure containing job search strategies, reasons for seeking employment and information on the negative consequences of unemployment. They find small but positive overall effects. Belot et al. (2019) provide information on alternative occupations to the ones they are considering online. They find that giving job-seekers information on alternative occupations increases the number of occupations they consider and increases the number of job interviews. Briscese et al. (2020) analyse online employment assistance that randomly exposes job-seekers to a website with editable resumes, templates for

[4]For an overview of earlier studies, see Lavecchia et al. (2016) or French & Oreopoulos (2017).

cover letters and information on job searches and applications. They find heterogeneous but overall positive effects on employment and matching quality.

Most studies of information interventions for students focus on providing information concerning the variety of choices, the application process and the labour market outcomes (Mulhern, 2021). However, while another major determinant of occupation choice is preferences (Wiswall & Zafar, 2018; Baker et al., 2018), few information interventions are aimed at matching students' preferences to occupations (Berkes et al., 2019). Berkes et al. (2019) provide, among other things, information on non-pecuniary labour market returns by college major, finding overall small but heterogeneous effects. In line with the idea that providing advice on preferences about occupations helps students make a well-informed decision, I hypothesise as follows:

H1: Giving students information on occupations matching their preferences (tailored low-cost information) increases the number of occupations they apply for job shadowing.

Altmann et al. (2018) state that the effect heterogeneity of interventions is of growing interest to researchers and policymakers alike. Indeed, they find that providing job-seekers with an information brochure on job search strategies and the consequences of unemployment affects job-seekers at risk of long-term unemployment more strongly than other job-seekers. Another labour economics study finds that its information intervention increased job interviews only for job-seekers with a narrow job search but not for those who searched more broadly (Belot et al., 2019). Briscese et al. (2020) analyse the effect of web assistance on job search behaviour finding different effects depending on age. In education economics studies using information interventions tend to differentiate their analyses according to socio-economic status. They find effects mostly for participants from low socio-economic backgrounds (Barone et al., 2017; Peter & Zambre, 2017; Baker et al., 2018; Peter et al., 2018).

Another subgroup of major interest is gender. Evidence on gender differences in information processing mostly comes from education economics. While Wiswall & Zafar (2015) do not find gender differences in processing information about earnings, other studies do. Studying the effect of an information campaign on the choice of continuing with higher education, McGuigan et al. (2016) find stronger effects for male students, who are compared to female students more at risk of dropping out of education. Barone et al. (2019) study the effect of information about the profitability of a university field of study on the choice of field, finding that female participants enrol less often in fields of study with low profitability but finding no effect for male participants. They test various explanations for their findings – like initial information gap or different receptiveness to treatment – concluding that female participants were more responsive to the information provided. Berkes et al. (2019), examining information provision on labour market outcomes, find negative effects for male students. Finger et al. (2020) analyse whether male

students respond differently to income information on university fields of study than female students. They find that the information intervention influenced the choice of fields of study only for male students, attributing this result to their considering the information more relevant for their decision.

One study in labour economics analyses gender differences in information-processing (Briscese et al., 2020). Providing templates and information for job searching, they find that their intervention was stronger for women and attribute this stronger effect to women's being more responsive to the assistance provided.

These findings on gender-specific effects in education and labour economics also translate into occupation choice. Therefore, I expect female and male students to react differently to information on preferences matching occupations. According to the findings of Kerr et al. (2020), preferences are more important for females than males. In line with the notion that females are more responsive to information they care about, I hypothesise as follows:

H2: Information on matching occupations to preferences increases the number of occupations for job shadowing application more for female students than for male ones.

According to Matthews et al. (2009), job searches in rural areas differ from those in urban areas. They find that job-seekers living in rural areas commonly use their social capital to find employment, whereas those living in urban areas use formal job-searching pathways rather than personal networks. They therefore conclude that job-seekers living in rural areas are more constrained in their job search. Similarly, Kuhn & Wolter (2019), analysing how regional gender norms affect occupation choice, show that regions with stronger gender equality norms (i.e. urban areas) choose less gender-stereotypical occupations. Hence information on suitable occupations is handled differently between those living in rural areas and those living in urban areas, with urban residents less constrained in their occupation choice. Thus, in line with the notion of an urban-rural difference in occupation choice, I hypothesise as follows:

H3: Information on matching occupations to preferences increases the number of occupations for job shadowing more for students living in urban areas than for those living in intermediate or rural areas.

1.3 Methodology

1.3.1 Data

The data for this chapter stem from Yousty, one of the largest online platforms in Switzerland for dual VET positions. On this platform lower-secondary education students can register to find and apply for work shadowing positions or dual VET positions at training firms, and training firms can find suitable students for apprenticeships. The platform

not only shows open positions at training firms but also provides guidance on how to apply, news about occupation fairs, information on training firms, an application tool for work shadowing positions, dual VET positions and employment positions, and extensive information on most of the roughly 240 occupations in dual VET (SERI, 2020). The occupation information includes programme length, programme requirements, estimates of occupation salaries for each programme year, continuing education possibilities, suggestions of similar occupations, pictures of individuals at work, videos of firm activities, and a description of occupation activities. Students can search for a specific occupation, area or firm. When students open a Yousty account, they can manage and send their applications online.

On August 1, 2018, Yousty launched a new tool called the 'occupation finder', with the aim of matching students and their preferences with occupations. To learn each student's preferences, the online tool uses 33 statements such as 'I would like to work outdoors' and 'I would like to consult with other people'. Students have four possible answers: i) 'I'd like this very much', ii) 'I'd like this rather well', iii) 'I'd rather not do this', and iv) 'I don't want to do this at all'. The statements always appear in the same order. After giving one of the four answers to each of the 33 statements, students then receive a ranked list of the three occupations best matching their stated preferences including the percentage overlap. As the entire process is online, students can explore the three recommended occupations right away by following the link to the occupation webpage. From January 15, 2019, the occupation finder not only displayed the three occupations best matching the preferences but also allowed each student to click to the next webpage for information on the top 20 occupations. This additional information might have a controversial[5] effect on the application behaviour of students which leads me to concentrate the analyses to the initial period of the occupation finder.

Anybody using Yousty after August 1, 2018 had access to the occupation finder. I only observe students' use of the occupation finder, when they were logged in into their accounts, while accessing the finder. Yousty shows the results on matching occupations

[5]Although receiving more information improves occupational decision-making, insights from behavioural economics indicate that providing too many options harms that process (Babcock et al., 2012; Lavecchia et al., 2016). Babcock et al. (2012) argue that individuals have limited attention. In the same vein, Lavecchia et al. (2016) state that neoclassical models assume that more choice leads to at least as good a decision because individuals are able to remember all options and pick the best after careful evaluation of all of them. Like this, more options raise the probability of finding a good match (Lavecchia et al., 2016). However, as few people have the cognitive skills to keep track of such an overwhelming number of available options, most individuals choose the simplest or most familiar option (Bonin et al., 2016). Thus far only one study (Jaik & Wolter, 2019) finds that having more options on potential occupations – due to a favourable labour market situation – leads to more school-leavers, suggesting that students evaluate their options less carefully when a great many are available.

only to the students, so it is safe for them to pick their actual preferences without having to adjust them to any socially or parentally desired preference. Furthermore, students wanting to manipulate the results will have a hard time doing so, because which decision leads to which occupation is not transparent. Thus anticipating how an answer will affect a suggested occupation is not realistic.

The Yousty database contains data on all registered students and their application histories. Thus I have cross-sectional data, which I aggregate on the student level, i.e. I loss all the information on the application level including information on training firms and open positions. I restrict the data to students still in lower-secondary education but aged older then 11 and younger than 18, to occupations where students will earn a VET diploma and to applications send for work shadowing. I also limit the maximum number of occupations students apply to no more than nine[6] occupations. For the analysis I focus on the data between January 1, 2016 to November 30, 2019, whereby I consider all applications within that period. To avoid the controversial effect from enlarging the recommended occupations from three to 20 occupations, I only keep students registering and using the occupation finder before January 15, 2019. This data cleaning leaves me with a total of 12,019 observations.

For my analyses I focus on the number of different occupations in which students apply for work shadowing at any point in time during my observation period. Work shadowing is part of the second year in lower-secondary education, lasts mostly between one and five days and is recommended to take place during the sports, spring or summer holidays (berufsberatung.ch, accessed on February 7, 2021). This variable is of interest because work shadowing provides the student's a first real impression of an occupation (Hofer et al., 2020). In Switzerland most students have at least one experience of work shadowing (99%), whereby 81% have even more (Golder et al., 2018).

Furthermore, as the decision to apply for work shadowing in an occupation has no binding consequences for any future decision, students are open to new discoveries, and their choice is less influenced by parents, peers, teachers or training firms. This freedom of choice for work shadowing is essential for analysing the full impact of the information intervention. Later decisions, such as applications for dual VET positions at training firms or the actual dual VET position they finally obtain, are influenced by other factors, such as the social environment or firms' supply of dual VET positions and their choice of student for their open positions (Neuenschwander & Hartmann, 2011; Möser et al., 2019). Thus these later decisions do not necessarily reflect the pure occupation preferences of students.

[6] 99% of students apply to nine or less occupations for work shadowing, thus students applying to more than 9 occupations are outliers. To ensure that the results are not driven by the outliers I modify the number of occupations by replacing higher number of occupations by nine.

I create the variable 'number of occupations' by aggregating the number of applications per student to different VET diplomas for job shadowing. To count only actual different occupations I combine VET diplomas within the same occupation but with different specialisations or performance level to the same occupation, i.e. the VET diploma merchant has specialisations in for example banking, tourism or notary and at the same time also three different performance levels. In the end there are 151 different occupations.

On the student-level I have data about students' age, gender, school programme[7], and their canton[8] of residence. Unfortunately only few students report their school year (every third), so that I do not include that variable into the analysis. To capture the weekday of registration I create a set of dummy variables indicating the weekday (i.e. Sunday till Saturday).

The data also provides information for two subsamples: gender and living area. Gender is a dummy variable being zero for male students and one for female students. Living area (called urban) is also a dummy variable being one for students living in urban areas and zero for students living in intermediate or rural areas. The data did not initially contain information on the living area but Yousty matched upon request students living address to the area typology of the Swiss Federal Statistical Office from 2012 (though the composition of the political regions are from 2017; Statistischer Atlas der Schweiz). This typology attributes every region one of three categories: urban, intermediate and rural.

1.3.2 Estimation method

The introduction of the occupation finder allows me to apply a regression discontinuity research design (RDD), in which I compare students registering to Yousty right before August 1, 2018 to students registering right after (e.g. Lee & Lemieux, 2010; Cattaneo et al., 2019; Cattaneo et al., 2018). Thus, I use as the forcing variable students' date of registration, the threshold is August 1, 2018 and the treatment is students' usage of the occupation finder. The idea is that in the neighbourhood around the threshold being above or below the threshold is as good as random. In the literature on RDD a special framework exists called regression discontinuity in time when the running variable is a time variable such as age or date (e.g. Hausman & Rapson, 2018). Although I use time,

[7] School programme covers five lower-secondary programmes, those being pre-baccalaureate (e.g. Progymnasium, Bezirksschule), secondary school A (e.g. Sekundarschule or Sek. A), secondary school B (e.g. Realschule or Sek. B), secondary school C (e.g. Oberschule or Sek. C) and bridge year (e.g. tenth school year or gap year). I create a dummy variable for each programme.

[8] There are 26 cantons in Switzerland, which are political entities much like US states. However, I focus on the 19 German-speaking cantons as Yousty is most active in the German-speaking part of Switzerland. Thus, I have 19 dummy variables indicating the respective canton.

i.e. the registration date, as running variable the estimations do not fit in the conventional frameworks of regression discontinuity in time because instead of panel or time series data I have cross-sectional data and treatment is not inevitable (Lee & Lemieux, 2010). Therefore, I stick to the conventional cross-section RDD methodology.

To identify the effect of the introduction of the occupation finder on students application behaviour I estimate a sharp regression discontinuity design (sRDD; e.g. Cattaneo et al., 2019). In a sharp RDD I assume that all students registering before August 1, 2018 did not do the occupation finder, whereas all students registering after August 1, 2018 did do it. The resulting effect from this estimation is the intend-to-treat (ITT) effect. The corresponding estimation equation is as follows:

$$Y_i = \beta_1 T + \beta_2 f(X_i) + \beta_3 C_i + \varepsilon_i \tag{1.1}$$

where Y is the number of occupations to which a student (i) applied for work shadowing at any point in time. T is a binary variable equal to one if students are eligible for treatment, i.e. has registered after the introduction of the occupation finder and zero otherwise. X is the students' date of registration in days before and after the introduction of the occupation finder centred at 0 and in this RDD the running variable. $f(X)$ is a first order polynomial function of X. In RDD covariates (C) do not unbias the estimates but might increase precision and reduce noise (Lee & Lemieux, 2010). I include age, gender, school programme, canton of residence and weekday of registration as control variables for the first hypothesis on the general effect of the occupation finder. For the subsample estimations in the second hypothesis on gender I drop gender from the control variables and in the third hypothesis on living area differences I drop canton of residence from the control variables. ε is an individual-specific and robust error term.

In my case the ITT effect does not coincide with the effect of doing the occupation finder as the treatment assignment does not coincide completely with the actual treatment condition – compliance is imperfect because of self-selection into treatment. For this data there is two-sided imperfect compliance as there are students registering before August 1, 2018 using the occupation finder and students registering after August 1, 2018 not using the occupation finder.

To estimate the actual effect of using the occupation finder, I apply a fuzzy regression discontinuity design (fRDD; e.g. Cattaneo et al., 2018), which relies on the subgroup of compliers (i.e. the students sticking to their assignment). The fuzzy RDD exploits the discontinuity in the probability of using the occupation finder by instrumenting the actual usage of the occupation finder from the date of registration and the eligibility of the occupation finder. Thus, being eligible for the occupation finder only indirectly influences the number of occupations students apply through actually using the occupation finder (first stage or exclusion restriction). The second stage provides the actual effect of using the occupation finder by identifying the local average treatment effect (LATE) of the

occupation finder for students around the threshold. The estimation equations for the first and second stage of the fuzzy RDD are as follows:

$$Firststage : \widehat{D}_i = \gamma_1 T_i + \gamma_2 f(X_i) + \gamma_3 C_i + \varepsilon_i \tag{1.2}$$

$$Secondstage : Y_i = \beta_1 \widehat{D}_i + \beta_2 f(X_i) + \beta_3 C_i + \mu_i \tag{1.3}$$

where the new variable D is a binary variable equal to one if a student did the occupation finder and zero otherwise. ε and μ are individual-specific and robust error terms.

The estimations follow the continuity-based approach, which uses local polynomials and thus is non-parametric (e.g. Cattaneo et al., 2019). Although having a discrete forcing variable, which would call for a local randomization approach, I follow a continuity-based estimation approach because this approach has less restrictive assumptions about the functional form. Therefore, the continuity-based approach is the better choice when the number of mass points, i.e. unique values which are shared by many students, is high (Cattaneo et al., 2018). My data consists of 12,019 observations with 1,045 mass points – a high number.

To reduce bias arising from the use of data further away from the threshold (e.g. Gelman & Imbens, 2019), I use a non-parametric local polynomial regression discontinuity estimator with robust bias-corrected confidence intervals (Stata command 'rdrobust'[9]; Calonico et al., 2014a; Calonico et al., 2017). The non-parametric estimation requires specification of a kernel function, an algorithm for optimal bandwidth size selection, the order of the local polynomial to construct the point estimator and the order of the local polynomial to construct the bias correction. The default options for the kernel function is triangular, for the algorithm of optimal bandwidth size selection is one common mean square error (MSE)-optimal, for the order of local polynomial point estimator is local linear and for the order of the local polynomial bias correction is local quadratic. The estimations rely on the default options.

For the subgroup analysis on gender and living area I apply the method suggested by Carril et al. (2018; Stata command 'rddsga'). This method allows binary subgroup analysis in RDDs, by re-weighting the subgroups with propensity score weighting to isolate the treatment effect from other observables. According to Carril et al. (2018) this method tackles the problem of subgroups having i) a different relationship between the outcome and running variable and ii) any other systematic variation of characteristics between subgroups, which renders any other treatment-subgroup-interaction approach invalid. The variables included for the propensity score weighting in the gender analysis are the control variables except gender and in the living area analysis the control variables

[9]This command is build on the theoretical work of Calonico et al. (2014b), Calonico et al. (2018), Calonico et al. (2019), Calonico et al. (2020b) and Calonico et al. (2020a)

without canton of residence. The Stata command 'rddsga' estimates standard errors and confidence intervals with non-parametric bootstrap as default (Carril et al., 2018).

1.4 Results

1.4.1 Descriptive statistics

Table 1.1 displays the summary statistics of the data separating students who did not do the occupation finder (11,467; 95%) from them who did (552; 5%). The average number of occupations students apply for work shadowing is 1.68 when they did not do the occupation finder and 2.56 otherwise, with some students only applying to one occupation and some students applying to up to 9 occupations. The average registration date indicates that students not using the occupation finder (control group) indeed register clearly before the introduction of the occupation finder whereas students using the occupation finder register shortly before the introduction or afterwards. In line, roughly two-thirds of the sample (68%) is eligible to use the occupation finder when they did compared to only one-third (34%) otherwise. The data consists of slightly more female students using the occupation finder (45% compared to 41%) and students using the occupation finder living slightly less in urban areas (64% compared to 67%).

The summary statistics of the control variables are very similar for the students using the occupation finder and the ones not using it. The average age is 14 and most students (48%) attend secondary school A followed by secondary school B (39% resp. 38%). I have observations on all German-speaking cantons of Switzerland but for two (AI and UR) where no student used the occupation finder. Most observations are from the cantons Aargau (13% resp. 16%), Bern (15% resp. 16%) and Zurich (40% resp. 36%). Students send slightly more applications on weekdays than weekends with a peak on Wednesday (20% resp. 22%), most probably taking advantage of the in some cantons common free afternoon on Wednesday.

Table A.1 in the appendix shows the correlation coefficients of all variables with the number of occupations, the registration date, eligibility for the occupation finder and take-up of the occupation finder. Of special interest are the relations between taking-up the occupation finder to number of occupations (coef. 0.13), taking-up the occupation finder to registration date (coef. 0.13) and taking-up the occupation finder to eligibility for occupation finder (coef. 0.15).

Table 1.1: Summary statistics by take up of occupation finder (D)

	No occupation finder					Occupation finder				
	Obs	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max
Number of occupations (Y)	11467	1.68	1.35	1	9	552	2.56	2.08	1	9
Registration date (X)	11467	-194.18	265.34	-942	167	552	-29.40	183.86	-919	165
Eligibility (T)	11467	0.34	0.47	0	1	552	0.68	0.47	0	1
Gender	11467	0.41	0.49	0	1	552	0.45	0.50	0	1
Urban	11467	0.67	0.47	0	1	552	0.64	0.48	0	1
Age	11467	14.31	1.02	12	17	552	14.22	0.98	12	17
Bridge year	11467	0.06	0.24	0	1	552	0.07	0.26	0	1
Secondary school C	11467	0.03	0.18	0	1	552	0.03	0.18	0	1
Secondary school B	11467	0.39	0.49	0	1	552	0.38	0.49	0	1
Secondary school A	11467	0.48	0.50	0	1	552	0.48	0.50	0	1
Pre-baccalaureate	11467	0.04	0.20	0	1	552	0.04	0.19	0	1
AG	11467	0.13	0.34	0	1	552	0.16	0.37	0	1
AI	11467	0.00	0.04	0	1	552	0.00	0.00	0	0
AR	11467	0.00	0.03	0	1	552	0.00	0.04	0	1
BE	11467	0.15	0.35	0	1	552	0.16	0.37	0	1
BL	11467	0.04	0.19	0	1	552	0.05	0.21	0	1
BS	11467	0.01	0.12	0	1	552	0.01	0.11	0	1
GL	11467	0.00	0.05	0	1	552	0.00	0.04	0	1
GR	11467	0.02	0.14	0	1	552	0.01	0.09	0	1
LU	11467	0.07	0.26	0	1	552	0.07	0.26	0	1
NW	11467	0.01	0.10	0	1	552	0.01	0.10	0	1
OW	11467	0.00	0.05	0	1	552	0.00	0.06	0	1
SG	11467	0.07	0.25	0	1	552	0.06	0.23	0	1
SH	11467	0.01	0.08	0	1	552	0.01	0.10	0	1
SO	11467	0.04	0.19	0	1	552	0.03	0.18	0	1
SZ	11467	0.02	0.13	0	1	552	0.01	0.07	0	1
TG	11467	0.01	0.08	0	1	552	0.01	0.11	0	1
UR	11467	0.00	0.04	0	1	552	0.00	0.00	0	0
ZG	11467	0.03	0.16	0	1	552	0.03	0.18	0	1
ZH	11467	0.40	0.49	0	1	552	0.36	0.48	0	1
Monday	11467	0.15	0.36	0	1	552	0.11	0.31	0	1
Tuesday	11467	0.16	0.37	0	1	552	0.16	0.37	0	1
Wednesday	11467	0.20	0.40	0	1	552	0.22	0.41	0	1
Thursday	11467	0.16	0.37	0	1	552	0.17	0.38	0	1
Friday	11467	0.13	0.34	0	1	552	0.13	0.33	0	1
Saturday	11467	0.08	0.27	0	1	552	0.09	0.28	0	1
Sunday	11467	0.12	0.32	0	1	552	0.12	0.33	0	1

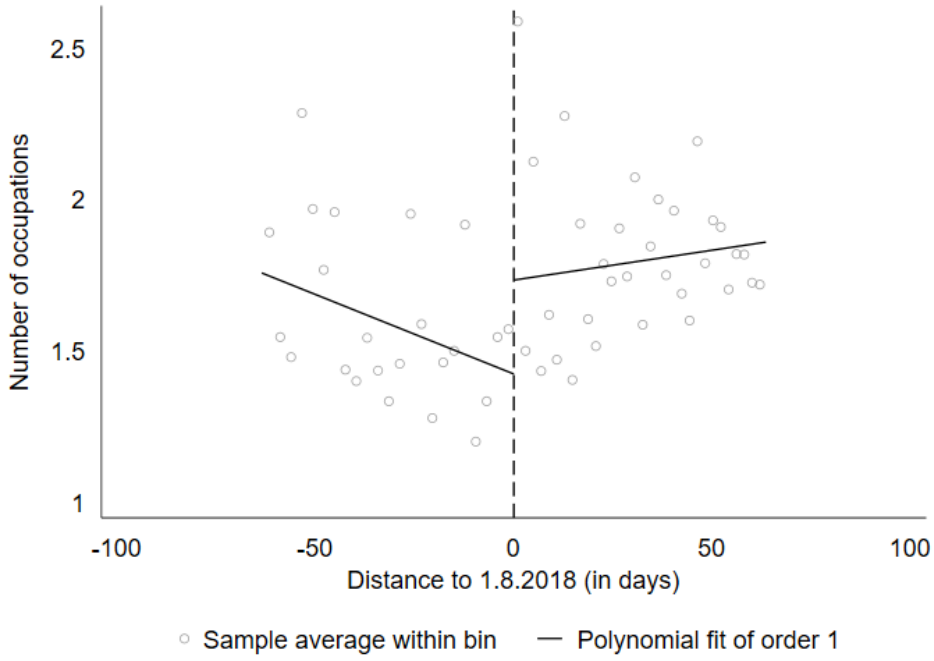
Notes: The table shows the summary statistics for students not using the occupation finder and students using the occupation finder separately. It reports the number of observations (Obs), the variable mean (Mean), standard deviation (SD), minimum value (Min) and maximum value (Max).

1.4.2 The effect of new information on students' application behaviour

Figure 1.1 provides a visual identification of the ITT effect of the occupation finder on students number of occupations they apply for job shadowing. The x-axis shows the number of days away from the introduction of the occupation finder, and the y-axis shows the average number of occupations to which students applied for work shadowing. There is a clear discontinuity in the number of occupations students apply for work shadowing at the time of introduction of the occupation finder. This effect is positive indicating that introducing the occupation finder increases the number of occupations that student consider for job shadowing.

Table 1.2 provides the results for OLS estimations (OLS), sharp regression discontinuity estimations (sRDD) and fuzzy regression discontinuity estimations (fRDD) without (uneven numbering) and with (even numbering) control variables. The significant coefficients from the OLS estimations (columns 1 and 2) suggest that the occupation finder incentives nine out of ten students to apply to an additional occupation. The estimates from the sharp RDD (ITT; columns 3 and 4) are smaller and less significant though also indicating that the introduction of the occupation finder incentivized three out of ten students to apply to an additional occupation. Turning to the fuzzy RDD columns 5 and 6 show that the first stage estimations of the fuzzy RDD are only significant for estimations without control variables. The second stage estimates (LATE) indicate that using the occupation finder increases the number of occupations students apply significantly by roughly six additional occupations (column 7). This result becomes insignificant when adding the control variables (column 8).

Figure 1.1: ITT effect of occupation finder on number of occupations



Notes: This figure shows the intention-to-treat effect (ITT) without control variables. The y-axis shows the number of occupations students apply for job shadowing. The x-axis shows the number of days away from the introduction of the occupation finder. The dots indicate the sample means of number of occupations within a bin and the solid line is the corresponding fitted line. The estimation uses a triangular kernel, a one MSE-optimal bandwidth selector, a first order polynomial fitting and a mimicking variance evenly-spaced method for bin selection.

Table 1.2: Effect of occupation finder on number of occupations

VARIABLES	(1) OLS Number of occupations	(2) OLS Number of occupations	(3) sRDD Number of occupations	(4) sRDD Number of occupations	(5) fRDD (FS) Occupation finder	(6) fRDD (FS) Occupation finder	(7) fRDD (SS) Number of occupations	(8) fRDD (SS) Number of occupations
Occupation finder	0.881***	0.876***	0.310**	0.319**	0.052*	0.041	6.357*	7.394
	(0.0892)	(0.0889)	(0.155)	(0.150)	(0.025)	(0.026)	(3.534)	(5.216)
R-squared	0.017	0.027						
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Effective obs	12019	12019	2134	2199	2258	1978	2258	1978
Kernel type			Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
BW type			mserd	mserd	mserd	mserd	mserd	mserd
VCE method			NN	NN	NN	NN	NN	NN
BW estimate (h)			63.55	65.92	68.49	59.24	68.49	59.24
BW bias (b)			110	113.7	122.2	120.4	122.2	120.4
Order estimate (p)			1	1	1	1	1	1
Order bias (q)			2	2	2	2	2	2

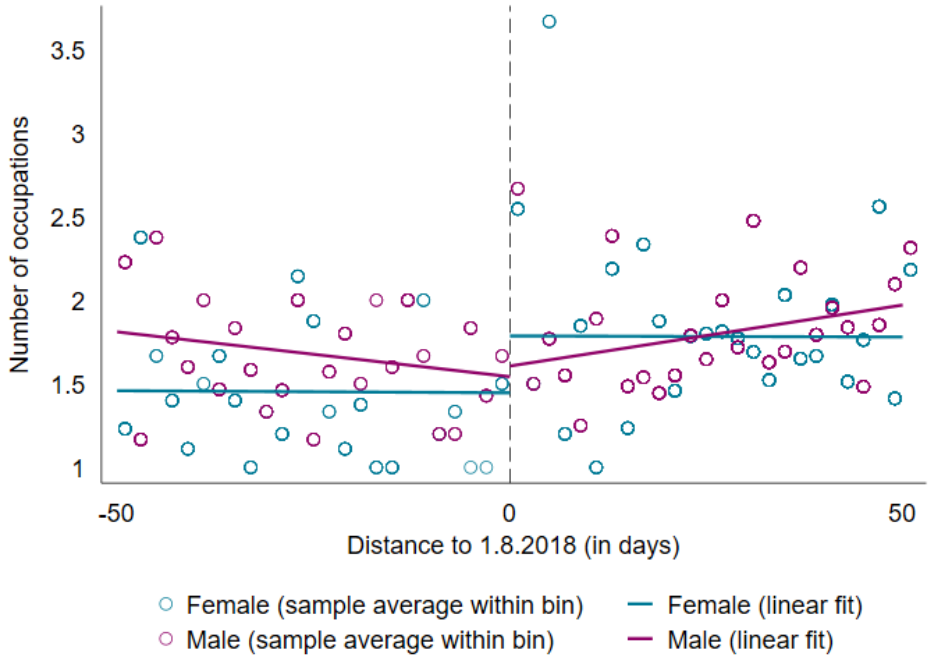
Notes: This table shows the regression coefficients and standard errors (in parenthesis below the coefficients) from OLS (columns 1 and 2), sharp RDD (sRDD; columns 3 and 4) and the first (FS; columns 5 and 6) as well as second stage (SS; columns 7 and 8) of fuzzy RDD (fRDD) estimations. Columns with uneven numbering display the estimations without control variables whereas columns with even numbering display the estimations with control variables. The control variables used are gender, age, school programme, canton of residence and weekday of registration. Standard errors are robust. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively. For the RDD estimations the table further contains information on the specifications of the kernel type, bandwidth selection, variance-covariance matrix estimator, actual bandwidth used to construct the point estimator as well as the bias-correction estimator and polynomial order for constructing the point estimator as well as the bias correction. mserd stands for one common MSE-optimal bandwidth selector and NN for heteroskedasticity-robust nearest neighbour variance estimator with a minimum of three neighbours.

1.4.3 Gender differences in the effect of the occupation finder

Figure 1.2 provides a visual identification of the ITT effect of the occupation finder on female and male students number of occupations they apply for job shadowing separately. The x-axis shows the number of days away from the introduction of the occupation finder, and the y-axis shows the average number of occupations to which students applied for work shadowing. For female students there is a clear discontinuity in the number of occupations female students apply for work shadowing when Yousty introduced the occupation finder. The jump is positive. For male students there is practically no discontinuity. Thus, introducing the occupation finder had an increasing effect on the number of occupations female students applied for job shadowing and no effect for male students.

Table 1.3 displays the results of an OLS estimation (column 1), a sharp RDD estimation (column 2), and the two stages of a fuzzy RDD estimation (first stage in column 3 and second stage in column 4). The results of the OLS estimation are positive and significant for both female (0.7) and male students (1.0) though larger for male students. The difference (0.3) is significant and suggests that male students are more probable of

Figure 1.2: ITT effect of occupation finder on number of occupations by gender



Notes: This figure shows the intention-to-treat effect (ITT) for female (teal) and male (pink) students. The y-axis shows the number of occupations students apply for job shadowing. The x-axis shows the number of days away from the introduction of the occupation finder. The dots indicate the sample means of number of occupations within a bin and the solid line is the corresponding fitted line (linear fit). The estimation uses inverse propensity score weighting on age, school programme, canton of residence and weekday of registration. The bandwidth estimation builds on a triangular kernel, a one MSE-optimal bandwidth selector and a linear fitting.

taking a look at an additional occupation. The results of the sharp RDD estimation (ITT) in contrast find no significant effect of the occupation finder neither for female students (0.4) nor for male students (0.1). The difference (0.3) is not significant either. The results of the fuzzy RDD show similar findings. The first stage is significant for female students (0.1) and not significant for male students (0.03). The coefficients from the second stages (LATE) are both positive and the female coefficient is larger (6.5 for female students and 0.6 for male students), but neither the coefficient for female students nor the coefficient for male students are significant, nor is the difference.

1.4.4 Area differences in the effect of the occupation finder

Figure 1.3 provides a visual identification of the ITT effect of the occupation finder on the number of occupations students apply for job shadowing for students living in urban and students living in intermediate or rural areas separately. The x-axis shows the number

Table 1.3: Effect of occupation finder on number of occupations by gender

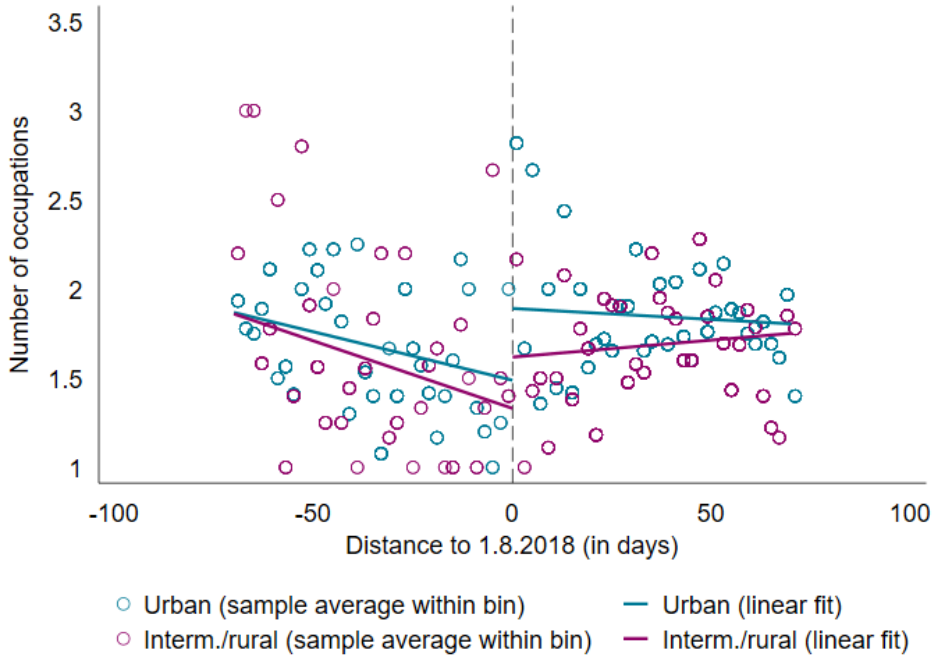
	(1) OLS	(2) sRDD	(3) fRDD (FS)	(4) fRDD (SS)
VARIABLES	Number of occupations	Number of occupations	Occupation finder	Number of occupations
Female students	0.655***	0.366	0.080*	6.489
	(0.118)	(0.319)	(0.043)	(366.807)
Male students	1.000***	0.087	0.029	0.589
	(0.129)	(0.253)	(0.033)	(46.202)
Difference (t-test)	0.345**	0.279	0.051	5.901
Observations	12019	890/705	1055/833	1055/833
R-squared	0.028	0.007	0.014	.
Controls	Yes	Yes	Yes	Yes
Bandwidth		50	57	57
Spline		linear	linear	linear
Standard errors		Bootstrap	Bootstrap	Bootstrap

Notes: This table shows the regression coefficients and standard errors (in parenthesis below the coefficients) from OLS (column 1), sharp RDD (sRDD; column 2) and the first (FS; column 3) as well as second stage (SS; column 4) of fuzzy RDD (fRDD) estimations for female and male students separately. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively. Standard errors are robust. The OLS estimation includes control variables (age, school programme, canton of residence and weekday of registration) whereas the RDD estimations use the same variables for inverse propensity score weighting. The table further displays information on the RDD estimations concerning their bandwidth size, their spline and the computation method of their standard errors. The selection of the bandwidth is data-driven. I estimated the recommended bandwidth for female and male students separately and picked the larger of the two (male one) for these RDD subgroup estimations.

of days away from the introduction of the occupation finder, and the y-axis shows the average number of occupations to which students applied for work shadowing. For both students living in urban and students living in intermediate/rural areas there is a clear discontinuity in the number of occupations students apply for work shadowing around the time that Yousty introduced the occupation finder. The effects are positive for both living areas, though the effect is larger for students living in an urban area. Thus, introducing the occupation finder increased the number of occupations students from urban areas as well as intermediate or rural areas applied for job shadowing.

Table 1.4 displays the results of an OLS estimation (column 1), a sharp RDD estimation (column 2), and the two stages of a fuzzy RDD estimation (first stage in column 3 and second stage in column 4) for students living in urban areas and students living in intermediate or rural areas. The coefficients of the OLS estimation are positive and significant for both students living in urban (1.0) and intermediate or rural areas (0.8). The effect from the occupation finder is larger for students living in urban areas (0.2) but this difference is not significant. The coefficients of the sharp RDD estimation (ITT) are positive for both areas too (0.4 urban areas and 0.2 intermediate/rural areas) but only the one from students living is urban areas is significant. However, the difference between student

Figure 1.3: ITT effect of occupation finder on number of occupations by area



Notes: This figure shows the intention-to-treat effect (ITT) for students living in urban areas (teal) and students living in intermediate or rural areas (pink). The y-axis shows the number of occupations students apply for job shadowing. The x-axis shows the number of days away from the introduction of the occupation finder. The dots indicate the sample means of number of occupations within a bin and the solid line is the corresponding fitted line (quadratic fit). The estimation uses inverse propensity score weighting on age, gender, school programme and weekday of registration. The bandwidth estimation builds on a triangular kernel, a one MSE-optimal bandwidth selector and a linear fitting.

living in urban areas and students living in intermediate or rural areas is not significant. The coefficients of the fuzzy RDD in the first stage are both positive (0.05 urban areas and 0.004 intermediate/rural areas) and not significant. The coefficients in the second stage of the fuzzy RDD (LATE) are positive for students living in urban areas (7.947) and negative for students living in rural areas (-34.980). The result for students living in rural areas is significant but the difference between the two areas is not.

1.4.5 Validation and robustness checks

Cattaneo et al. (2019) suggest five validation and robustness checks for strengthening the findings. Those five checks are (i) covariate balance, (ii) density of running variable, (iii) alternative threshold values, (iv) donut hole approach and (v) alternative bandwidths. In the following, I am going to perform these checks on the entire data for the sharp RDD estimation (ITT) without control variables. This enables a visual representation of the

Table 1.4: Effect of occupation finder on number of occupations by area

VARIABLES	(1) OLS Number of occupations	(2) sRDD Number of occupations	(3) fRDD (FS) Occupation finder	(4) fRDD (SS) Number of occupations
Urban areas	1.036***	0.386*	0.046	7.947
	(0.111)	(0.203)	(0.035)	(34.902)
Intermediate/rural areas	0.803***	0.218	0.004	-34.980*
	(0.149)	(0.184)	(0.049)	(18.146)
Difference (t-test)	0.233	0.168	0.042	42.927
Observations	12019	842/1446	552/932	552/932
R-squared	0.025	0.005	0.017	.
Controls	Yes	Yes	Yes	Yes
Bandwidth		70	48	48
Spline		linear	linear	linear
Standard errors		Bootstrap	Bootstrap	Bootstrap

Notes: This table shows the regression coefficients and standard errors (in parenthesis below the coefficients) from OLS (column 1), sharp RDD (sRDD; column 2) and the first (FS; column 3) as well as second stage (SS; column 4) of fuzzy RDD (fRDD) estimations for student living in urban and intermediate/rural areas separately. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively. Standard errors are robust. The OLS estimation includes control variables (age, gender, school programme and weekday of registration) whereas the RDD estimations use the same variables for inverse propensity score weighting. The table further displays information on the RDD estimations concerning their bandwidth size, their spline and the computation method of their standard errors. The selection of the bandwidth is data-driven. I estimated the recommended bandwidth for students living in urban areas and students living in intermediate/rural areas separately and picked the larger of the two (intermediate/rural one) for these RDD subgroup estimations.

results. The estimation results are available upon request. The validation and robustness checks overall provide no serious doubts on the findings.

Covariate balance

A common robustness test for RDD is to show that the treatment has no effect on the covariates, i.e. control variables (e.g. Cattaneo et al., 2019). Thus, I run the sharp RDD estimation with the exact same specifications as for my first hypothesis without control variables for every single control variable – age, gender, school programme, canton of residence and weekday of registration – as depending variable, i.e. the control variables are placebo outcomes. Figure A.1 in the appendix shows the visual identification of the ITT for the control variables.[10] Although in some of the sub-figures it appears like the

[10]It was not feasible to graph the results of all control variables because for the cantons AI, AR, BS, GL, OW, SH, SZ, TG and UR there is not enough data or missing values.

treatment had an effect on the control variables (e.g. of gender or secondary school A), only the results for Bern (BE) and Zurich (ZH) as the canton of residence and all weekdays but Tuesday and Saturday are significant.

Density of the running variable

Sorting around the introduction date of the occupation finder is unlikely because only after its introduction and availability on the webpage did Yousty promote the occupation finder by for example mentioning it in their August newsletters or showing it during occupations fairs from end of August to end of November.

A way to show that no sorting happened is to test whether the density of the running variable is continuous at the threshold (McCrary, 2008). I use the method proposed by Cattaneo et al. (2019), because it is completely data-driven with the default settings (Stata command 'rddensity'; Cattaneo et al., 2018). The resulting p-value is 0.466, which indicates that there is no statistical evidence for the running variable being manipulated, i.e. there is no discontinuity at the threshold. However, although the corresponding plot in Figure A.2 in the appendix does not show an immediate jump it shows that more students registered in the period after the introduction of the occupation finder than before. A reason might be Yousty's promotion of their platform during the fairs between August and November.

Alternative threshold value

To show that the effect actually stems from the treatment, I choose August 1, 2017 and November 1, 2018 as alternative threshold values. For the first threshold in 2017, removing all students registering on August 1, 2018 or later results in a data of only untreated students, i.e. students not having access to the occupation finder. Thus, around the threshold of August 1, 2017 there are only untreated students so that one should not observe a treatment effect. Indeed, Figure A.3 in the appendix shows a small discontinuity with negative jump in the number of occupations students applied to before and after this new threshold.

In contrast, as I drop all students registering before August 1, 2018 for the estimation around the second alternative date, November 1, 2018 the data consists of treated students only. So, there should be no treatment effect visible either at the threshold. Figure A.4 in the appendix shows a small discontinuity with a positive jump in the number of occupations. Both jumps are not significant, thus supporting the estimation strategy.

Donut hole approach

This robustness check analyses whether observations around the threshold were manipulated. It does so by excluding very close observations on both sides of the threshold for the estimations giving it the name donut hole approach (see for example Cattaneo et al., 2019). I drop one day on both sides of the threshold for the size of the hole, which consists of dropping 8 observations. Due to the new estimation of the optimal bandwidth the estimation sample diminishes from 2134 observations to 1414 observations. This large reduction of the estimation sample results in a smaller jump and insignificant estimation result. See Figure A.5 in the appendix for a visualisation.

Alternative bandwidths

The bandwidth for the estimation of the ITT is 63.55 days (roughly two months) on both sides of the threshold. According to Cattaneo et al. (2019) the results are very sensitive to the bandwidth selection as this selection balances a bias-variance trade-off. Therefore, the change of the bandwidth should be rather small.

For widening the bandwidth I add seven days to the optimal bandwidth. Figure A.6 in the appendix displays the new discontinuity. The change resulted in a slightly larger coefficient (0.339 instead of 0.310) which though is insignificant when using robust standard errors. For narrowing the bandwidth I subtract seven days from the optimal bandwidth. Figure A.7 in the appendix shows the new discontinuity. The change resulted in a slightly smaller coefficient (0.306 instead of 0.310) which is insignificant as well when using robust standard errors.

1.5 Conclusion

This chapter analyses the effect of a low-cost personalized information intervention on the number of occupations students apply for job shadowing before dual VET. The intervention is the introduction of an occupation finder, which recommends occupations to students based on their work preferences. To analyse the effect of the introduction of the occupation finder and its usage, I use a regression discontinuity design with time as running variable and the day of introduction of the occupation finder as threshold. Students before the introduction belong to the control group whereas students after the introduction belong to the treatment group. I estimate the intention-to-treat effect (sharp RDD) as well as the local average treatment effect on the treated (fuzzy RDD), because of imperfect compliance by students to their treatment status.

I have four findings. First, the introduction of the occupation finder (ITT) increases the number of occupations to which students apply by 0.3. That is three out of ten students

apply to an additional occupation or one out of ten students applied to three additional occupations. This effect is significant. The size of the effect is rather small but acceptable for the occupation finder not being mandatory and mostly unknown at its introduction.

Second, using the occupation finder (LATE) increases the number of occupations for which students apply by six additional occupations for compliers, i.e. those students who stick to their treatment assignment. This result is significant without the control variables. Adding the control variables makes the first stage insignificant, so the results in the second stage cannot be interpreted. As the occupation finder suggests three occupations, the size of the effect is large. A possible explanation is that students using the occupation finder are less sure about their occupational choice or that the provision of unknown occupations stimulated students' curiosity so they apply to occupations listed as similar to the ones being recommended.

Third, the results show that the effect comes from female students as their coefficient is about the size of the overall effect and the coefficient for male is close to zero. However, both coefficients are not significant, neither as ITT nor as LATE. The difference between the findings for female and male students is also not significant. Thus, I cannot conclude any gender differences in the effect of the occupation finder.

Fourth, the occupation finder affected students living in urban areas significantly. Introducing the occupation finder resulted in applications to more occupations among urban students (ITT of 0.4): four out of ten students applied to an additional occupation. The effect for students living in rural areas is slightly smaller (ITT of 0.2) and not significant. The effect of the occupation finder is also not significantly different for students living in urban areas and those living in rural areas. Estimating the LATEs is not possible as the first stages are not significant.

These findings are in line with those of the literature on college choice and job search in that personalised information interventions affect individuals' choices (Mulhern, 2021; Altmann et al., 2018; Belot et al., 2019; Briscese et al., 2020). They also support the idea of looking at effect heterogeneity as recommended by Altmann et al. (2018) and implemented by studies in education and labour economics (e.g. Barone et al., 2017; Baker et al., 2018; Belot et al., 2019; Briscese et al., 2020). For teachers, professionals in career guidance and policymakers, the findings indicate that providing personalized information for career guidance at low cost is possible but may generate different effects across subgroups.

The limitations of this chapter concern its external validity, data availability and the choice of its dependent variable. Using a RDD limits the findings to students registering around the threshold, most probably to those registering in July and August. These two months are the early season for applications because the new school year starts mid-August, and with it the application activities. Therefore, it is possible that students starting the process of occupational choice at this early stage are different from students starting

later. The early students might be more unsure about their occupational choice so that the effect of the invention is overestimated. In contrast, these early students may also have very clear ideas which occupation they want, and take up registering early to find a good firm. In this case, the effect would be underestimated. A further limit to external validity is that, although Yousty is among the largest online platforms for career guidance in Switzerland, I do not observe whether some students also applied for work shadowing outside of the platform. I also am not able to control potential selection among students using Yousty and those using other online platforms or offline means of application.

Although the data is extensive in its number of observations on students, it is limited regarding control variables. For example, information on school level is only available for a third of the sample and even less information is available on final occupation choices. Knowing students' nationality would provide another potentially interesting subgroup for analysis.

Finally, I cannot observe the actual effect of the intervention on the stability of occupational match. At the time of this writing, students using the occupation finder were still in their second or third year of dual VET. I have no information on drop-outs, nor on students changing their occupations. As a result, I cannot determine whether the occupation finder has an actual effect on students leaving education or wanting to change their occupation after the end of dual VET. Therefore, this chapter sets the groundwork for future analyses examining whether the intervention had a positive effect on occupational matches.

Chapter 2

No experience, no employment: The effect of vocational education and training work experience on labour market outcomes after higher education[1]

2.1 Introduction

Workers with experience are in high demand in the labour market (Salvisberg, 2010) due to high productivity (Arrow, 1962) and low training costs (Thurow, 1975). This demand for experienced workers is the reason that institutions of higher education – such as universities and universities of applied sciences (hereafter, 'UAS')[2] – have begun providing work experience in their curricula, including (mandatory) internships (Cranmer, 2006; Helyer & Lee, 2014; Billett, 2014; Silva et al., 2018). This work experience equips students with marketable skills before they graduate and enter the labour market.

[1] This chapter is joined work with Ursula Renold and the original manuscript of an article published by Economics of Education Review, 2021, 80(2), 102065 available online under https://doi.org/10.1016/j.econedurev.2020.102065.

[2] UASs are institutions of higher education that teach and conduct applied research Lehnert & Pfister (2018). Pfister et al. (2018, p. 1) state that the name 'Universities of Applied Sciences' is used for Swiss institutions called 'Fachhochschulen' or for German institutions called 'Fachhochschulen' and more recently 'Hochschulen für angewandte Wissenschaften (HAW)'.

However, a number of empirical studies that account for self-selection into work experience opportunities before graduation from higher education find mixed results for labour market outcomes after graduation. These studies typically analyse the effects of having an internship, a student job, or both during higher education (San, 1986; Ehrenberg & Sherman, 1987; Häkkinen, 2006; Klein & Weiss, 2011; Weiss et al., 2014; Baert et al., 2016; Nunley et al., 2016; Baert et al., 2017; Margaryan et al., 2019; Bolli et al., 2019). Moreover, evidence on the effect of internships shows either no effect (Klein & Weiss, 2011; Weiss et al., 2014) or a significantly positive one (Nunley et al., 2016; Margaryan et al., 2019; Bolli et al., 2019). Evidence on student jobs also shows mixed results: some studies find no effect (Ehrenberg & Sherman, 1987; Häkkinen, 2006; Baert et al., 2016), whereas others find positive effects (San, 1986; Weiss et al., 2014). Two major drawbacks of gaining work experience while studying – the time it takes away from studying and its possible lack of relevance to the student's field (Stern et al., 1990) – may account for these mixed results.

Although students who gain work experience before studying can avoid these drawbacks, they suffer from the drawback of delayed graduation. However, the evidence of the effect of pre-study work experience on labour market outcomes after higher education is scarce. Weiss et al. (2014) analyse work experience from employment prior to studying, finding no significant effects on wages, search time or class positions. An as yet underexplored way of gaining work experience before studying without delaying graduation is from vocational education and training (VET), an upper-secondary education pathway lasting three to four years and combining formal education at school with curricula-driven practical training (OECD, 2004). In school-based VET, the practical training takes place in classroom workshops, and in dual VET the training takes place at a company, usually in the form of apprenticeships (Wolter & Ryan, 2011). The likely advantage of VET, especially dual VET, is that its graduates enter the labour market with work experience and have the option of continuing to higher education.

The evidence on the impact of VET work experience on labour market outcomes is also mixed. Shaw (2012) finds that upper-secondary VET diplomas improve labour market outcomes after higher education in the UK, while Agarwal et al. (2019) find that VET work experience reduces search time after graduation but negatively impacts wages, working hours and job positions in Italy. However, neither the UK nor Italy has a great deal of dual VET, limiting the amount of work experience that students can gain from those programmes. Similarly, their education systems are either not very permeable,[3]

[3]The definition of permeability from the European Centre for the Development of Vocational Training is as follows: 'Capacity of education and training systems to enable learners to (1) access and move among different pathways (programmes, levels) and systems; (2) validate learning outcomes acquired in another system or in non-formal/informal settings'.

meaning that relatively few students progress from VET to higher education (Pauline & Simon, 2013), or appear unlinked to the needs of the labour market (OECD, 2017).

By focusing on VET work experience and its effect on labour market outcomes after higher education, this chapter analyses the value of work experience for higher education graduates. We focus on dual VET in a permeable education system where students commonly progress from VET to higher education. We use a case study in which dual VET predominates over school-based VET, which has weaker labour market outcomes (Bolli et al., 2019). This distinction is important in times when policymakers are promoting VET, because neglecting the difference is likely to lead to the erroneous conclusion that all types of VET constitute a second-best option. Such a conclusion is especially harmful because dual VET enhances students' motivation to stay in education (Wolter & Ryan, 2011) and is not prone to the drawbacks of delayed graduation or field-unrelated work experience. Moreover, little is known about the channels through which the effects of VET work experience on labour market outcomes after higher education flow. Yet knowing these channels is critical for finding the best strategy for improving the youth labour market.

To analyse the effect of VET work experience on labour market outcomes after higher education, we use Switzerland as a case study. Three features of the Swiss labour market and education system make Switzerland ideal for this analysis. First, the Swiss labour market functions well and has for years had very low unemployment rates,[4] so that highly educated individuals can easily find work. Second, in the Swiss education system VET at the upper-secondary level accommodates about two-thirds of a cohort (SERI, 2020), roughly 90% of whom follow a dual VET programme (SERI, 2020), which contains a substantial amount of workplace training. Third, the Swiss education system is permeable, with open access to two types of academic higher education institutions (universities and UASs) after graduation from upper-secondary education.[5]

We exploit data from the Swiss graduate survey conducted in 2011, 2013, 2015 and 2017 on higher education graduates (HE graduates) one year after graduation and in 2015 and 2017 on HE graduates five years after graduation. These surveys provide data on their labour market outcomes, such as wage, search time, internship, unemployment and employment position. Moreover, these data allow us access to a rich collection of variables about personal characteristics, education, continuous education, work experience and employer characteristics.

[4]From 2010–2017 the unemployment rate (according to the ILO definition) ranged from 3.5% to 5.5% (source: Federal Statistical Office of Switzerland – Swiss Labour Force Survey, 4 May 2020).

[5]Some additional requirements may apply, e.g. an additional day at vocational baccalaureate school (parallel to the VET) or a university aptitude test for students with a VET diploma, and a working year in the desired field of education for students with an academic diploma.

Given the self-selection of HE graduates into obtaining an academic diploma[6] or a VET diploma at the upper-secondary level, we use two estimation methods. In the first method, we include a large set of control variables on observable characteristics. In the second method, to capture unobservable differences, we use instrumental variable regressions. Our instrument for having VET work experience is the regional[7] enrolment rate into VET. Specifically, we use the enrolment rate into VET when HE graduates were 14, in the region where they were living before starting higher education. Because HE graduates are mobile after graduation (Oggenfuss & Wolter, 2018), the regional enrolment rate into VET does not influence their labour market outcomes.

A second self-selection of students takes place at the transition from upper-secondary education to higher education. We argue that the higher education programmes influence students in such a way that, by graduation time, those who actually graduate have become much closer in their knowledge, expertise and practices. Hence focusing on HE graduates and including control variables for their education, work experience and employer characteristics should largely account for this second self-selection.

We find that, one year after graduation, HE graduates with VET work experience have significantly higher wages of 7% to 19% and need significantly less time (about two months) to find their first job. However, we find no significant effect on the likelihood of their doing an internship after graduation. Although these positive effects from work experience are very robust to the inclusion of control variables, they diminish over time: five years after graduation the estimated coefficients for wages, unemployment and employment position remain positive but are no longer robustly significant. As for the channel through which VET work experience operates, we find that the benefits stem from employers' knowing the worker's productivity level (screening), an increase in human capital (both general and specific) and employers' receiving a signal of higher productivity. Our robustness checks confirm that we are measuring work experience, that we have representative results for HE graduates, and that our findings do not suffer from selection bias.

Our results contribute to the literature on VET in three ways. First, we show empirically that VET work experience from predominantly dual programmes in a permeable education system has a significant positive effect on labour market outcomes, even after higher education. Second, we show that the advantage of VET diminishes only slowly over time for HE graduates. Third, we identify the channels through which VET work experience operates as screening, human capital and signalling, not social network. Starting with dual VET is beneficial not only for early entry into the labour market but also

[6]In Switzerland the academic diploma is called an 'academic baccalaureate' or 'academic certificate'. In this chapter we use 'academic diploma' for graduates of academic upper secondary programmes, not only for ease of reading but also because both are upper secondary diplomas.

[7]The 26 regions in Switzerland, called 'cantons', are its member states, much like states in the US.

for later entry after higher education. Although the stigma that VET is a second-best option exists even in Swiss society, where VET is the majority educational pathway (Wolter et al., 2014), these results show that VET offers a stronger start even for eventual HE graduates.

Furthermore, the results underline the importance of having a permeable education system for complementing the short-term benefits of dual VET with the long-term benefits of an academic degree. Given that the 2010 Bruges communiqué and Europe 2020 strategy have put the idea of a permeable education system in the centre of attention in Europe, one can view VET as a first step in a lifelong learning process (Cedefop, 2012). Moreover, given that technological and other changes make lifelong learning a necessity, the permeability of an education system is particularly important for all countries (Laal & Salamati, 2012).

This chapter is organised as follows. In section 2.2, we discuss work experience and summarise the literature on causal estimations of work experience. In section 2.3, we present our estimation methods. In section 2.4, we show the results of our analyses and discuss robustness tests on the validity of our results. In section 2.5, we discuss our findings and conclude.

2.2 Literature review on work experience and hypotheses

Although economists consider work experience when estimating earnings, no clear economic definition of work experience exists. Most economic studies treat work experience as a kind of skill (see, e.g. Rosen, 1972; Mincer, 1974; Yamaguchi, 2010). Raelin (1997) defines experience as the ability to make decisions in complex, novel situations. Similarly, Gruber (1999, p. 47) defines work experience as 'the ability to repeatedly cope with complex situations that have changing elements'.[8] Therefore, work experience is the skill of reacting appropriately to new and complex circumstances.

Both individuals and the labour market value work experience. For individuals, having work experience is a good way of differentiating themselves from other similarly educated job applicants (Tomlinson, 2008). Moreover, work experience is transferable from previous employment to new employment (Yamaguchi, 2010). The degree of transferability depends on the extent to which the work experience is firm-specific or general (Jung & Magrabi, 1991). The more general it is, the better the work experience can be applied in a new environment (Burdett et al., 2011). Individuals with work experience also

[8] Authors' translation from German.

need less training, thereby reducing employers' training costs (Thurow, 1975). Hence the labour market values work experience by paying higher wages and offering better conditions (e.g. Mincer, 1974; Altonji & Shakotko, 1987; Williams, 1991; Lemieux, 2006; Dustmann & Meghir, 2005; Heckman et al., 2006), resulting in higher lifetime earnings for individuals with experience (Mincer, 1974).

The method and means by which individuals obtain work experience are well known. Individuals gain work experience when they actively solve a problem (Arrow, 1962). In this process of learning by doing (Dustmann & Meghir, 2005; Burdett et al., 2011), learning and attaining work experience are complementary (Rosen, 1972; Mincer, 1974). Therefore, work experience is not learnt at school but rather best obtained at the workplace. For example, Mincer (1974) argues that certain skills, such as practical problem solving, are best learnt at the workplace. Cranmer (2006) finds that although education institutions attempt to transmit marketable skills, their success is mixed, and the effort would be better spent on transmitting real experience. Billett (2008) goes further, arguing that work experience ('marketable skills') can only be acquired at the workplace. From this perspective, gaining work experience is a way of acquiring marketable skills that are useful in the labour market (Autor, 2001), skills that are best acquired – or that can only be acquired – at the workplace.

Because the labour market values workers with work experience, many students gain this experience during their education. Studies show that work experience gained during upper-secondary education – whether through a student job after school or on weekends (e.g. Ruhm, 1997), an internship during holidays (Neyt et al., 2019) or vocational education and training (VET; e.g. Arum & Shavit, 1995) – has a positive impact on the transition into the labour market and earnings. Yet, these advantages may come at the cost of worse educational outcomes (for an overview see Ruhm, 1997), less educational attainment (Neyt et al., 2019) or worse long-run labour market outcomes (e.g. Hampf & Woessmann, 2017).

Students also gain work experience before graduating from higher education, either before or during their education. Work experience opportunities during higher education include student jobs, internships, sandwich placements (also known as 'industrial placements'), work-based higher education that includes both studying and working part-time, or vocational bachelor and master degrees. Studies analysing the effects of work experience during higher education on labour market outcomes find mixed results for HE graduates. For example, for labour market outcomes, Ehrenberg & Sherman (1987) find no effect of student jobs, whereas Baert et al. (2016) find no overall effect of work experience from a student job but negative effects for certain subgroups. In contrast, San (1986) and Häkkinen (2006) find positive effects of work experience from student jobs for HE graduates, although only when HE graduates did not extend their studies past the official programme length.

Internships, sandwich placements, work-based higher education, and vocational bachelor or master degrees may have different effects from general student jobs, because they are often related to the students' field of study. For internships, Nunley et al. (2016), Margaryan et al. (2019) and Bolli et al. (2019) find positive effects of work experience on labour market outcomes after higher education, but Klein & Weiss (2011) and Weiss et al. (2014) find no effect. Work experience from sandwich placements has positive effects on labour market outcomes (Brooks & Youngson, 2016).

Despite a great deal of evidence on the effect of work experience from internships on labour market outcomes, we find no such evidence for the effect of work experience from work-based higher education. The evidence on vocational bachelor and master degrees is that they increase earnings (Böckerman et al., 2018; Böckerman et al., 2019). These overall mixed results for work experience gained during higher education may arise from the two major drawbacks of gaining work experience while studying: i) the time it takes away from studying may result in lower grades, and ii) it may negatively affect students' choice to continue with higher education (Stern et al., 1990; Curtis & Shani, 2002; Bartolj & Polanec, 2018; Neyt et al., 2019).

If students wish to gain work experience before entering higher education, they can enter the labour market for regular employment or obtain a VET diploma. There is little evidence on the effect of these sources of work experience on labour market outcomes after higher education, with the only study on regular employment finding no significant effect on labour market outcomes (Weiss et al., 2014). The disadvantage of these sources of work experience is delayed graduation, and therefore less time for obtaining returns from their investment in higher education.

VET's structured curriculum and recognised diploma differentiate it from other workplace training, such as internships (Steedman, 2012). Again, the evidence for the effect of work experience from VET on labour market outcomes after higher education is mixed. Two studies directly examine the relation between VET and the labour market outcomes of HE graduates. Shaw (2012) qualitatively studies the labour market outcomes after graduation for six female BA (Hons) Educational Studies graduates in the UK. Three of the six had entered higher education with an academic diploma; the other three, with a VET diploma. She finds that having a VET diploma is a positive factor. For Italy, Agarwal et al. (2019) compare the effect of a VET diploma to that of an academic diploma after higher education. They find that while a VET diploma helps HE graduates find jobs more quickly after graduation, it creates disadvantages for other labour market outcomes such as employment, wages, working hours and job position.

This contradictory evidence for VET may stem from the variation in VET programmes relative to workplace training. The OECD (2004) differentiates between school-based and work-based (dual) VET by the proportion of time spent at work. In school-based VET, 75% or more of the learning takes place at school, while dual VET students spend

between 10 and 75% of their time at school and the rest in training workshops or at a company. The workplace training in dual VET allows VET students to have contact with real clients, experience teamwork with older co-workers, and apply school-taught theory to practice (Ryan, 2001; Wolter & Ryan, 2011). In this way, VET students gain work experience. Dual VET is also more closely linked to the labour market because of the shared responsibility between the education and employment systems (Rageth & Renold, 2019). Thus differences among VET programmes relative to workplace training affect their effects in the labour market. For example, Bolli et al. (2019) show that only dual VET programmes have a positive effect on labour market outcomes.

Tuor & Backes-Gellner (2010) consider different education pathways and their impact on labour market outcomes. They find that following a mixed pathway (vocational upper-secondary education followed by academic higher education, or the opposite) increases earnings after higher education, although they cannot account for student self-selection into education pathways. They also stress that a permeable education system is key for this finding, because students must be able to transition between vocational and academic education. This chapter examines a system in which dual VET is the norm. Because dual VET provides work experience, and because a permeable education system with a large share of dual VET in upper-secondary education enables transitions, we expect VET work experience to generate an advantage for HE graduates. We therefore hypothesise as follows.

H1: HE graduates with VET work experience will have better labour market outcomes one year after graduation than HE graduates with an academic diploma.

Thus far, no studies have looked at the longer-term impacts of VET on labour market outcomes after higher education. The evidence on the long-term effect of work experience shows that the effect of work experience fades with time due to the depreciation of human capital, with diminishing returns to work experience (Mincer, 1974; Burda, 2001). Hence, HE graduates with an academic diploma will catch up over time in terms of labour market outcome. Nevertheless, unless HE graduates with an academic diploma postpone retirement, the lifetime earnings of HE graduates with VET work experience will remain larger.

That a reversal in labour market outcomes will occur such that HE graduates with an academic diploma have better labour market outcomes is unlikely, because all HE graduates have the same highest education regardless of their upper-secondary education. Thus the differences in general education should be minimal. Therefore, in contrast to the literature on long-term effects of VET, we do not expect to find that VET can become a liability in the long term as a result of fewer general skills (Forster et al., 2016; Hanushek et al., 2017; Hampf & Woessmann, 2017; Roezer & Bol, 2019). Furthermore, not all evidence finds a negative effect of VET. Hanushek et al. (2017) argue that the disadvantage of VET does not apply to all countries (in this case Switzerland, p. 82). However, for

VET not to be a disadvantage, it has to be mostly dual, contain a great amount of general education, and be part of a permeable system (Wolter & Ryan, 2011). We therefore hypothesise as follows:

H2: Five years after graduation from higher education, no significant difference will remain between the labour market outcomes of HE graduates with a VET diploma and HE graduates with an academic diploma.

The literature on work experience offers various explanations for how such experience influences labour market outcomes (Bills, 2003; Weiss et al., 2014; Margaryan et al., 2019). We examine four of them: social networks, screening, human capital (specific and general) and signalling.

The social network channel, first defined by Granovetter (1973), entails building up personal relationships to find employment more easily in the future. In VET, students have the opportunity to build an extensive network, through not only their supervisors and colleagues but also their peers' co-workers. HE graduates with an academic diploma do not have that opportunity. The advantage of VET work experience might be that the network established during VET helps HE graduates with VET work experience to find a job. We therefore hypothesise for the social network channel as follows:

H3a: If VET work experience operates through the social network channel, only HE graduates finding their employment through their social networks will have better labour market outcomes.

The screening and signalling channels are related, because both entail efforts at reducing information asymmetry. By screening potential workers, employers reduce information asymmetry through observation of the employee at work (Stiglitz, 1975). Before offering employment, employers might use VET work experience as a screening device to sort the productive workers from the unproductive ones (Brooks & Youngson, 2016). However, only the VET student's training company would have that information. Thus we hypothesise for the screening channel as follows:

H3b: If VET work experience operates through the screening channel, only HE graduates starting work for a previous employer will have better labour market outcomes.

According to the human capital channel, a concept dating back to Becker's human capital theory (1962; 1964), the labour market pays workers according to their skills and productivity. Mincer (1974) states that work experience is a major source of productivity, along with schooling. Experience also reduces training costs by shortening initial unproductive time (Thurow, 1975). Some studies argue that VET provides only specific human capital, which is suitable at the training firm or a firm in the same industry. However, VET work experience can also build general human capital, in which marketable skills are transferable across occupations (Winkelmann, 1996; Rauner & Maclean, 2008; Shaw, 2012). In dual VET, where the education and employment systems cooperate in

developing national curricula (Rageth & Renold, 2019), VET work experience also entails general human capital. Therefore, we hypothesise for the human capital channel as follows:

H3c1: If VET work experience operates through the specific human capital channel, then HE graduates with VET work experience related to their studies or employment will have better labour market outcomes than HE graduates with unrelated VET work experience.

H3c2: If VET work experience operates through the general human capital channel, then HE graduates with VET work experience unrelated to their studies or employment will have better labour market outcomes than HE graduates with an academic diploma.

Spence's (1973) signalling theory states that employers cannot observe the actual productivity of new workers due to information asymmetry. To reduce this asymmetry, workers look for ways to signal their high productivity to employers. Any observable characteristic that highly productive workers can more easily obtain is suitable for signalling, such as educational attainment or accumulation of work experience (Heckman et al., 2006). Indeed, Van Belle et al. (2019) find in a vignette study that work experience signals better work attitude, larger social network, sense of responsibility, motivation and maturity to employers. Hence VET work experience may constitute a signal of higher productivity, because entering higher education calls for those with a VET diploma to have put in additional effort, i.e. additional academic education.

We exploit the Swiss education system's having both universities and UASs. Although the State Secretariat for Education, Research and Innovation promotes the two higher education types as equivalent, they differ in their curricula, so that employers perceive UAS graduates as having more hands-on experience than university graduates. Thus when VET has the same effect for graduates of either type of higher education, signalling is the best explanation. We therefore hypothesise for the signalling channel as follows:

H3d: If VET work experience operates through the signalling channel, then the effect of VET work experience on the labour market outcomes for university graduates and UAS graduates will be the same.

Thus far, there is no evidence on the channel through which VET work experience operates. While studies on work experience from internships during higher education predominantly find signalling to be the operational channel (e.g. Weiss et al., 2014; Nunley et al., 2016), evidence for the general human capital channel also exists (Bolli et al., 2019).

2.3 Methodology

In this section we describe our dataset, define the variables for the analysis and explain the estimation methods.

2.3.1 Data

Our data stem from the Swiss graduate survey conducted by the Swiss Federal Statistical Office (SFSO) every second year on all graduates from formal institutions of higher education. The SFSO survey contains detailed information on employment and education during studies, and for both one and five years after graduation. Our dataset consists of pooled cross-sectional data from the one-year post-graduation survey waves in 2011, 2013, 2015 and 2017, and the five-year post-graduation survey waves in 2015 and 2017.[9]

We limit our analysis to HE graduates from fields of study in which work experience is not largely included, nor an internship required, after graduation. We therefore drop all HE graduates with a teaching, medical, law or doctoral degree. Next, to have HE graduates with uninterrupted study paths – thereby avoiding unobserved work experience – we restrict our sample to HE graduates not older than 30. Further, they must have completed their entry diploma for higher education (i.e. academic or vocational diploma) within seven years before higher education graduation. This time span gives them five years for studying for both bachelor and master degrees, an additional year for repeating a semester, and another year for fulfilling potential entry requirements. Finally, we focus on HE graduates from the Swiss education system who transitioned directly into the labour market. Therefore, we drop all HE graduates who have a non-Swiss educational background, acquired a higher education degree abroad, continue their higher education studies, are self-employed, or do not seek employment due to family, health or other issues.

[9]The average response rate for the one-year post-graduation surveys is 60% of all HE graduates. For the five-year post-graduation surveys, 70% of all contacted HE graduates taking part in the first survey and agreeing to take part in a future survey responded. We cannot rule out estimation bias from non-response, such as HE graduates who did not find employment not taking part in the survey. This issue potentially influences the size of the coefficients in our estimations, under- or overestimating the actual effect. For the overall findings, however, where we compare HE graduates with a VET diploma to HE graduates with an academic diploma, the potential bias becomes a problem only if the survey participation of unemployed HE graduates with a VET diploma systematically differs from that of unemployed HE graduates with an academic diploma. We see no reason why unemployed HE graduates should behave differently from one another, no matter what their upper-secondary education.

We consider a set of dependent variables because, as Nunley et al. (2016) argue, work experience might operate through different channels, thereby influencing the labour market outcomes differently at different stages in the recruitment process. One year after graduation, only a handful of HE graduates remain unemployed. Therefore, we analyse the impact of work experience on wages, search time and internships (within one year after graduation). To analyse longer-term consequences, we consider wages and employment positions five years after graduation, as well as whether HE graduates had any unemployment spells during that period.

Wage is important because it measures the labour market value of an employee. We define gross wage – expressed in full-time employment – as comprising contract wage, wage from additional hours, and bonuses. Time of job search stands for a period of wage absence and insecurity: the shorter, the better. We construct the search time variable by accumulating all search time before and after graduation in months (censored at 24 months), including HE graduates who were offered a job at zero search time and therefore did not seek employment.

We capture work place security and forgone wages by looking at internships after graduation, at the employment position and at unemployment spells. As internships pay less – if they have a wage at all – than regular employment, HE graduates entering the labour market via an internship forgo wages (generation internship; for more information see *The Economist*, 2014; Schmidlin & Witmer, 2007; Cerulli-Harms, 2017). Our variable for employment position has five levels: apprentice, non-managerial employee, lower management employee, middle management employee and higher management employee. Unemployment spells indicate whether HE graduates were unemployed during the five years after graduation.

Given the permeability of the Swiss education system, Swiss HE graduates can choose between two main upper-secondary pathways towards a higher education degree (SERI, 2020; Hoffman & Schwartz, 2015). They decide between obtaining an upper-secondary academic diploma and an upper-secondary VET diploma. The four-year academic diploma qualifies its graduates for direct entry into a university or federal institute of technology (Uni). It also gives them access – albeit indirectly, through a working year – to UASs.

The VET diploma, which takes three to four years to complete, qualifies its graduates for the labour market or a UAS when attending school an additional day per week. To enter a Uni, VET graduates must have an additional year of academic education. As long as students fulfil these entry requirements, they are free to attend any university or UAS.

One main difference between the two education pathways at the upper-secondary level is that the academic diploma involves a completely theoretical education, whereas the VET diploma includes both theoretical education and practical training. In Switzerland, about two-thirds of students completing compulsory education enrol in VET. Most enter a dual VET programme (SERI, 2020), in which the practical training is performed at a

workplace. Therefore, graduates with a VET diploma have not only an academic education but also work experience gained during their education. In contrast, graduates with an academic diploma have no in school work experience. This difference in work experience is precisely what we analyse: our variable of interest is whether the HE graduate has obtained an academic diploma or a VET diploma[10] in upper-secondary education.

We can account and control for observable differences in personal characteristics, education, further education, experience and current employer characteristics, all of which may affect labour market outcomes (Altonji & Blank, 1999). For personal characteristics we consider age, gender (male/female), parents' highest education (socio-economic background), marital status, having children, region of residence and region of origin. For education we control for type of institution (Uni/UAS), level of education (BA/MA), educational institutions (20), [11] subject (10),[12] number of semesters, final grade and cohort.

For further education we have information on continuing studies (e.g. doctorate), additional studies (i.e. non-university education), and continuing education (e.g. course or training). For life experience we differentiate between kinds of work experience (i.e. work experience gained before higher education, student internship, student job and work-based higher education) and other experience (e.g. a year at another university). For employer characteristics we use whether the company is from the public sector, size according to full-time employees, industry (21 on NOGA-1),[13]and the labour market region of the employer (17).[14, 15]

However, HE graduates do not randomly pick their education pathway but rather have unobservable selection criteria. Thus we face an endogeneity problem, or the risk of an

[10]To enter higher education, VET students may attend school for an additional day each week instead of being at the workplace. About 15% of VET students choose that option. Thus HE graduates with a VET diploma have at least the additional day at vocational baccalaureate school when at UAS or even the additional academic year (university aptitude test) when at university. As not all VET students are able to obtain these additional requirements, we encounter sorting of VET students into the higher education programmes. However, because our analyses focus only on comparing HE graduates with a VET diploma to HE graduates with an academic diploma, this sorting among VET students does not bias our estimations.

[11]The 20 education institutions are universities from Basel, Bern, Fribourg, Geneva, Lausanne, Lucerne, Lugano, Neuchatel, St. Gallen and Zurich as well as the Swiss Federal Institutes of Technology in Lausanne and Zurich. The UASs are from Bern, Central Switzerland, Eastern Switzerland, Kalaidos, Northwestern Switzerland, Southern Switzerland, Western Switzerland and Zurich.

[12]The 10 education subjects are the humanities, the arts, educational sciences, economics, natural sciences, medical sciences, health, engineering, agricultural sciences and 'interdisciplinary'.

[13]The 21 industries are agriculture, forestry and fishing; mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities; construction; wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities; information and communication; financial and insurance activities; real estate activities; professional, scientific, and technical activities; administrative and support service activities; public administration and defence; compulsory social security; education;

omitted variable confounding with the labour market outcomes and the decision to obtain a VET diploma. For example motivation to work could be higher for people choosing the VET diploma, in turn leading to higher labour market outcomes even had they not chosen the VET pathway. Not accounting for such issues biases the estimates. As instrumental variables constitute one way of solving this problem, we use a variable correlating with the decision to obtain a VET diploma but not with the labour market outcomes of HE graduates (Angrist et al., 1996; Angrist & Krueger, 2001). However, this method provides causality only for the group of HE graduates who would have changed their choice had the instrument changed (local average treatment effect, LATE). Therefore, the external validity of the results is limited, an issue that we discuss more thoroughly in the conclusion.

Some studies use regional borders as the instrumental variable for looking at the effect of an intervention (Bolli & Hof, 2018; West & Woessmann, 2010; Frölich & Lechner, 2010; Card & Krueger, 1994). Following Bolli and Hof (2018), we use the VET enrolment rates of the HE graduates' pre-study region (origin) at the time they were in their second year of lower-secondary education, when they had to decide their future education pathway. Figure 2.1 shows the variation in VET enrolment rates among regions and within regions for individuals of different cohorts. The regional VET enrolment rate at the time of education decision correlates with the decision to enrol in VET. The first-stage coefficients are significant and robust (see appendix B.2). This variable also fulfils the exclusion restriction, because students are mobile within Switzerland after their graduation from higher education (Oggenfuss & Wolter, 2018), so that their labour market outcomes do not depend on the VET enrolment rate in their region of origin.

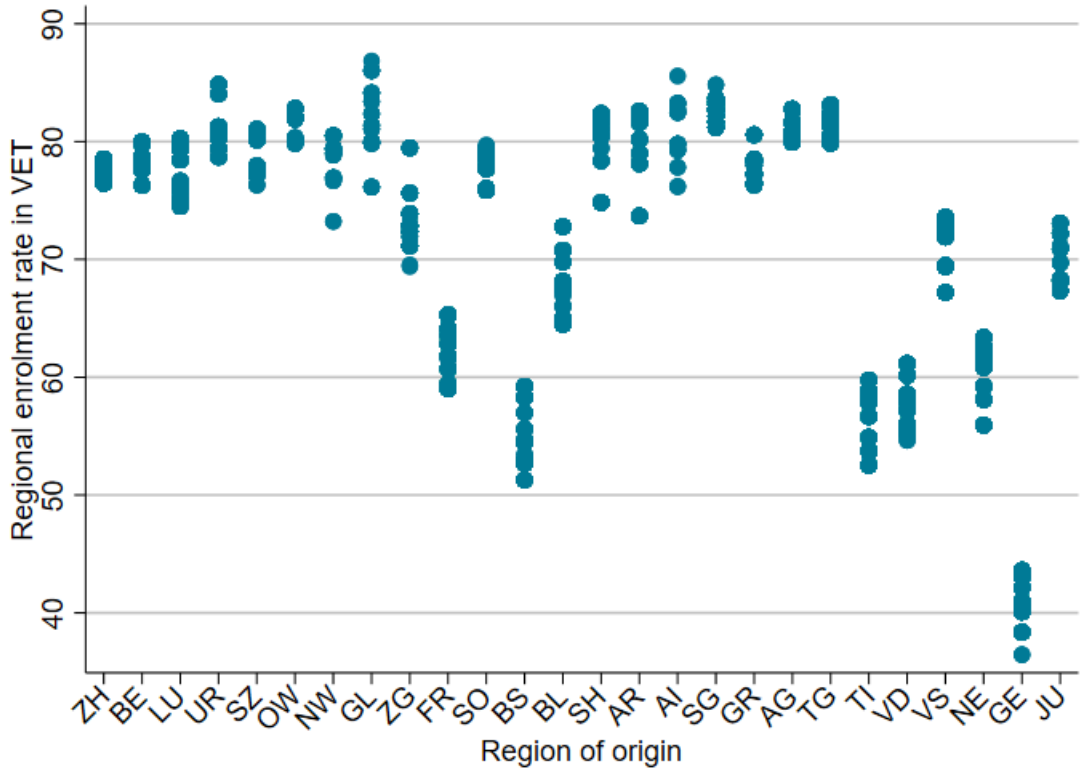
To account for the second self-selection of students from upper-secondary education into higher education, we focus on HE graduates and include a large set of control variables on their education, work experience and employer characteristics. The focus on HE graduates is important because in general only the more able VET students, who obtained

human health and social work activities; arts, entertainment and recreation; other service activities; activities of households as employers; undifferentiated goods- and services-producing activities of households for own use (no data); and activities of extraterritorial organisations and bodies.

[14]The 17 labour market regions are Aarau-Olten, abroad, Basel, Bellinzona, Bern, Biel, Chur, Geneva, Fribourg, Lausanne, Lugano, Luzern, Neuchatel, Sion, St. Gallen, Winterthur-Schaffhausen and Zurich.

[15]As most of the controls are measured after the choice of upper-secondary pathway, they might be an outcome of the pathway choice, that is, bad controls. This concern particularly affects type of institution, subject, company size and industry. However, the choice of upper-secondary pathway does not restrict students to either a type of institution or a subject. The permeability of the Swiss education system allows switching at relatively low costs, if any at all. Our focus is on HE graduates, whose higher education will weigh much more in the choice of company and industry than their upper-secondary education. Therefore, we argue that these controls are not bad at all.

Figure 2.1: Variation of VET enrolment rate by region and within region for different cohorts



Notes: The figure shows variation in enrolment rates in VET both across regions and within regions, because the enrolment rate in a region fluctuates from year to year.

a vocational diploma or even the additional year of academic education will continue with higher education. In contrast, most students with an academic diploma will continue with higher education.

However, Bolli et al. (2019) show that although both pathways in upper-secondary education have high-ability students, the academic pathway has more of the students with higher cognitive abilities, so that the actual differences in ability between students with a VET diploma or an academic diploma entering higher education remain unclear. Given that in Switzerland everyone with a diploma (academic or vocational) is allowed to enter higher education without further entry examinations, the sorting of students takes place in the first year of higher education. We argue that this sorting of more able students and the following higher education studies influence students in such a way that those who

graduate have become very similar in their abilities. Hence the inclusion of the extensive set of control variables should account for the remaining differences.

To identify the channel through which work experience from VET operates, we use three additional variables. The first indicates whether or not the VET diploma is related to the educational subject, to employment, or to both.[16] The second variable is on HE graduates' finding employment through their social networks (family and previous employer).[17] The third variable captures HE graduates' starting employment at a previous employer.

2.3.2 Estimation method

To estimate the effect of work experience from VET on the labour market outcomes, we use explanatory analysis, exploiting our rich set of control variables. Thus we tackle endogeneity by including controls for presumably all differences between HE graduates with VET diplomas and those with academic diplomas. For wages one year and five years after graduation, we assume a log-level specification following the Mincer earnings function (Mincer, 1974) and use a tobit model with left-censoring at zero. We also assume a log-level function in line with survival analysis for search time until first employment, using the Cox proportional hazard model for estimation. The regression equation reads:

$$log(y_i + 1) = \beta_0 + \beta_1 VET_i + \beta_2 X_i + \varepsilon_i \tag{2.1}$$

[16]The variable VET diploma – related to education subject, employment, or both – is a binary variable that we generate from four questions on the HE graduates' survey. The first question asks HE graduates to rate (on a five-point Likert scale) whether there is a connection between their VET diploma and higher education studies. We attribute values of 4 and 5 to the VET diploma's being related to the higher education study generating a one in our binary variable; otherwise the variable is zero. The second question asks HE graduates whether their current employment is related to the university education, previous employment or both. The options are i) yes, in relation to both the university education and previous employment; ii) yes, in relation to the university education; iii) yes, in relation to the previous employment; and iv) no to university education or previous employment. Our binary variable is already one for options i) and ii) from the previous question. Thus the variable needs to become one for option iii), but only when the previous employment was (most probably) VET. The answers to the following two questions make our variable more exact. The third and fourth questions ask graduates about their engagement in paid employment (related or unrelated to their studies) during their studies. We change our binary variable to one only if the answers to the third and fourth questions are 'never'.

[17]We construct this variable from a survey question asking graduates which of their search strategies was decisive for finding employment. The two answer options were i) seek employment through people I have met in connection with a student job (or internship or project work) and ii) seek employment with the help of personal relationships (relatives, friends, acquaintances, fellow students). From this question we generate a binary variable. Employment through social network is one if the answers were i) or ii) and zero otherwise.

The y_i stands for a labour market outcome of a graduate, i. β_0 is a constant, β_1 the coefficient of interest as it tells us the effect of experience from VET, β_2 is a vector of coefficients for the control variables, and ε_i stands for the individual-specific error term. VET_i indicates the education pathway taken in upper-secondary education, and X_i is the vector of control variables, which include education of father, education of mother, region of residence, institution, subject of study, cohort, company size, industry and labour market region as fixed effects. We include these fixed effects to account for the possibility that participation in VET may be induced by background factors or students' foreseeing the demand for specific skills in key industries or in their local areas.

For the other labour market outcome variables – internship during the first year after graduation, unemployment spells during the five years after graduation, and the employment position five years after graduation – the underlying function is level-level:

$$y_i = \beta_0 + \beta_1 VET_i + \beta_2 X_i + \varepsilon_i \tag{2.2}$$

However, due to the different ranges of the dependent variables, we use a probit model for internship and unemployment, and an ordered probit model for the employment position. All models are estimated with robust standard errors.

Although our set of controls is very rich, we cannot argue that we capture all differences. Therefore, to tackle unobserved heterogeneity from confounding factors, we use an instrumental variable (IV) approach as a second specification. This estimation consists of two stages. The first stage (FS) estimates having a VET diploma ($\widehat{VET_i}$) from the enrolment rate into VET of the region of origin ($regVET$), and the second stage (SS) uses the estimation for the VET diploma to analyse its effect on the HE graduates' labour market outcomes. to further reduce heterogeneity (X_i), we include our control variables in both regressions. The γ are coefficients in the first stage, and η_i the individual-specific error term of the first stage. The error terms are robust.

$$FS: \widehat{VET_i} = \gamma_0 + \gamma_1 regVET + \gamma_2 X_i + \eta_i \tag{2.3}$$

$$SS: y_i = \beta_0 + \beta_1 \widehat{VET_i} + \beta_2 X_i + \varepsilon_i \tag{2.4}$$

As VET is a binary variable, we use a probit specification for the first stage and various models for the second stages. We use the OLS estimator with left-side truncation at zero for wages one year and five years after graduation and use interval regression with left-side truncation at zero for the search time (Bartus & Roodman, 2014). The estimation method for internship during the first year after graduation and unemployment spells is probit, and the method for employment positions is ordered probit. Conditional mixed-process models (command 'cmp' in Stata; Roodman, 2011) are optimal for modelling the

two stages with different estimators. For these estimations, we also use robust standard errors.[18]

We perform subsample analyses by using the previous estimation methods to identify the channel through which VET work experience operates. However, we only perform this analysis for the dependent variables for which we initially found significant results – search time and wage one year after graduation. We examine the social network channel by comparing HE graduates with a VET diploma who find their job through their social networks with those who do not. For screening, we compare HE graduates with a VET diploma who work for a previous employer to those who do not. To identify the specific human capital channel, we compare HE graduates with work- or study-related VET and HE graduates without it. To examine whether VET has general human capital component, we compare HE graduates with a VET diploma unrelated to their studies or work to HE graduates with an academic diploma, restricting our initial sample to only those graduates and estimating the standard models. To examine the signalling channel, we analyse the differences between HE graduates from universities and those from UASs with a VET diploma.

2.4 Results

Subsection 2.4.1 briefly describes our variables in the dataset. In subsection 2.4.2 we present results on the effect of VET work experience on the labour market entry outcomes of HE graduates. In subsection 2.4.3 we examine whether our results are a short-term effect or if they persist four years later. In subsection 2.4.4 we examine the channel through which VET work experience operates. In subsection 2.4.5 we present robustness checks to support that our results are measuring work experience, are representative for Swiss HE graduates, and are examining comparable groups with each other.

2.4.1 Descriptive statistics

In our dataset 38% of HE graduates have a VET diploma (5341, compared to 8558 HE graduates with an academic diploma). The correlation matrices in Table B.1 and Table B.2 of Appendix B.1 show how the variables in our dataset correlate with one another for both one year and five years, respectively, after graduation. For the important relation between

[18]None of the estimations includes survey-sampling weights because, according to Solon et al. (2015), including them in causal effects estimations is not essential and in some cases even harmful. However, they recommend checking whether estimates with and without weighting differ. If they differ, that difference indicates heteroscedasticity or endogenous sampling problems. Therefore, we perform the estimations of our main findings with and without the weights. However, the results show no difference.

having a VET diploma and the dependent variables, we find that VET is positively correlated with wage and employment position but negatively correlated with search time, an internship after graduation and unemployment spells.

We focus on the differences between HE graduates with an upper-secondary academic diploma (ACC) and an upper-secondary VET diploma (VET). We report the descriptive statistics separately for those groups. The left side of Figure 2.2 displays the dependent variables for HE graduates with ACC and VET one year after graduation. We observe that HE graduates with VET earn on average roughly CHF 78,700 ($\sim$ 73,300 Euro) in the first year after graduation, which is about CHF 9,000 ($\sim$ 8,400 Euro) more than HE graduates with ACC. On average, HE graduates with VET also search three-fourths of a month less for employment, i.e. searching for four months while HE graduates with ACC search for 4.74 months. About one in every 10 HE graduate with VET starts the career with an internship, whereas twice as many HE graduates with ACC (one in five) do so. The regional enrolment rate in VET is higher for HE graduates with VET (75%) than for those with ACC (70%).

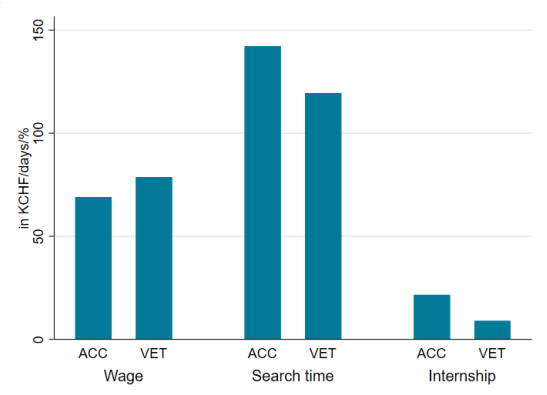
Concerning the control variables, on average 34% of HE graduates with VET are female, compared to 60% of HE graduates with ACC. HE graduates are on average 26 years old, and 6% are married. The parents of HE graduates with VET have slightly more vocational qualification than those of HE graduates with ACC. HE graduates with ACC study at UASs 40% of the time, compared to 96% of HE graduates with VET. Just as they choose different institutions, HE graduates with VET or ACC also choose different subjects. The average grade of HE graduates with ACC (5.14) is slightly higher than for those with VET (5). Both groups of graduates have work experience from pre-study jobs (around 90%) and student jobs (roughly 87%), although HE graduates with ACC have more internship experience (59% vs. 26%), a finding that is not surprising, given that an internship is a UAS admission requirement for HE graduates with ACC. While HE graduates with ACC are more likely to work for a public employer (36% vs. 27%), company size, industry and employer region are comparable.

In 71% of cases, HE graduates with VET obtained their VET diploma in an occupation related to their studies, current employment or both. In finding employment, 22% of HE graduates with ACC rely on their social network, while only 19% of HE graduates with VET. Furthermore, 15% of HE graduates with VET return to a previous employer, whereas 8% of HE graduates with ACC do. Table B.3 in Appendix B.1 contains the details.

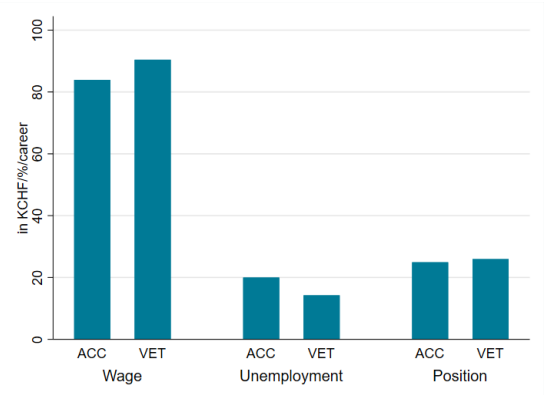
The right side of Figure 2.2 shows the dependent variables for HE graduates with VET or ACC five years after graduation. We observe that wages of HE graduates with VET have increased to CHF 90,400 ($\sim$ 84,200 Euro) and are still higher by CHF 7,000 ($\sim$ 6,500 Euro) than those of HE graduates with ACC wages. HE graduates with VET were about one-fourth less likely to be unemployed during the post-graduation period,

Figure 2.2: Descriptives of dependent variables by upper-secondary education pathway

(a) 1 year post-graduation



(b) 5 years post-graduation



with only about every seventh unemployed, compared to every fifth HE graduate with ACC. HE graduates with VET have slightly higher employment positions (2.6 vs 2.5). In this dataset, as in the preceding one, the regional enrolment rate in VET is 71% for HE graduates with ACC and 75% for HE graduates with VET.

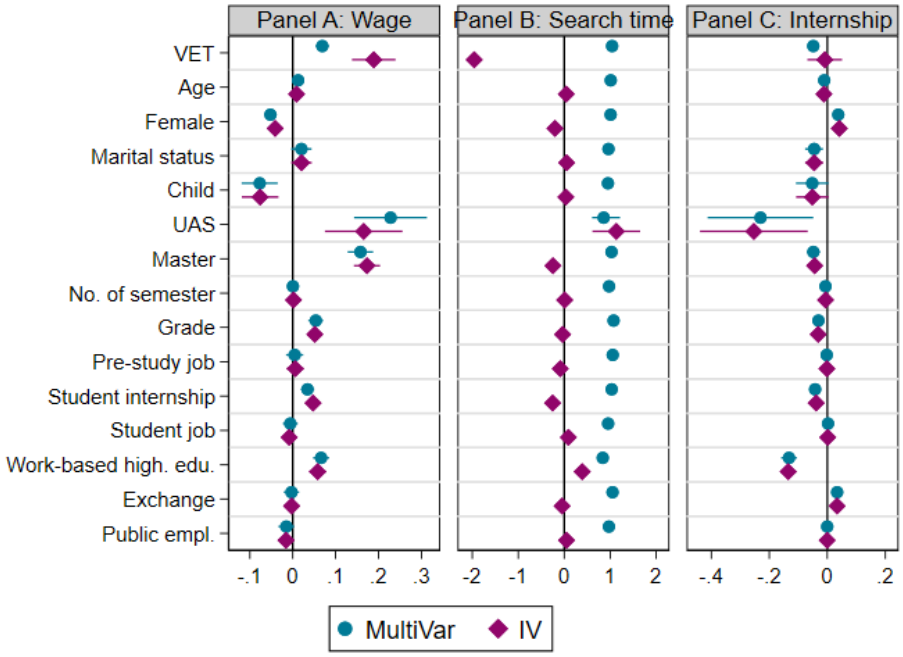
For the difference between HE graduates with VET or ACC in the control variables, we find the same patterns as in the preceding dataset for gender, parents' education, institution, subject, education level and employers characteristics. They have the same average age (29), are married equally often (21%), are equally likely to have children (13%), and attain further education at the same rate (10% additional studies, 12% continuing education, and 12% continuing studies). Table B.4 in Appendix B.1 displays all the details.

2.4.2 The effect of VET work experience on higher education graduates' outcomes for labour market entry

We start our analysis by estimating the effect of VET work experience on HE graduates wages, search time until first employment, and internships one year after graduation. Figure 2.3 shows the results for all three labour market outcomes.

Panel A shows the estimation results for wages. Having a VET diploma in the tobit (multivariate) estimation model increases wages by 6.9% for an average HE graduate (average treatment effect, ATE). The results for the estimates from the IV model suggest also that having a VET diploma increases wages for HE graduates. The wage increase is 18.9% for HE graduates, who are likely to be affected by the instrumented variable (local average treatment effect, LATE). To test the plausibility of our estimation, we analyse the other variables. As expected, age, master degree and grade have significant positive

Figure 2.3: Estimation results for labour market outcomes one year after graduation from higher education



Notes: Panel A shows the effect of VET on wages one year after graduation from higher education. The blue dots show the results from the tobit estimation; the pink dots, the results from the IV estimation. Panel B shows the effect of VET on search time until the first job after graduation from higher education. The blue dots show the hazard ratios from the Cox survival estimation; the pink dots, the coefficients from the IV estimation. Panel C shows the effect of VET on internship after graduation from higher education. The blue dots show the marginal effects from the probit estimation; the pink dots, the marginal effects from the IV estimation. The horizontal lines in all panels indicate the point estimates with robust 95% confidence intervals.
Tables B.5- B.7 in Appendix B.2 show the estimated coefficients. The tables display all estimates, whereas the figure does not display the estimates of the fixed effects for fathers' highest education, mothers' highest education, region of residence, institution, subject, cohort, size of employer, industry, or labour market region. To support the stability of the coefficients, these tables also report the estimates without control variables and with region of origin fixed effects.

effects on wages, whereas being female has a significant negative effect. We also analyse the robustness of our results by looking in the tobit regression and the IV regression at the effect without controls.

For the IV regression we further check whether our results still hold when we include region of origin fixed effects. This variable accounts for the difference in the enrolment rates into VET and ACC between regions, a difference that could lead to differences in wages and invalidate our instrument. Table B.5 in Appendix B.2 shows the estimated coefficients. For wage the coefficient for the models without control are larger, but they remain significantly positive. Including region-of-origin fixed effects does not change the results.

Panel B shows the estimation results for search time of HE graduates until first employment after higher education. The resulting hazard ratio from the Cox survival estimation model (multivariate) indicates that HE graduates with a VET diploma take less time to find employment (hazard ratio above 1). However, the result is not significant. The coefficient for the IV model is significantly negative, indicating that HE graduates with a VET diploma take about two months' less time to find employment. In sum, while the ATE for VET is not significant, the LATE is.

Comparing the size of the effect with the other variables, we find that while the Hazard ratio is comparable, the IV estimation is much larger than the effect of the other variables including the other work experience variables. Looking at the robustness of the finding, we see that the coefficients without controls have the same sign as those with controls but that only the Cox model remains significant (see all results in table B.6 in appendix B.2). Including the region-of-origin fixed effects does not influence the IV coefficients. Thus we conclude that VET work experience significantly reduces search time for HE graduates.

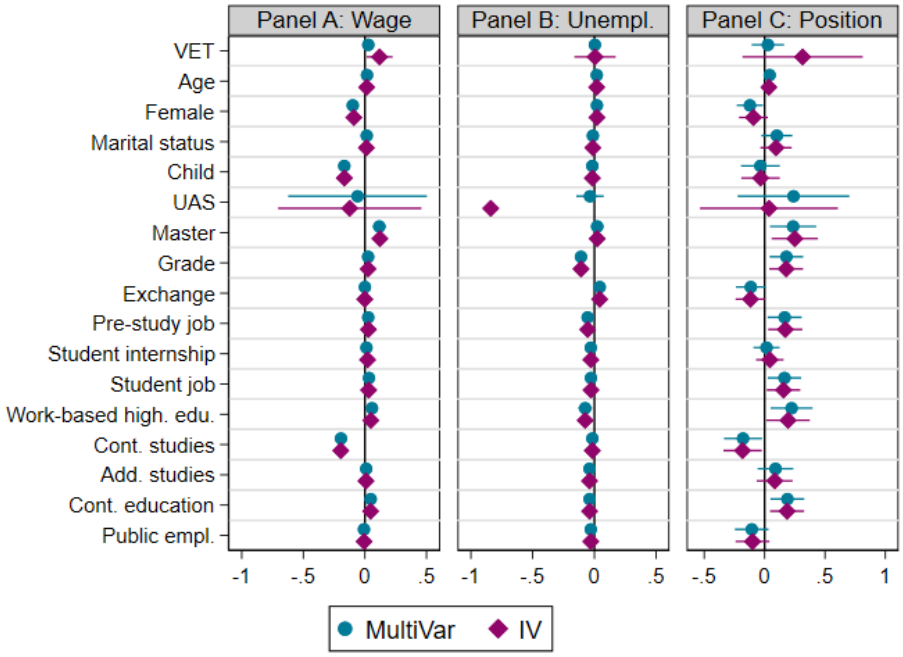
Panel C displays the marginal effects for doing an internship after graduation from higher education. In the probit model (multivariate), the marginal effect of a VET diploma is -0.05, meaning that the probability of doing an internship decreases by five percentage points when the HE graduate has a VET diploma (ATE). In the IV model, although we find the same marginal effect of five percentage points, this effect is not significant (LATE). The size of the effect has a similar magnitude to that of the other effects. Excluding the controls increases the size of the coefficients and is significant for IV (all estimates in table B.7 in appendix B.2). However, including the region-of-origin fixed effects does not change the IV coefficients. Therefore, we do not find a significant effect of VET on reducing internship experience after graduation from higher education.

2.4.3 The stability of VET work experience over time

We now examine whether the benefit of VET on HE graduates' labour market outcomes persists after four years, or whether the initial advantage turns into a disadvantage. Figure 2.4 shows the results for wages five years after graduation, unemployment spells and employment positions.

Panel A shows the results for wages five years after graduation from higher education. The coefficients for VET are positive but smaller than the previous estimate (2.7% vs. 11.8%). While the coefficient of the IV model remains significant, that of the tobit model does not. However, the IV model no longer works because the first stage is insignificant. The estimated coefficients are plausible, as age and master increase wages, but female decreases them. As excluding the control variables results in significant coefficients, the results are not robust. Introducing region-of-origin fixed effects into the IV does not influence the results, and the first stages are also insignificant (see table B.8 in

Figure 2.4: Estimation results for labour market outcomes five years after graduation from higher education



Notes: Panel A shows the effect of VET on wages five years after graduation from higher education. The blue dots show the coefficients from the tobit estimation; the pink dots, the coefficients from the IV estimation. Panel B shows the effect of VET on unemployment spells within five years after graduation from higher education. The blue dots show the marginal effects from the probit estimation; the pink dots, the marginal effects from the IV estimation. Panel C shows the effect of VET on employment position five years after graduation from higher education. The blue dots show the coefficients from the ordered probit estimation; the pink dots, the coefficients from the IV estimation. The horizontal lines in all panels indicate the point estimates with robust 95% confidence intervals.
Tables B.8- B.10 in Appendix B.2 show the estimated coefficients. The tables display all estimates, whereas the figure does not display the estimates of the fixed effects for fathers' highest education, mothers' highest education, region of residence, institution, subject, cohort, size of employer, industry, or labour market region. To support the stability of the coefficients, these tables also report the estimates without control variables and with region of origin fixed effects.

appendix B.2). Therefore, we do not find a robust effect of VET on wages five years after higher education.

Panel B displays the result for unemployment. We find no significant evidence for the influence of a VET diploma on HE graduates being unemployed during the first five years after graduation. Both estimation methods find a small positive effect. However, excluding the control variables changes the sign, so that the effect becomes significantly negative (all results appear in table B.9 in appendix B.2). As for wage, the first stage becomes insignificant when we include controls and region dummies in the IV estimation. Therefore, we find no evidence that VET work experience prevents unemployment after graduation.

Finally, Panel C shows the evidence for the effect of VET work experience on employment positions. Both coefficients for VET are positive but not significant. As in the two previous labour market outcomes, the results are not robust. When we exclude control variables, the results become significant, and when we add regional dummies they change sign (see results in table B.10 in appendix B.2). Therefore, we find no robust evidence that VET work experience significantly increases employment positions five years after graduation.

2.4.4 The channels through which work experience from VET operates

After finding that VET work experience has significant influence on short-term labour market outcomes, we extend our analysis to examine the four theoretical channels through which VET work experience may be an advantage (all results appear in table 2.1). For these analyses, we restrict our sample to HE graduates with a VET diploma and assume that the findings are transferable to the comparison of HE graduates with ACC and VET.

To analyse the social network channel, we compare HE graduates who found employment through their social networks with HE graduates who did not. We find that social network increases search time, but does not influence wage. Hence the VET diploma does not operate through the social network channel.

The analysis for the screening channel is similar to the one for the social network channel. We compare the effect of VET work experience when HE graduates find employment with a new employer to the effect of VET when HE graduates return to a previous employer. We cannot examine search time, because all HE graduates returning to their previous employer have zero search time. For wage, the coefficient of screening is significantly positive. Therefore, the VET diploma works for HE graduates through the screening channel for wages, increasing them by 4.7%.

Comparing HE graduates who have obtained their VET diploma in a field related to their employment or studies with HE graduates with an unrelated VET diploma, we find that HE graduates with 'related' VET have significantly higher wages (4.3%). This finding indicates a specific human capital component to VET, a component that generates generates benefits for wages but does not significantly affect search time. The results for comparing HE graduates with unrelated VET to HE graduates with ACC shows that HE graduates with unrelated VET still have an advantage over HE graduates with ACC in wages that are 4% higher and in reduced search time. Therefore, VET also has a general human capital component.

As to whether VET work experience operates through the signalling channel, we compare the effect of VET work experience of HE graduates of Unis with HE graduates of

Table 2.1: Regression table to identify channel

		Wage		Search time	
	N	Coef.	SE	HR	SE
Social network	4706/4706	-0.008	0.01	0.922**	0.03
Screening	5928/4995	0.047***	0.01	-	-
Specific HC	5975/5042	0.043***	0.01	0.994	0.03
General HC	10727/9760	0.040***	0.01	1.069**	0.03
Signalling	5975/5042	-0.031	0.02	0.958	0.07
Controls		yes		yes	

Notes: The table shows the regression coefficients (Coef.) from the tobit regression for wage and the hazard ratios (HR) for the Cox regression for search time. N indicates the number of observations for wage/search time. The first four estimations include all the previous controls, and the standard errors (SE) are robust. The last estimation (signalling) includes all the previous controls except the education institution, and the standard errors are robust. ***,** and * denote significance at the 1%, 5% and 10% level, respectively.

UASs. We find no effect for wages or search time. Therefore, VET signals higher productivity to employers.

In sum, we find that the advantages of a VET diploma for HE graduates operates through the screening, human capital and signalling channels, transmitting both specific and general human capital.

2.4.5 Robustness checks

As we make certain assumptions in our analyses, we now test these assumptions with empirical data.

Are we really measuring work experience?

Since Mincer (1974) economic scholars have used work experience and its quadratic form for the estimation of wages (also called earnings). However, scholars still debate how to approximate work experience. Some studies use potential work experience by taking a person's age and subtracting the number of school years and the entry age for school (e.g. Altonji & Blank, 1999). Others estimate actual work experience by looking at the work history of individuals (e.g. Light & Ureta, 1995). These procedures, however, generate an attenuation bias due to their crudeness (Gullason, 1990; Altonji & Blank, 1999; Blau & Kahn, 2013): they neglect the quality of work experience and the possibility of obtaining work experience during schooling. Economic scholars have developed new methods for measuring actual work experience (Light & Ureta, 1995; Regan & Oaxaca, 2009; Zveglich et al., 2019) and for capturing its quality (e.g. Gullason, 1990).

Nonetheless, one difficulty in measuring work experience is that more than one ideal type of work experience exists (Blackwell et al., 2001). Quiñones et al. (1995) avoid this difficulty by establishing a conceptual framework for classifying work experience along on two axes: measurement mode and level of specificity. Three elements contribute to their measurement mode: number of times that something (e.g. a task or job) was done, time spent doing it and the respective difficulty or complexity of doing it. Their level of specificity axis captures gaining work experience at different levels: task, job or organisation. Together, the two axes constitute a nine-cell matrix (p. 892).

In our focus on VET work experience, differentiation at the task level is sufficient because no job or organisation change is involved in VET. We focus on the number of times the task was performed, time spent on the task and the difficulty or complexity of the task. When we apply Quiñones et al.'s (1995) framework to VET, we find that students perform the same tasks over and over in a workplace, and that the time spent on the tasks will differ according to the required days at school in the occupational curriculum. The complexity of the task will also differ, especially in dual VET, because clients' varying needs lead to a variation in the complexity. For example, although a hairdressing apprentice will cut hair almost daily during dual VET, the time he or she spends on the haircut will differ according to the length of the hair, and the difficulty will depend on the hairstyle the client wants. Likewise, a salesperson in a store is responsible for handling cash at checkout but also for placing products on shelves, knowing the products well enough to give clients advice, and understanding the entire flow of warehouse goods.

Therefore, in Quiñones et al.'s (1995) framework, HE graduates with a VET diploma have work experience. The question then is whether we really measure work experience or something else connected to the VET diploma. One possible way of checking whether we actually measure work experience is to compare our coefficients from VET to the other work experience coefficients we have in our estimations. We can differentiate six sources of work experience, four that are related to students' field of study and two that are not. Internships and work done by part-time students (work-based higher education) might be included in the curriculum, and we can observe which pre-study work experience and student jobs are related to the field of study.

Conversely, we also observe pre-study work experience and student jobs that are unrelated to the field of study. We conduct this analysis to show that our results for the other work experience sources are in line with the argument that only related work experience is helpful (e.g. Geel & Backes-Gellner 2012; Baert et al. 2016). Drawing on Egg (2016), who relies on the experience classification framework of Quiñones et al. (1995), we hypothesise that the coefficient for VET should be about the same size as student internships and related student jobs, smaller than work-based higher education, and larger than pre-study employment.

Table 2.2: Regression table on work experience

	Wage		IVWage	
	Coef.	SE	Coef.	SE
First stage: VET				
Regional enrolment rate in VET			0.867***	(0.28)
Second stage: Wage				
VET	0.065***	(0.01)	-0.396***	(0.02)
Pre-study job	-0.012	(0.01)	-0.029**	(0.01)
Related pre-study job	0.027***	(0.01)	0.047***	(0.01)
Student internship	0.029***	(0.01)	-0.022**	(0.01)
Student job	-0.038***	(0.01)	-0.037***	(0.01)
Related student job	0.050***	(0.01)	0.063***	(0.01)
Work-based high. edu.	0.049***	(0.01)	0.074***	(0.01)
Observations	13490		13490	
Pseudo R^2	0.659			

Notes: The table shows the regression coefficients from the tobit regression and IV regression for wage. The estimations from the first and second stages include all the previous controls, and the standard errors are robust. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 2.2 shows the estimated coefficients for wage. For the tobit estimation, work experience from VET has about the double the effect of student internship and a slightly larger effect than student job related to the field of study. Work experience from VET is larger than that from pre-study employment related to the field of study and lightly larger than work-based education. However, the results from the IV estimation are puzzling. Differentiating between related and unrelated pre-study jobs for some reason influences the results for both VET and student internship, although why the differentiation has such an influence remains unclear. Therefore, we do not interpret those estimations. Nevertheless, from the first estimation, which shows slightly larger results but still comparable to those in the literature, we argue that we are measuring work experience.

Are the results representative for higher education graduates?

In our analysis we focus on HE graduates with bachelor or master degrees who enter the labour market and do not continue their studies.[19] Selection might occur, in the sense that more able students might continue studying and might have ACC. If so, our findings for VET would be upwards biased. To look for any possible bias, we compare the summary

[19] As PhD graduates constitute a special case with too many unknowns, we therefore exclude them.

statistics of the entire dataset with our sample (table B.11 in appendix B.3 contains the results).

Comparing the means of our dependent variables – wage, search time, internship – we see that the dataset has lower wages, higher search time and about the same amount of internship than our sample. Lower wages are expected because students remain in the dataset. A longer search time is unexpected, because students should not have had any. Finally, the proportion of students with a VET diploma in the dataset is lower (23%) than that in our sample (38%), indicating that HE graduates with VET are indeed over-represented in our sample. The regional enrolment rate in VET is about the same in both the dataset and our sample.

For personal characteristics, the students in the dataset and our HE graduates are comparable. The students in the dataset are only slightly older (27 rather than 26) and more likely to be married and have children. In the education characteristics we find no differences in the proportion of master students, the average final grade or the number of semesters. However, our sample contains an over-representation of HE graduates from UASs. The largest differences in the subjects are for economics and agricultural sciences, for both of which we have an over-representation. Finally, practically no differences exist between the dataset and our sample for work experience and its source.

This comparison shows that our sample contains a higher rate of HE graduates with VET and from UASs. As these two features are critical for our analysis, they might be driving our results. To rule out any special influence of these features, we estimate a Heckit – a two-stage Heckman correction model (Heckman, 1979). As an exclusion restriction we use two instruments: continued study and searched employment. Table B.12 in Appendix B.3 shows the results: the coefficient for VET is still significantly positive for wage. Hence the selection in our sample does not drive our results.

Are we comparing apples and oranges?

Another assumption we make is that HE graduates with VET or ACC are comparable, because having the same degree from the same institution in the same field of study generates similar crowds. To test this assumption, we estimate our results of wage with a nearest neighbour matching method. The observables on which we match HE graduates are age, gender, type of education, level of education, subject and grades. Our new results show that when we compare similar HE graduates with different educational backgrounds, work experience from VET affects wage significantly and positively (estimated coefficient appear in table B.13 in appendix B.3). Hence, our assumption about the graduates' comparability is reasonable.

2.5 Conclusion

This chapter analyses the effect of VET work experience on the labour market outcomes of HE graduates. Our findings show that having VET work experience increases wages and diminishes search time but does not reduce the probability of internships one year after graduation. Although this beneficial effect persists for five years after graduation, it is no longer significant for wage, unemployment spells or employment positions. The analysis of possible channels shows that screening, human capital and signalling, not social network, are the prevalent channels.

The benefits of work experience from VET one year after graduation are sizeable. The estimated effect for wages ranges between 7% higher wages for HE graduates with a VET diploma in the tobit model with controls and 19% higher wages in the IV model. Thus in Switzerland HE graduates with VET earn between CHF 4,800 ($\sim$ 4,470 Euro) and CHF 13,100 ($\sim$ 12,200 Euro) more one year after graduation than their counterparts with ACC. Having work experience from VET reduces search time by two months in the IV model, indicating that HE graduates with VET search three months for a job and HE graduates with ACC need to search for five months. For internship, work experience from VET significantly reduces the probability of doing an internship after graduation by 23.8% in the probit model but not significantly in the IV model.

Comparing these coefficients to the coefficients of the other sources of work experience makes the estimated coefficients from the IV model appear somewhat large. However, given that we estimated the local average treatment effect, the effects of the IV model are relevant only for HE graduates who would have switched employers, not for all HE graduates, thereby likely explaining the large differences. Our findings are in line with Shaw (2012) for VET in the UK. They are also in line with Nunley et al. (2016) in the United States, Margaryan et al. (2019) in Germany and Bolli et al. (2019) in Switzerland for internships , San (1986) and Weiss et al. (2014) for student jobs in Germany, and Böckerman et al. (2018) and Böckerman et al. (2019) for vocational degrees in Finland identifying a positive effect of work experience on labour market outcomes.

Five years after graduation, HE graduates with VET work experience have higher wages by 2.7% in the tobit model (not significant) and 11.8% in the IV model (significant) but are equally likely to be unemployed and have no significant difference in their employment positions. This finding of no negative effect for HE graduates with a VET diploma in the longer run (five years after graduation) is in line with Hanushek et al. (2017), who find no negative long-term effect of VET on labour market outcomes after upper-secondary education in Switzerland. Moreover, we still find positive effects that are simply not as robust as the results for one year after graduation. However, the results contrast with the findings from other countries of negative long-term effects of a VET diploma (Forster et al., 2016; Hanushek et al., 2017; Hampf & Woessmann, 2017).

We have three explanations for these opposing results. First, our sample focuses on highly educated individuals, and heterogeneity might exist in the effect of VET, depending on the highest education level attained. Second, as our time horizon is relatively short for the long run, that negative effects appear only after prime age may be possible. Nonetheless, we argue that the appearance of negative effects is unlikely because all HE graduates have general skills due to their highest educational degree coming from higher education. Third, Switzerland's VET system is so well established that a VET diploma is not a disadvantage.

We find that HE graduates with VET have an advantage over their academic peers at one year and similar outcomes after five years. We have no reason to expect that HE graduates with ACC will surpass their VET counterparts, because evidence shows that experience profiles converge in the long term rather than invert (Mincer, 1974). In addition, as all HE graduates have the same highest education level, we should not expect any differences in wages due to education.

Overall, our results suggest that – for individuals who are not sure whether to continue their education with a VET diploma or an academic diploma – starting with a VET diploma is not a disadvantage, even when continuing to higher education. Indeed, pursuing dual VET reduces the foregone earnings during upper-secondary education, results in higher wages after higher education, and helps HE graduates start earning wages sooner. These findings extend the evidence in the literature that labour market outcomes for VET are as good as or better than those for academic education when one controls for years of education (Tuor & Backes-Gellner, 2010) and demonstrates that VET is a good starting point even for individuals planning to attend higher education. While transitioning from higher education into the labour market can be a major challenge, HE graduates with VET can use their work experience to better capitalise on their higher education.

In line with the main findings in the literature (e.g. Weiss et al., 2014; Nunley et al., 2016), we find the signalling channel to be important. However, unlike the literature (except for Bolli et al., 2019), we also find the human capital channel to be important, joined to a lesser extent by the screening channel. VET can plausibly be a signal, because entering higher education requires some extra effort, which can constitute a signal for higher productivity. That work experience from VET works through the human capital channel is plausible insofar as VET conveys marketable skills according to a structured curriculum developed in cooperation with industry. Longer programme duration in VET – three to four years – ensures the acquisition of a durable level of work experience. Moreover, given that employers come to know the productivity level of HE graduates with VET, the screening channel is likewise plausible.

This chapter has two policy implications. First, VET is an appropriate and beneficial upper-secondary education even for students who plan to later attend higher education. Policy-makers should encourage VET in upper-secondary education not only for students

who may not attend higher education but also for those who plan to do so. HE graduates with VET benefit from increased wages and faster transitions into the labour market, all without incurring foregone earnings during upper-secondary education or lost time due to other methods of gaining experience. This upper-secondary education pathway may indeed be an important tool for improving equal opportunities, if VET helps young people from a lower socio-economic background to reach upper-secondary graduation and afford higher education without having to work on the side to gain work experience.

Second, certain VET programme design features are important for driving positive outcomes. This second implication of our findings defines the conditions under which such positive outcomes are possible. We find that the VET programme structure has an important impact on later labour market outcomes. Because the impact of VET is driven by human capital acquisition, the skills developed during VET must be both relevant and of high quality. These conditions imply that VET programmes need curricula developed in cooperation with industry and that a substantial amount of workplace learning is required. A school-based programme without any exposure to work-based learning, a dual programme that is too short, or a dual programme that is too narrow will not provide sufficient general human capital to increase work experience and drive positive impacts.

A limitation of our identification strategy is that we cannot completely rule out the self-selection of students into higher education. Hence there is the possibility that HE graduates with VET, for example have a higher ability in general and would therefore always have better labour market outcomes. In such a case, our estimates would overstate the benefit of VET. However, comparing HE graduates and including various controls on personal characteristics, education, work experience and employer characteristics largely minimise self-selection bias.

Another limitation of our results is that we are only able to causally identify the local average treatment effect. Therefore, the external validity for all HE graduates is not guaranteed, even though our results from the explanatory analysis suggest that the effects are present but smaller. Our results also only apply to HE graduates who enter the labour market and do not continue their studies. In addition, the possibility of generalising our results to other countries depends on the comparability of their education systems to the Swiss system, especially in terms of the strong linkage between actors of the education and employment systems as well as the substantial amount of workplace training VET graduates gain. Comparable countries for education systems and the education-employment linkage include Austria, Denmark and Germany. Finally, the advantages of VET might arise only in countries with a permeable education system, in which individuals with a VET diploma have the same access to educational possibilities as individuals with an academic diploma. Despite these limitations, our findings on VET work experience show that VET does not need to be a second choice education pathway in an education system, when the VET pathway is properly included in the system.

Chapter 3

Train drain? The availability of skilled foreign workers and firms' willingness to train[1]

3.1 Introduction

In many countries, part of the resident workforce fears the influx of foreign (skilled) workers, because they may lower native workers' job opportunities or wages,[2] or otherwise negatively affect their lives. In many countries, these fears have led to stricter immigration policies (VOAnews 2019; Hermann 2019). One common argument supporting migration restrictions is their likely influence on firms' willingness to invest in training their own workers.[3] Indeed, open borders may make it both easier and cheaper for firms to find workers with the right skills, likely reducing their motive to invest in the skills of native workers. Firms, however, counter that a strict stance barring most foreign skilled workers leads to skill shortages, thereby reducing their competitiveness and impeding their growth. Do open borders shift the costs of acquiring labour market skills from firms to their native workers, firms in the sending country, or the educational system

[1] This chapter is joined work with Michael Siegenthaler.

[2] There is mixed evidence on the effect of immigration on employment and wages, with some studies finding negative effects (e.g., Borjas 2003) whereas others find little positive to no effect (e.g., Card 1990; Ottaviano & Peri 2012; Ortega & Verdugo 2015). Dustmann et al. (2016) review the empirical literature on the impact of immigration on wages and employment.

[3] Denmark, for example, defends its strict immigration policies with the argument that Danish firms should invest more in the training of native workers to cover their hiring needs.The Minister president, Mette Frederiksen, is convinced that Denmark does not need to search for skilled workers outside the borders of the EU because there are enough young unskilled workers at home, who need a chance (Hermann, 2019).

of the sending country? If present, such shifts could reinforce the brain drain caused by free mobility of labour, with important implications for both education and immigration policy.

This chapter analyses the economic trade-off between open borders and firms' willingness to train unskilled native workers. The cost-benefit considerations inherent in most economic models of firm-provided training imply that a greater supply of skilled workers lower hiring costs for skilled workers thereby reducing firms' training motives.[4] We model this idea in a basic dynamic labour-demand model of training originally proposed by Stevens (1994). In this model, central to the dynamic decision-making problem of the firm are the assumptions that firms face exogenous separation from skilled workers and costs for replacing them, due to both training and hiring costs.[5] These hiring costs thus generate a motive for firms to train unskilled workers today to save on hiring costs for skilled workers tomorrow.

We extend this model to allow for skilled immigration. We assume that firms produce with a constant elasticity of substitution (CES) production function that has two labour inputs, skilled immigrant workers and skilled native workers. The CES framework allows the two labour inputs to be imperfect substitutes – a standard assumption in the economics of immigration (Ottaviano & Peri, 2012) and a plausible assumption in our empirical application.[6] We also assume that hiring costs are an increasing function of the total supply of skilled workers, that is, the greater the overall supply of trained workers, the lower the hiring costs, because finding workers with required skills and knowledge in the labour market is easier.

In this framework, a greater availability of skilled immigrant workers has two opposing effects. On one hand, a larger supply of skilled immigrant workers reduces firms' provision of training by lowering the future savings in terms of hiring costs associated with training (cost effect). On the other hand, a greater availability of skilled immigrant workers lowers their wage relative to the wage of skilled native workers, increasing the demand for skilled native workers if native and immigrant workers are imperfect substitutes (scale effect). The overall effect on training thus depends on the strength of the cost

[4]For comprehensive overviews on why firms train, see Becker (1962), Wolter & Ryan (2011), Leuven (2005).

[5]We use hiring (costs) in this chapter, meaning acquiring new skilled workers (including recruitment), respectively all costs involved in the hiring process of skilled workers. By 'hiring' costs we do not include the adjustment costs to the new environment, given that we assume that they are accounted for by the difference in wages.

[6]Other studies estimating the elasticity of substitution between native workers and immigrant workers for the US are Borjas (2003), Borjas et al. (2006) and Borjas (2008) finding native and immigrant workers to be perfect substitutes, as well as Card (2009), Peri (2011), and Ottaviano & Peri (2012) although finding native and immigrant workers to be imperfect substitutes.

and the scale effects, particularly on the extent to which a greater supply reduces firms' hiring costs and on the degree of complementarity between skilled immigrant and skilled native workers.

We causally test these theoretical predictions by exploiting quasi-experimental variation in the availability of skilled workers resulting from the implementation of the Agreement on the Free Movement of Persons (free movement policy) in Switzerland, applying an empirical strategy developed by Beerli et al. (2020, BRSP henceforth). This policy gave EU citizens full and free access to the Swiss labour market starting in 1999. As BRSP show, this reform affected regions near the border both earlier and more strongly, because of the abolition of pre-existing restrictions on hiring and employing European cross-border workers (CBWs). CBWs are workers who live in Switzerland's neighbouring countries (Austria, France, Germany, and Italy) and commute across the border for work. Between 1999 and 2004, Switzerland completely removed all former obstacles to hiring CBWs. Because CBWs work almost exclusively in regions within 30 minutes' commuting time of the border, both before and after the free movement policy, regions near the border experienced substantially larger inflows of foreign workers from the EU 2000–2012 than regions farther away.

The spatio-temporal variation in exposure to the opening of the Swiss labour market allows us to use a transparent Difference-in-Differences (DiD) design to study how the increase in the availability of skilled foreign workers affected firm-provided training. Our DiD design compares changes in outcomes near the border with changes in outcomes farther away. We measure firms' provision of general training by looking at their willingness to provide apprenticeships[7] for young adults.[8] Our empirical analyses are based primarily on panel data from the Swiss Business Census from 1995–2008, which provides information on the employment of the number of apprentices for the universe of establishments[9] in Switzerland, and representative firm-level surveys in 2000, 2004, and 2009 on the costs, benefits, and motives of apprenticeship provision in Switzerland (Schweri et al., 2003; Muehlemann et al., 2007; Strupler & Wolter, 2012).

We first show that the free movement policy had a strong and disproportionate impact on the employment of foreign workers in firms that are near the border and that offer

[7] Apprenticeships in Switzerland are part of dual vocational education and training. The latter is an upper-secondary level education programme combining attending school with work-based practical learning in firms, i.e. apprenticeships OECD (2004).

[8] Apprenticeships in Switzerland is largely composed of general (i.e., transferable) skills (Mueller & Schweri, 2015), and many studies have therefore used the firms' employment of apprentices to study firms' willingness to provide general training (e.g., Acemoglu & Pischke, 1998; Muehlemann et al., 2007; Mohrenweiser & Zwick, 2009; Muehlemann et al., 2013; Blatter et al., 2016).

[9] Our empirical analyses include data on the larger firm-level (cost-benefit data) and the smaller establishment-level (census data), that is, different establishments within a firm.

apprenticeships. These findings indicate that the setting we analyse constitutes a highly useful setting for examining whether a shock to the availability of skilled foreign workers affected the provision of apprenticeships in firms that train apprentices. Using the census data, we show that the free movement policy had a precisely estimated null effect on firms' probability of providing apprenticeships.

The evidence on whether this policy affected the number of apprenticeships offered by firms is mixed. Depending on specification and control variables, our estimates suggest that each additional foreign worker hired by highly treated establishments displaces between 0 and 0.1 apprenticeships. In our baseline specification, the estimate of 0.1 is marginally statistically significant. When we use the cross-sectional data from the cost-benefit surveys, we find no statistically significant impacts of the free movement policy on firms' willingness to train. Taken together, these results suggest a limited direct labour market competition between (skilled) foreign CBWs and apprentices in Switzerland.

Nonetheless, the free movement policy had effects on the training decisions of firms near the border. Exploiting the unusually rich, qualitative survey information on firms' motives for training apprentices from the cost-benefit surveys, we show that the policy had a negative influence on the probability of highly treated firms that they train apprentices to attract skilled workers. Similarly, treated firms became significantly less likely to train for the purpose of (a) saving hiring costs, (b) avoiding the risk of a poor hiring decisions, and (c) for training junior workers into skilled workers.

These results indicate that the free movement policy indeed made it both, easier and cheaper for firms to hire skilled workers in the external labour market, and they provide direct evidence for the empirical importance of the cost effect in mediating the effect of a greater supply of skilled workers on firms' training. Our theoretical considerations also provide an explanation that the overall effect of the policy on training was close to zero despite the evidence for the relevance of the cost effect: the scale effect may have been large enough to offset the cost effect.

Our finding that the early 2000s opening of CBWs' access to the Swiss labour market had limited negative effects on apprenticeship training stands in direct contrast to the results of a concurrent study by Aepli & Kuhn (2019). Using the business census data, they argue that the employment of CBWs significantly replaces firms' provision of apprenticeships. The difference in results relative to ours are due to the differences in research design. Aepli & Kuhn (2019) estimate the effect of CBWs on training by instrumenting firms' employment of them with an establishment's distance from the border. The first stage of this instrumental variable (IV) strategy relies on firms that are located near the border training substantially fewer apprentices than firms farther away – a result that we confirm.

However, Aepli and Kuhn's (2019) IV approach depends on the assumption that distance from the border affects firms' provision of training *only* through the greater supply

of CBWs near the border. In contrast, our DiD results suggest that the differences in training behaviour – measured by distance from the border – overstate the effect of the greater supply of CBWs near the border on the firms' provision of training positions. We find that part of the regional differences in the provision of apprenticeships are driven by time-invariant differences in the composition of firms across regions, differences that are unrelated to the supply of CBWs.

This chapter contributes to the literature on immigration and on firm-provided training in four important ways. First, it adds to the sparse evidence on the connection between the supply of skilled immigrant workers and firms' provision of training. It provides a theoretical framework that formalizes the notion that firms' cost-benefit considerations and production complementarities imply that a greater supply of skilled workers may reduce or increase firms' motives to provide training. Thus far, only Mountford & Wadsworth (2019) provide a theoretical model allowing for negative effects (through reallocation of skilled native workers into other sectors) and positive effects (through firm creation due to higher firm profitability) of immigration on training provision.

Second, by exploiting the quasi-experimental variation in the availability of skilled workers, this chapter provides novel empirical evidence on how firms' willingness to train depends on the ease with which they find skilled workers. Studies examining this question are largely observational, focus on smaller-scale immigrant inflows, and reach conflicting conclusions. The studies providing descriptive evidence find either no effect of immigration on training (Baker & Wooden, 1992; Muehlemann & Wolter, 2013) or negative effects (Mountford & Wadsworth, 2019; Aepli & Kuhn, 2019). Campo et al. (2018) use a standard shift-share IV approach to show that higher skilled immigration has a positive impact on firms providing training to native workers. Our population-wide data on training allows us to study in detail, with great accuracy whether the policy change affected firms' provision of training (apprenticeships). Furthermore, our rich survey data allows us to exploit qualitative survey questions that reveal firms' motives to train apprentices, thereby analyzing the underlying mechanisms in detail.

Third, by focusing on firms' provision of training, this chapter also adds a novel angle to recent studies looking at the effects of immigration on wages and employment (Mansour, 2010; Dustmann et al., 2017) and on firms (BRSP) by exploiting changes in commuting policies. An attractive feature of this approach is that the increase in the aggregate number of immigrant workers and its unequal regional impact are a direct consequence of the exogenous change in immigration policy. This approach is in contrast to the traditional shift-share IV approach to isolate supply-driven variation in regional immigration flows. That approach hinges on the assumption that historical immigrant concentrations across regions are uncorrelated with the current regional distribution of labour-demand shocks. However, this assumption, is not always warranted (Jaeger et al., 2018). Another

difference of using changes in commuting policies is that possible consumption-side effects of immigration (e.g., on the demand for local housing) are muted because CBWs do not relocate to the country they work in. While this absence of reallocation likely increases the scope for displacement effects in the labour market, it also makes it easier for us to isolate the cost and scale effects highlighted by our demand-side framework, because consumption-side effects are unlikely to constitute a major driver of firms' decisions.

Fourth, by tying our empirical results to the introduction of the free movement policy, this chapter has important implications for policymakers on the potential societal costs of training opportunities for young adults in the receiving country – particularly given growing opposition to the free movement of workers in several European countries. In Switzerland, with widespread fears that immigration may harm the economic opportunities of citizens, the majority Swiss citizens voted for a 2014 referendum – the 'stop mass migration' initiative – which was intended to restrict the free movement of persons. One argument in the pre-voting debate was that open borders incentivize firms to hire cheap labour from abroad (Blocher, 2011), thereby undermining firms' willingness to invest in the training of unskilled citizens and reinforcing the brain drain caused by (skilled) migration. The results of this chapter show at these fears are largely unfounded.

This chapter is organized as follows. Section 3.2 gives an overview of the literature on training and the role of hiring costs. Section 3.3 presents our theoretical model. Section 3.4 provides the institutional background on (a) the graduated reform process of the free movement policy and (b) the apprenticeship system in Switzerland, from a firms' perspective. Section 3.5 describes the data in the empirical part and explains the research design. Section 3.6 presents the empirical results and important robustness checks. Section 3.7 discusses our main findings and concludes.

3.2 Literature review

An extensive literature in migration economics examines the effects of skilled immigration on the labour market outcomes – especially wages and employment – of native workers in receiving countries (e.g., Borjas, 2003, Card, 2009 or Ottaviano & Peri, 2012). Dustmann et al. (2016) argue that the mixed evidence of immigration on wages and employment results from the differences in estimation specifications, with some studies estimating a relative wage effect (e.g., Borjas, 2003) and others estimating the total wage effects of immigration (e.g., Ottaviano & Peri, 2012). Kerr et al. (2015) arguing that more research on the role of firms is needed and start by analyzing the effect of H-1B visas for high-skilled immigrant workers in the U.S. on firms' employment behaviour. Their study launched numerous further studies (see Wittek, 2019 for an overview) analyzing the role

of firms in who migrates and how high- and low-skilled migration affects firm outcomes such as productivity, size, and innovation.

To understand how immigration might affect firms' provision of training, one first has to understand why firms provide worker training at all. The reasons for firms' decisions to provide training are widely discussed in the economic literature (see Picchio & van Ours, 2011 for a brief overview). In the classic model of Becker (1962), firms only provide training for firm-specific skills, in sharp contrast to the empirical regularity that firms provide training for general skills (e.g., apprenticeships in countries such as Germany and Switzerland). Acemoglu & Pischke (1998; 1999a; 1999b) started a strand of literature arguing that firms provide the training of general skills due to labour market imperfections. These imperfections allow firms to reap parts of the benefit of training, even if the training consists of general skills.[10]

According to Becker's human capital theory (Becker, 1964), training workers increases firms' productivity but also induces costs. Firms ultimately provide training only when the benefits are larger than the costs. Therefore, cost-benefit considerations of firms are central to the empirical literature on firm-provided training (see Wolter & Ryan, 2011 for an overview). The three most common approaches to training in this literature are reputation, production, and investment. The reputation approach argues that firms use training to signal high quality to clients and potential workers, thereby likely fulfilling a socially desirable norm (Sadowski, 1980 found in Wolter & Ryan, 2011; Kuhn et al., 2019). In the production approach, the training costs are covered during training through the productive work of the worker in training (Lindley, 1975). This requires that workers accept wages that are below their marginal productivity during the training phase. In this approach, firms use training as a means of producing their output more cheaply.

In the investment approach, firms use training to prepare their future workforce (Oatey, 1970; Lindley, 1975; Merrilees, 1983). Oatey (1970) argues that firms may find it easier and cheaper to train skilled workers than hire them from the labour market, implying that firms face a trade-off between training costs and hiring costs. Stevens (1994) formalizes this trade-off in a dynamic labour-demand model to explain the collapse in the demand for apprentices in the British engineering industry in the 1980s.[11] In the investment approach, firms' willingness to train depends crucially on the costs to hire skilled

[10] Leuven (2005) provides an overview on the theoretical literature. The most current theoretical models (not covered in the previous overview) use search and matching models to explain firm-provided training, for example, Shintoyo (2008) and Shintoyo (2010).

[11] In the investment approach, a disincentive for firms to train is that trained skilled workers cannot be forced to stay at the firm when other firms offer, for example, better working conditions. Although a number of studies show that firms are able to retain a fraction of their trained skilled workers (e.g., Winkelmann, 1996; Cappelli, 2004; Mohrenweiser & Zwick, 2009), such poaching might be an issue for training firms planning to keep their newly skilled workers. Indeed, Muehlemann & Wolter (2011) show that firms train

workers on the labour market. Empirical studies' estimates of the monetary size of firm hiring costs range from a few weeks' up to half a year's worth of wage payments (e.g., Oi, 1962; Manning, 2011;[12] Blatter et al., 2012; Muehlemann, 2016; Muehlemann & Strupler Leiser, 2018). According to Muehlemann & Strupler Leiser (2018), hiring costs consist of initial low productivity (53%), disruption costs of informal instructions (26%), and search costs (2%). Blatter et al. (2016) find that the supply of training increases with higher hiring costs and that firms are less likely to provide training when hiring costs are lower than training costs. In turn, hiring costs increase with the hiring rate, skill requirements, and labour market tightness (Blatter et al., 2012; Muehlemann & Strupler Leiser, 2018).

If firms train to save on future hiring costs, it is thus natural to expect that firms will lower their provision of training when the availability of skilled workers in the labour market is greater (Blatter et al., 2016). In turn, we expect that open borders decrease labour market tightness (see, e.g., Chassamboulli & Peri, 2020). This decrease, eases firms' search of skilled workers, which in turn lowers hiring costs, and should thus reduce the training provision of firms. Despite of this prediction, there exists only one theoretical model that formalizes the impact of skilled immigration on the training provision of firms. Mountford & Wadsworth (2019) provide an equilibrium model in which training is available only in the non-traded goods sector. They expect both positive and negative effects of immigration on on-the-job training. Empirically, they provide evidence that immigration has a negative impact on firms' provision of training.

Empirical studies find positive, negative or no evidence for an effect of immigration on firms' provision of training (Baker & Wooden, 1992; Muehlemann & Wolter, 2013; Campo et al., 2018; Aepli & Kuhn, 2019). Baker & Wooden (1992) analyse three types of training: in-house, external, and on-the-job. Using a two-step approach to address the endogeneity of immigration, they find a slight substitution between immigrant workers and in-house training but no overall reduction in the training provision of firms in Australia. Similarly, Muehlemann & Wolter (2013) report for Switzerland that immigration does not lessen the provision of firm training unless the firm has already relied on recruitment from abroad. In contrast, Campo et al. (2018) find a potential positive impact of skilled immigration on on- and off-the-job training acquired by workers in the UK. Their identification strategy relies on a shift-share instrumental variable approach.

less in dense labour markets. Nonetheless, there is also evidence that the training behaviour of firms that were victims of poaching does not actually change (Mohrenweiser et al., 2019).

[12]Manning (2011) provides an extensive review of the literature on pre-2011 hiring costs.

3.3 Theoretical framework

Our theoretical framework, developed by Stevens (1994), is based on a dynamic labour-demand model with adjustment costs, augmented with firms' investment in training. The central dynamic trade-off formalized in the model is that firms can hire skilled workers either by hiring them externally tomorrow at certain hiring costs or by training unskilled workers internally today at certain training costs. In the following section, we first present a simplified version of Stevens' model. In section 3.3.2, we extend this model to study the effects of a greater availability of skilled immigrant workers.

3.3.1 A two-period dynamic labour-demand model of training

Stevens (1994) studies firms' provision of training for unskilled workers within an otherwise standard dynamic labour-demand model. We present Stevens' baseline training model and, for our purpose, simplify it along two dimensions: we omit the discount rate[13] and focus on only two periods. Although these simplifications have no implications for our main theoretical predictions, they make the exposition of the mechanisms easier.

The model contains two types of workers: unskilled workers, T_t, and skilled workers, L_t. It assumes that only skilled workers contribute to the revenue of the firm. The revenue function is a real net function that depends only on skilled labour ($R_t[L_t]$ with $R' > 0, R' \leq 0$). Firms hire skilled workers to be productive in both this period and later ones, and they can choose to hire unskilled workers (T_t), to train them and thus have skilled workers for the next period. There are constant and exogenous voluntary quit rates for trained unskilled workers (γ) and for skilled workers (δ). Firms' skilled employment in period t, L_t, therefore consists of the skilled workers remaining from the previous period, the remaining trained unskilled workers from the previous period T_{t-1} (newly trained skilled workers), and skilled workers (X_t) newly hired from the external labour market:

$$L_t = (1-\delta)L_{t-1} + (1-\gamma)T_{t-1} + X_t \tag{3.1}$$

Firms face costs for hiring skilled workers and net costs for training unskilled workers, that is, the productivity of unskilled workers does not cover the training costs. The net training costs depend only on the number of unskilled workers in training and do not influence the productivity of skilled workers.[14] Both net training costs and hiring costs

[13] The discount rate is not affected by immigration, thus we do not focus on its role.

[14] In reality, the training costs consist of wages for workers in training, hiring costs, investment costs, material costs, and other costs (Strupler & Wolter, 2012). As one of the largest cost factors in training is wages for the unskilled workers in training (OECD, 2018b), the assumption of Stevens (1994) that training costs only depends on the number unskilled workers is a simplification.

are quadratic, a mathematical requirement for a closed form solution. The hiring cost function is $B_t[X_t] = \frac{1}{2} b_t X_t^2$, and the training cost function is $C_t[T_t] = \frac{1}{2} c_t T_t^2$ ($b_t, c_t \geq 0$). The assumption that net training costs are positive implies that training is never profitable per se but that unskilled workers in training could make up for the part of their training costs near the end of the training period. Moreover, the model assumes that skilled workers earn a competitive wage in every period t, w_t.

In the first period, firms gain revenue from the production of their skilled workers, have wage costs for these workers (to whom they pay a competitive wage), incur training costs for unskilled workers, and have hiring costs for skilled workers. In the second period, firms have revenues from that period, wage costs for skilled workers, and hiring costs of additional skilled workers not covered by the current stock of employees or the trained unskilled workers. The profit-maximizing firms operate on a competitive product market. The profit optimization problem thus is:

$$\max_{T_0, L_0} R_0[L_0] - w_0 L_0 - C_0[T_0] - B_0[X_0] + R_1[L_1] - w_1 L_1 - B_1[X_1] \tag{3.2}$$

where, in the first period, all skilled workers are new hires (i.e., $X_0 = L_0$). In the second period, the newly hired skilled workers fill the gap between the required skilled workers and the remaining skilled workers from the first period, together with the trained unskilled workers from the first period: $X_1 = L_1 - (1-\delta)L_0 - (1-\gamma)T_0$.

To find the optimal employment and training levels, we derive the first-order conditions (FOC). The FOC for employment is:

$$L_0 : R'[L_0] - w_0 - b_0 L_0 + (1-\delta) b_1 (L_1 - (1-\delta)L_0 - (1-\gamma)T_0) = 0 \tag{3.3}$$

and for training it is:

$$T_0 : -c_0 T_0 + (1-\gamma) b_1 (L_1 - (1-\delta)L_0 - (1-\gamma)T_0) = 0 \tag{3.4}$$

Following Stevens, we define H_0 as a function of exogenous variables displaying the ratio between hiring costs of skilled workers and training costs unskilled workers:

$$H_0 \equiv \frac{1}{b_1} (1-\gamma)^{-2} c_0 \tag{3.5}$$

with $H_0 \geq 0$; $\frac{\partial H_0}{\partial b_1} \leq 0$; $\frac{\partial H_0}{\partial c_1} \geq 0$ because of $c_t \geq 0$. Firms do not train when the hiring costs approach zero. Conversely, when training costs are zero, firms train all additional skilled workers needed for the future. Rearranging the FOC for training (eq. 4) and replacing H_0 (eq. 5) yields the decision rule for training unskilled workers:

$$(1-\gamma)T_0 = \frac{1}{(1+H_0)} (L_1 - (1-\delta)L_0) \tag{3.6}$$

Therefore, firms train unskilled workers to cover a fraction $\frac{1}{(1+H_0)}$ of future employment, that is, a proportion of the additionally needed skilled workers in the future. The number of unskilled workers that firms train therefore depends on the training costs relative to the hiring costs: the greater the training costs relative to the hiring costs, the larger the number of trainees and vice versa. We obtain the decision rule for employment by inserting the decision rule for training (eq. 6) into the FOC for employment (eq. 2):

$$R'[L_0] - w_0 - b_0 L_0 + (1-\delta) b_1 (1 - \frac{1}{1+H_0})(L_1 - (1-\delta)L_0) = 0 \tag{3.7}$$

This equation shows that the intertemporal employment decision does not depend on the number of unskilled workers in training. Firms can simply choose the future number of skilled workers by assuming lower hiring costs for skilled workers.

3.3.2 Immigration in the dynamic labour-demand model

We modify the two-period model to include immigration, with the labour force now consisting of skilled native workers and immigrant workers. Ottaviano & Peri (2012) observe that even if *native* and *immigrant* workers have similar education and age, they differ in the skills they have, the jobs they work in, and the productive tasks they perform. In their analysis, Ottaviano and Peri thus find that both native and immigrant workers in the U.S. are imperfect substitutes. Studies on other countries find similar results (e.g., Gerfin & Kaiser, 2010, for Switzerland). Therefore, we allow skilled native and skilled immigrant workers to be imperfect substitutes. We continue to assume that firms can only use skilled workers in production. Moreover, we assume that firms only train unskilled native workers. These assumptions imply that the skilled employment in time t is:

$$L_t = N_t + I_t \tag{3.8a}$$

$$\text{with} \quad N_t = (1-\delta)N_{t-1} + (1-\gamma)T_{t-1} + X_t^N \tag{3.8b}$$

$$\text{and} \quad I_t = (1-\delta)I_{t-1} + X_t^I \tag{3.8c}$$

To include skilled immigration, we moreover adapt the revenue function. For simplicity we set the price to unity, so that the revenue function equals the production function. We use a constant elasticity of substitution (CES) production function with two inputs, skilled native workers and skilled immigrant workers. The CES production function formalizes the idea that skilled immigrant and native workers may be imperfect substitutes, where the elasticity of substitution between the two inputs $\sigma = \frac{1}{1-\rho}$ measures the degree of imperfect substitutability. The two labour inputs are perfect substitutes if $\sigma = \infty$ (Ottaviano & Peri, 2012). The production function also contains a parameter measuring total

factor productivity (A_t), and a productivity parameter measuring the relative efficiency of skilled immigrant and native workers (α):

$$Y_t = R_t[N_t, I_t] = A_t(\alpha N_t^{\rho} + (1-\alpha) I_t^{\rho})^{\frac{1}{\rho}} \tag{3.9}$$

To model the impact of a change in the supply of skilled immigrant workers on firm behaviour, we assume that hiring costs are a function of total supply of skilled labour in the labour market $L_t = N_t + I_t$. The idea is that the greater supply of skilled labour makes it easier and faster for firms to find workers with the required skills, thereby lowering their hiring costs (adaptation and search costs). A market-level increase in the availability of skilled immigrant workers increases L^s by increasing L^I. The hiring cost function therefore is adapted to: $B_t[X_t] = \frac{1}{2} b_t[L^s] X_t^2$, where $b_t'[L^s] < 0$.

As in the previous model, we set up the profit maximization problem by focusing on two periods. The difference is that now the labour force consists of skilled native workers and skilled immigrant workers with separate competitive wages (w_N and w_I, respectively). Moreover, we assume that hiring costs are the same for skilled native and skilled immigrant workers. An alternative way of stating the same assumption is that possible differences in hiring costs between the two skilled labour inputs are fully translated into differences in wage levels. The profit maximization equation is now:

$$\begin{aligned} \max_{T_0, N_0, I_0} & A_0(\alpha N_0^{\rho} + (1-\alpha) I_0^{\rho})^{\frac{1}{\rho}} - w_0^N N_0 - w_0^I I_0 - \frac{1}{2} c_0 T_0^2 - \frac{1}{2} b_0[L^s](N_0 + I_0)^2 \\ & + A_1(\alpha N_1^{\rho} + (1-\alpha) I_1^{\rho})^{\frac{1}{\rho}} - w_1^N N_1 - w_1^I I_1 \\ & - \frac{1}{2} b_1[L^s]((N_1 + I_1) - (1-\delta)(N_0 + I_0) - (1-\gamma) T_0)^2 \end{aligned} \tag{3.10}$$

The FOC for training, skilled native workers, and skilled immigrant workers are:

$$T_0 : -c_0 T_0 + (1-\gamma) b_1[L^s]((N_1 + I_1) - (1-\delta)(N_0 + I_0) - (1-\gamma) T_0) = 0 \tag{3.11}$$

$$\begin{aligned} N_0 : A_0 \alpha N_0^{\rho-1} & (\alpha N_0^{\rho} + (1-\alpha) I_0^{\rho})^{\frac{1}{\rho}-1} - w_0^N - b_0[L^s](N_0 + I_0) \\ & + (1-\delta) b_1[L^s]((N_1 + I_1) - (1-\delta)(N_0 + I_0) - (1-\gamma) T_0) = 0 \end{aligned} \tag{3.12}$$

$$\begin{aligned} I_0 : A_0 (1-\alpha) I_0^{\rho-1} & (\alpha N_0^{\rho} + (1-\alpha) I_0^{\rho})^{\frac{1}{\rho}-1} - w_0^I - b_0[L^s](N_0 + I_0) \\ & + (1-\delta) b_1[L^s]((N_1 + I_1) - (1-\delta)(N_0 + I_0) - (1-\gamma) T_0) = 0 \end{aligned} \tag{3.13}$$

Inserting the three FOC into each other and solving for the three variables of interest (T_0, N_0, I_0), we obtain the following decision rule for training unskilled workers:

$$T_0 = \frac{1}{H_0 + 1}((N_1 + I_1) - (1-\delta) I_0 (G_0 + 1)) \tag{3.14}$$

where H_0 again defines the ratio between training and hiring costs, $H_0 \equiv \frac{c_0}{b_1[L^s](1-\gamma)^2}$, and where we express the first-period use of skilled labour $N_0 + I_0$ as a function of I_0 and G_0 which relates the first-period wages of skilled native to those of skilled immigrant workers, that is, $G_0 \equiv (\frac{1-\alpha}{\alpha}\frac{w_0^N}{w_0^I})^{-\sigma}$.

This comparison of equations 3.6 and 3.14 reveals that the difference in the training decision of firms between the model with and the model without immigration lies in the firms' dependence on the overall supply of skilled labour and the dependence of the training of unskilled native workers on the relative wages between skilled immigrant and skilled native workers.

To derive the decision rule for skilled native and skilled immigrant workers, we apply the standard CES solution to express the wages of skilled native workers to skilled immigrant workers, resulting in:

$$log\frac{N_0}{I_0} = \sigma * (log\frac{\alpha}{1-\alpha} - log\frac{w_0^N}{w_0^I}) \tag{3.15}$$

Thus the employment decision of skilled workers as in the Stevens' model does not depend on the number of trained unskilled workers. Nonetheless, the decision to train unskilled workers depends on (a) the future employment of skilled workers and (b) the current employment of skilled native and immigrant workers. The model shows that exogenous variables affect the decision to train workers in period 0 as follows:

$$T_0 = T(b_1[L^I + L^N]^+, c_0^-, \alpha^-, \frac{w_0^N(L^N)^+}{w_0^I(L^I)}) \tag{3.16}$$

An increase in the supply of skilled immigrant workers (an increase in L^I) has two opposing effects on firms' willingness to train. On one hand, with more skilled immigrant workers in the labour market to hire, hiring additional skilled workers becomes cheaper, due to lower hiring costs in period 1, reducing the firms' willingness to train (cost effect). The size of this effect depends on the extent to which the greater supply of skilled immigrant workers affects hiring costs. On the other hand, the greater availability of skilled immigrant workers increases the wage of skilled native workers relative to that of skilled immigrant workers $\frac{w_0^N}{w_0^I}$, because a larger supply of skilled immigrant workers shifts the market-level labour supply curve to the right, leading to a decrease in w_0^I.[15] The reduction

[15] We leave this channel implicit in the model. A possible approach to show this channel is to bring together our labour-demand framework with aggregate labour supply schedules for skilled native and skilled immigrant workers that are increasing in the respective market-level wage. At the labour market level, a greater supply of skilled immigrant workers leads to a reduction in their relative wage (see, e.g., Borjas, 2003).

in wage costs induces firms to hire more workers overall, incentivising them to train more unskilled workers. This scale effect depends on the degree of complementarity between skilled immigrant and skilled native workers, characterized by the elasticity of substitution σ between them. If skilled immigrant workers are perfect substitutes ($\sigma = \infty$), the scale effect is zero.

In sum, our model predicts that if skilled native and skilled immigrant workers are perfect substitutes, an increase in the availability of skilled immigrant workers decreases the firms' willingness to train, due to a reduction in future hiring costs (cost effect, no scale effect). Otherwise, an increase in the availability of skilled immigrant workers may have a decreasing, an increasing, or no effect on the firms' willingness to train, depending on the strength of the cost and scale effects.

3.4 Institutional background

This section explains the reform steps for firms coming from the agreement of the free movement of persons and provides an overview on the circumstances firms face when providing apprenticeships as part of dual vocational education and training in Switzerland.

3.4.1 Agreement on the free movement of persons

In 1999, Switzerland and the EU signed a bilateral agreement, called the 'Agreement on the Free Movement of Person' (hereafter, free movement policy), in which they agreed on free worker mobility for both Swiss and EU citizens within Switzerland and the EU. By lifting all restrictions against resident immigrant workers and CBWs, the reform that followed the free movement policy opened the Swiss labour market to all workers from EU countries. As Beerli et al. (2020, BRSP) show, the removal of restrictions for CBWs had a stronger effect on regions near the border. Conversely, the removal of labour market barriers to EU immigrants affected all Swiss regions uniformly, independent of their distance from the Swiss border. We focus on CBWs because of the regional differences in the effect of the free movement. We now give a brief overview of the free movement policy reform on CBWs (for a more detailed description, see BRSP).

Before the free movement policy was enacted, firms that wanted to hire CBWs were allowed to do so only under specific conditions. First, CBWs had to have lived at least six months within the border region[16] of their country of origin before obtaining permission

[16]Between 1928 and 1973, a set of municipalities – administrative entities along the lines of U.S. counties – located near on either side of the Swiss border with Austria, France, Germany and Italy had been defined bilaterally with each neighbouring country as border region. This border region did not follow any culture,

to work in Switzerland. Second, the firm had to show that no Swiss worker with skills equivalent to those of the CBW was available ('priority requirement'). Thus the priority requirement required firms to undergo a government-controlled CBW admission process, creating direct hiring costs because hiring CBWs took time and involved a waiting period.[17] Third, the Swiss hiring firm had to be situated within the Swiss border region, a set of well-defined Swiss municipalities located close to the border. Figure 3.1 shows the border region in Switzerland together with the estimated travel time to the closest border crossing. The border region had been defined bilaterally with each neighbouring country between 1928 and 1973 and did not follow any culture, religious nor administrative borders.

The implementation of the free movement policy was a stepwise process. It was approved by the Swiss parliament and signed in 1999. It then required the approval of each EU member state – and of the Swiss electorate, which ratified the policy in May 2000. BRSP's results indicate that firms in regions near the border experienced somewhat larger inflows of CBWs and immigrant workers between 2000 and 2002, possibly because cantonal[18] offices had started to handle CBW applications in a more relaxed way. Therefore, we allow for possible anticipation effects during this period.

The transition phase of the free movement policy started with a series of labour market liberalizations in 2002, when most pre-existing geographical and occupational restrictions for CBWs were lifted. First, Swiss firms in the border regions could now hire anybody from the neighbouring country, that is, the hiring zone was no longer restricted to the border region on the other side of the border. Second, CBWs were no longer required to have lived within the border region for at least six months. Third, CBWs were no longer obligated to go back home every day. Instead, they could live in Switzerland during the week and need to go home only once weekly. Fourth, their working permits were now generally valid for five years instead of one year, nor were they bound to a specific job. In sum, CBWs now enjoyed occupational and geographic mobility that made it easier for firms to hire them.

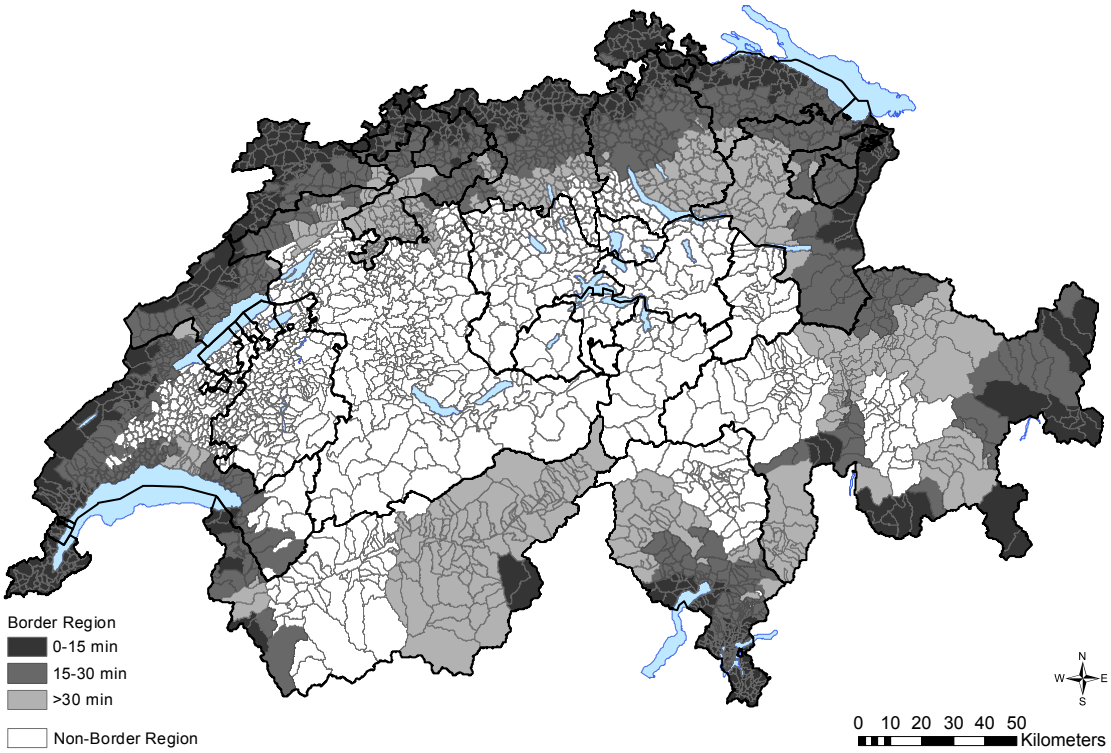
The liberalization in the border region ended in 2004, when Switzerland finally abolished the priority requirement. Swiss firms no longer had to prove that no equivalent

religious nor administrative borders. Figure 3.1 shows the border region in Switzerland, together with the estimated travel time to the nearest border crossing.

[17] To hire a CBW, firms had to prepare an application detailing the job requirements, the contract and working conditions offered. They also had to demonstrate that they had searched unsuccessfully in Switzerland, which generally meant that they had to search for a worker within Switzerland for a certain number of weeks. The processing of the application, handled by the cantonal and federal migration offices, lasted about one to three months. The migration offices evaluated each application individually, notably by comparing the job requirements with the qualifications of resident unemployed.

[18] In Switzerland a canton is a sub-regional entity similar to U.S. states.

Figure 3.1: Swiss border region by travel time



Source: Beerli et al. (2020)

Notes: This figure shows the municipalities belonging to the Swiss border region, differentiating in different shades of grey three travel times by car to the nearest border crossing. The regions belonging to the central regions are in white independent of their travel time. The cantonal borders are shown with black lines.

resident worker was available, and CBWs had unrestricted access to the workplaces at firms situated in the Swiss border region. Importantly, however, the liberalization period between 2002 and 2004 only affected the border region, because hiring CBWs remained restricted to firms located in the central region. This geographic restriction was dropped only in 2007, when all firms in the country gained permission to hire CBWs.

We use the step-wise implementation of the free movement policy to evaluate how an increase in the availability of foreign skilled workers affects the willingness of firms to train apprentices. As shown by BRSP, and as we show using our data, the policy had a disproportionate impact on the hiring of CBWs and immigrant workers in firms located in the border region very near the border. CBWs were almost exclusively hired by firms within 15 minutes of the nearest border crossing, both before and after the policy. Indeed, by 2010, CBWs represented almost a third of all workers in firms located within 5 minutes

of the border, an increase of 22% from 2000. Even today, CBWs are much less important in firms located with 15–30 minutes of the border, and irrelevant in firms located more than 30 minutes away.

One consequence is that the 2007 liberalization has limited empirical importance for our analyses, because only very few firms outside the former border region are located near enough to the border to be really affected. We thus follow BRSP's transparent DiD approach and assign firms in Switzerland to one of three groups, depending on their distance from the border: Firms are *highly treated* if they are located within 15 minutes of the border, *slightly treated* if they are located 15–30 minutes of the border, and in the *control group*[19] if they are located more than 30 minutes from the border. To avoid any bias from the abolition of the priority requirement, we discard the very few firms in the central region located less than 30 minutes from the border.

This discussion of the free movement policy contains two important insights into the interpretation of our results. First, like BRSP, we view the policy as an *increase in the availability of CBWs*, partly because the policy increased the geographical and occupational mobility of the pre-existing stock of CBWs and partly because it led to a reduction in hiring costs (e.g., by abolishing the priority requirement and by improving firms' chances to find skilled workers). We thus focus on the *reduced-form effects* of the free movement policy throughout, not presenting instrumental variable (IV) estimates. The IV approach would use the policy as an instrumental variable for the effect of the CBWs share on outcomes. However, the policy likely had effects on firms beyond those mediated through the increased employment share of CBWs, which would invalidate the exclusion restriction.

Second, the free movement policy opened the borders for Swiss CBWs to work in Switzerland's neighbouring countries. Yet despite lifting of all the restrictions, cross-border commuting out of Switzerland remained almost negligible, because it is financially unattractive: Both nominal wages and the cost of living are substantially higher in Switzerland. Therefore, the influx of foreign CBWs into Switzerland was nine times higher than the influx of Swiss CBWs into its neighbour countries (BRSP). Thus our estimates reflect the effects of a greater availability of foreign workers to Swiss firms, not the effects of a larger labour market on both sides of the border. For the same reason, we argue against the likelihood that the policy had an impact on the training decisions of Swiss firms via increased fear that foreign firms could poach their trained workers.

[19]The control group consists of firms located in the border region more than 30 minutes from the border and firms located in the central region more than 30 minutes from the border. We show the results for the two possible control groups when appropriate separately.

3.4.2 Vocational education and training in Switzerland

Every year, about two thirds of a cohort ending compulsory education in Switzerland start vocational education and training (VET). Thus VET is the largest programme at the upper-secondary education level and highly embedded in the Swiss education system. The federal act on vocational and professional education and training (VPETA) mandates the involvement of three partners (the federal government, professional organizations, and cantons) and defines their roles (SERI, 2020). The VPETA moreover mandates that each of the 240 training occupations has its own VET ordinance stating the content, length, learning sites, and qualification procedures. Therefore, VET is different from active labour market programmes or on-the-job training, both of which are less regulated and not part of the educational system.

The largest fraction (90%) of VET students, takes a dual VET track, where they spend about one to two days at vocational schools, obtaining formal education, and three to four days at a training firm (apprenticeship), learning practical skills and acquiring work experience. The dual VET programmes last between three and four years, during which students follow a structured national curriculum, culminating in a final external examination leading to a federal diploma. The federal diploma constitutes a national recognized certification ensuring a well-defined set of skills in each occupation. Given that these skills are transferable between firms within an occupation, trained apprentices are typically considered skilled workers (Mueller & Schweri, 2015). The Dionisius et al.'s (2009) cost-benefit calculations suggest that Swiss apprentices, by their final year, reach 75% of the productivity of an average skilled worker at a firm.

Firms decide on their own whether to participate in training apprentices, and providing apprenticeships is neither mandatory nor subsidized (Wolter et al., 2006). As long as firms comply with the regulations in the VPETA,[20] they may also freely decide in which of the 240 occupations they offer an apprenticeship and to whom. Schweri et al. (2003) present an overview of the factors influencing the costs and benefits of Swiss firms. Findings of the cost-benefit studies suggest that even during the training period roughly 60% of firms obtain a net benefit by participating in training apprentices (Strupler & Wolter, 2012). The other 40% of training firms incur net costs during the training period (Strupler & Wolter, 2012). These firms incurring a net cost are keener to keep their trained apprentices, so that poaching considerations play a role in their decision to train (Muehlemann et al., 2007; Muehlemann & Wolter, 2011).[21]

[20] Examples of such regulations are that firms have to obtain a training permit, firms and students need to sign an apprenticeship contract approved by the local cantonal authority (Art. 14 VPETA), and workplace trainers at firms need adequate training (Art. 45 VPETA).

[21] Nevertheless, even though only a third of all apprentices stay at their training firm within one year after graduating, the apprenticeship system works well (Moretti et al., 2019).

For our DiD approach to work it is essential that firms near the border and firms farther away were not differentially affected by some other reforms taking place during the same period as the implementation of the free movement policy. The Swiss VET system underwent one major reform during the implementation of the free movement policy, comprising a revision of the VPETA and including from 2004 onwards health, social, art, and agriculture and forestry occupations in the VET system (BBT, 2003). A priori, we do not expect that this reform affected regions near the border differently than regions farther away, given that the changes touched all cantons at the same time. We nevertheless show that the reform of the VET system (including the apprenticeships) does not drive our results by excluding the occupations most affected by this VET reform.[22]

3.5 Empirical strategy

In this section, we first describe our two datasets and explain what variables we use in our analyses. Second, we present our estimation method.

3.5.1 Data

Our empirical analyses are based on two datasets, one on establishment level, the other on firm level. The first is the Swiss business censuses from 1995, 1998, 2001, 2005, and 2008. In each year, the census provides information on total employment and the workforce composition of private and public establishments in Switzerland in September of that year. The census also provides information on the number of apprentices working in each establishment and gives the precise geo-coordinates of each establishment. We use this information to compute the travel time (by car) to the nearest border crossing.[23] We drop all establishments from the agricultural sector because they are not available for all waves. We also drop observations from a small number of establishments for whose assignment to the border or central region is unclear.

The other dataset consists of administrative and representative Swiss firm-level survey data from three waves (2000, 2004, 2009). These surveys contain unusually detailed information on firms' training behaviour and their costs and benefits for training apprentices, including their motives for training them. For a consistent dataset across waves, we

[22] Tables C.17 and C.18 display the estimations without the occupations carpenter, computer scientist, electrician, retail specialist, salesman. We find qualitatively no differences in the coefficients except for the training motive attracting skilled workers.

[23] We follow BRSP computing the travel time to the nearest border crossing in minutes by assigning each firm to its 1998 location. We use the same data as BRSP on the location of border crossings in Switzerland.

drop occupations that are either available only in 2004 and 2009 or not available for non-training firms.[24] As in the previous dataset, we drop observations if we are unsure about their assignment to a border or central region. We end up with 10,626 observations for non-training firms and 4,018 observations for training firms.[25] In contrast to the business census, where we have an indicator to follow an establishment over time and generate a panel dataset, we cannot link firms over time in the cost-benefit surveys so that this second dataset consists of cross-section data.

Using the cost benefit dataset, we analyse the effect of the free movement policy on the training behaviour and motives of firms for offering apprenticeships. We measure the training behaviour with a binary variable equal to one if a firm trains apprentices (trfirm), the inverse hyperbolic sine (IHS) of the number of apprentices that a firm trains (noappr, IHS[26]), the percentage of apprentices of the total employees in a firm (trintens), and the recrutive opportunity benefits (i.e., the costs saved by hiring a former apprentice instead of a worker from the external labour market; recopp, IHS).

We obtain training motives from a qualitative survey question asking about the importance of different training motives on a 5-point Likert scale (ranging from 1 not so important to 5 very important). Interestingly, non-training firms were asked to answer the question, too, though in a hypothetical fashion (see Table 3.1). The question was whether firms train – or would train – to attract skilled workers (skillw), save hiring costs (hirecost), avoid the risk of a poor hiring decision (poor), replace unskilled workers (uskillw), save adjustment costs (adjucost), hire the best young person (choice), avoid turnover (turn), train junior workers into skilled workers (train), or secure a talent pipeline in the sector/region (secur). For the exact and complete wording of the questions, see Table 3.1.

Table 3.2 gives the summary statistics of the variables from the cost-benefit dataset separately for non-training firms and training firms. The average number of apprentice is seven per training firm. The percentage of apprentices of the total employees – the training intensity – is 12.9% in these firms. The recrutive opportunity benefits for training firms is on average roughly 9,200 Swiss Francs.[27] For the training firms, the three most important motives for training apprentices are to secure a talent pipeline in the sector/region

[24] Those occupations are auto mechanic, carpenter, dental assistant, electronics technician, health specialist, logistics, medical practice assistant, painter, plumber, other 3-year VET programmes, and other 4-year VET programmes (in total, 3,663 observations).

[25] The observations for the recrutive opportunity benefits are 2,448 training firms (see Table 3.2).

[26] The inverse hyperbolic sine (IHS) of the number of apprentices accounts for the substantial amount of firms without students and the long right tail of the distribution. The transformation of the outcome y with IHS is $IHS(y) = ln(y + \sqrt{1+y^2})$. This transformation is attractive for the estimation on number of apprentices, because it approximates the log of the outcome and is still defined at 0 (Doran et al., 2014).

[27] One Swiss Franc corresponds to approximately one U.S. dollar.

Table 3.1: Questions on firms' training motives

Variable name	Question
	Training firm: For your firm, how important are the following reasons to train apprentices? **Non-training firm:** Assuming that your firm meets all the requirements and decided to start training apprentices, how important would the following aspects of training apprentices be for your firm?
skillw	Attracting skilled workers because it is hard to find qualified personnel on the external labor market
hirecost	Saving on the cost of hiring for personnel on the labor market
poor	Avoiding the risk of poor hiring decisions that comes with external hiring
uskillw	Replacing unskilled and semi-skilled workers with apprentices' training work
adjucost	Saving the money used for training (adjustment cost) external specialists
choice	Having the opportunity to hire the "best" young person as apprentices
turn	Avoiding high turnover by hiring specialists whose skills match your needs very closely
train	Training junior workers into skilled workers whose skills exactly match the company's requirements
secur	Securing a talent pipeline in the sector/region

Notes: The table presents the questions used in the cost-benefit survey to inquire the training motives of firms. Training firms got a direct question on their reason to train. Non-training firms are asked a hypothetical question if they immediately started with training. All firms had to rate the importance of each training motive on a 5-point Likert scale.

(3.97 out of 5), train junior workers into skilled workers (3.46), and attract skilled workers (3.42). The non-training firms report that they would train primarily to train junior workers into skilled workers (3.58), to attract skilled workers (3.49) and to secure a talent pipeline in the sector/region (3.43). Moreover, the table shows that training firms are on average somewhat larger than non-training firms, and that training firms are on average somewhat farther from the border and less likely to be located in the border region than non-training firms.

Table 3.2: Summary statistics of cost benefit data

	Non-training firms					Training firms				
	obs	mean	sd	min	max	obs	mean	sd	min	max
A. Dependent variables										
No of apprentices	10626	0.00	0.00	0.00	0.00	4018	6.64	42.65	1.00	1953.00
Training intensity	10626	0.00	0.00	0.00	0.00	4018	12.87	19.20	0.02	300.00
Opportunity benefits	10626	0.00	0.00	0.00	0.00	2448	9184	13407	0	64576
Attract skilled workers	10626	3.49	1.29	1.00	5.00	4018	3.42	1.17	1.00	5.00
Save hiring cost	10626	2.57	1.13	1.00	5.00	4018	2.64	1.09	1.00	5.00
Risk of poor hiring decision	10626	2.87	1.17	1.00	5.00	4018	2.80	1.11	1.00	5.00
Replace unskilled workers	10626	2.56	1.15	1.00	5.00	4018	2.54	1.13	1.00	5.00
Save adjustment cost	10626	2.81	1.18	1.00	5.00	4018	2.82	1.18	1.00	5.00
Hire the best young person	10626	3.09	1.22	1.00	5.00	4018	3.24	1.17	1.00	5.00
Avoid turnover	10626	3.09	1.19	1.00	5.00	4018	3.01	1.11	1.00	5.00
Train junior workers	10626	3.58	1.17	1.00	5.00	4018	3.46	1.11	1.00	5.00
Secure talent pipeline	10626	3.43	1.27	1.00	5.00	4018	3.97	1.02	1.00	5.00
B. Explanatory variables										
Duration	10626	4.30	2.18	1.00	8.00	4018	4.65	2.16	1.00	8.00
Border region	10626	0.73	0.44	0.00	1.00	4018	0.68	0.47	0.00	1.00
C. Control variables										
Firm size	10626	1.45	0.76	1.00	4.00	4018	2.72	1.13	1.00	4.00

Notes: The table presents number of observations (obs), mean, standard deviation (sd), minimum value (min), maximum value (max) of the main variables we use in the empirical analysis for non-training and training firms separately. The data is from the cost-benefit dataset. The first three dependent variables, number of apprentices (No of apprentices), training intensity within a firm, and the opportunity benefits saved from hiring an apprentice are only available for training firms. The following nine dependent variables, from attract skilled workers to secure talent pipeline, capture the training motives for non-training and training firms. The explanatory variables are the distance to the border, which we measure by the time it takes to get to the closest border (duration) and whether the firm is located within the previously defined border zone or not. As control variable we include the size of the firm. Further control variables not displayed in the table are year fixed effects and industry fixed effects.

3.5.2 Regression model

We estimate the effect of the greater availability of skilled workers on firms' training behaviour using a Difference-in-Differences (DiD) approach. Closely following BRSP, the DiD approach exploits the larger impact of lifting the labour market restrictions for CBWs on establishments near the border. For each firms (and in the census data for each establishment), we compute the travel time to the nearest border crossing (d_i) and assign it to one of three groups: firms located within 15 minutes of the border within the border region $I(d_i \leq 15)$, henceforth highly treated firms, firms located 15 to 30 minutes of the border within the border region, $I(15 < d_i \leq 30)$, henceforth slightly treated firms and firms more than 30 minutes of the border either within or outside the border region, henceforth untreated firms. The variables of interest are the interactions between the indicators of travel time with the indicators of the survey year (t). The survey year indicators take the value of one in their survey wave and zero otherwise. For the cost benefit data in

2000, 2004, and 2009, we estimate the following DiD model:

$$\begin{aligned} y_{i,t} =& \beta_{d1}[I(d_i \leq 15)] + \beta_{d1}^{t=2004}[I(d_i \leq 15) * I(t = 2004)] \\ &+ \beta_{d1}^{t=2009}[I(d_i \leq 15) * I(t = 2009)] + \beta_{d2}[I(15 < d_i \leq 30)] \\ &+ \beta_{d2}^{t=2004}[I(15 < d_i \leq 30) * I(t = 2004)] \\ &+ \beta_{d2}^{t=2009}[I(15 < d_i \leq 30) * I(t = 2009)] \\ &+ \alpha_i + \alpha_t + \varepsilon_{i,t} \end{aligned} \tag{3.17}$$

In this model, $y_{i,t}$ represents the training outcome of firm i in year t. The β coefficients capture the DiD of this outcome for highly treated firms and slightly treated firms *relative* to untreated firms (consisting of two control groups). We control for year fixed effects (α_t), which capture aggregate macroeconomic shocks common to all firms such as changes in aggregate prices and foreign demand. In the estimations with the business census data, we additionally include establishments fixed effects (α_i), which control for pre-existing differences between establishments and the regions in which they are located. Such differences could have been a direct result of the earlier cross-border policy that restricted the hiring of CBWs to establishments in the border region. In the estimations with the cost-benefit data we cannot include firms fixed effects, due to having three repeated cross-sections, therefore we control for important firm characteristics. These controls comprise a set of firm size fixed effects in four broad categories (0–9 workers, 10–49 workers, 50–99 workers and 100+ workers) and industry fixed effects (19 industries[28]).

The central identifying assumption of our research design is that, had the border not opened, the three regions would have had the same *change* in outcomes. This common trend assumption would be invalidated, for example, if there were unobserved third factors that affect the training behaviour of establishments or firms located near the border differently from establishments or firms farther away at the time of the border opening. Potential confounders are other concurrent reforms, such as the reform of the Swiss VET system mentioned in section 3.4.2, or unobserved region-specific shocks to prices, demand, or productivity. Such shocks could affect regions differently because of regional differences in the sectoral composition or the input mix and thus invalidate the common trend assumption.

[28]Those 19 industries are construction, food product and beverage manufacturing, textile and apparel manufacturing, wood and paper product manufacturing, chemical manufacturing, metal products manufacturing, machinery and equipment manufacturing, electrical equipment manufacturing, other manufacturing, trade and repair, food and beverage service activities, transport and telecommunication, financial services and insurance, real estate, IT, education, human health and social work, public administration, and other services.

Although with a DiD we cannot directly test the validity of the common trend assumption, BRSP provide an extensive set of robustness checks that support the validity of this assumption in the current setting. For example, they show that establishments both near and farther from the border displayed similar trends for a variety of establishment outcomes in the pre-free-movement-policy period. We provide additional evidence along these lines by generalizing the DiD model to an event study, with a focus on establishments' training behaviour. We also present several additional robustness checks specifically for the outcome variables studied in this chapter in section 3.6.3.

3.6 Results

In this section, we report descriptive and causal evidence for the effect of the opening of the border on the establishments' employment of immigrant workers and on firms' willingness to train.

3.6.1 Descriptive evidence

Using business census data, Table 3.3 compares the pre-reform characteristics of establishments in the four regions that we compare in our DiD estimation: establishments in highly treated regions (establishments within the border region up to 15 minutes of the border), slightly treated establishments (establishments within the border region 15–30 minutes of the border) and establishments in the two control groups (establishments more than 30 minutes of the border a) within the border region and (b) in the central region). We provide the statistics separately for establishments that exist in all census waves (panel A) – a balanced sample of establishments that forms the basis of our empirical results in section 3.6 – and for establishments with at least one apprentice in at least one census wave.

Table 3.3, first, suggests that the four regions are very comparable in their industry composition. BRSP additionally show that the regions are also comparable in terms of labour market size, important worker characteristics, and workers' mean log hourly wages. Nevertheless, we observe some important establishment differences across regions such as highly treated establishments being somewhat larger and more likely to be exporters than those in the two control groups. Second, even before the free movement policy, establishments in the border region had employed more foreign workers than establishments farther away. As expected, the table shows that employment of the CBWs before the policy was much larger in the treated regions. Third, the table suggests that neither control group is clearly more comparable to the highly treated region. Thus, the

Table 3.3: Establishment characteristics prior to the reform, by region

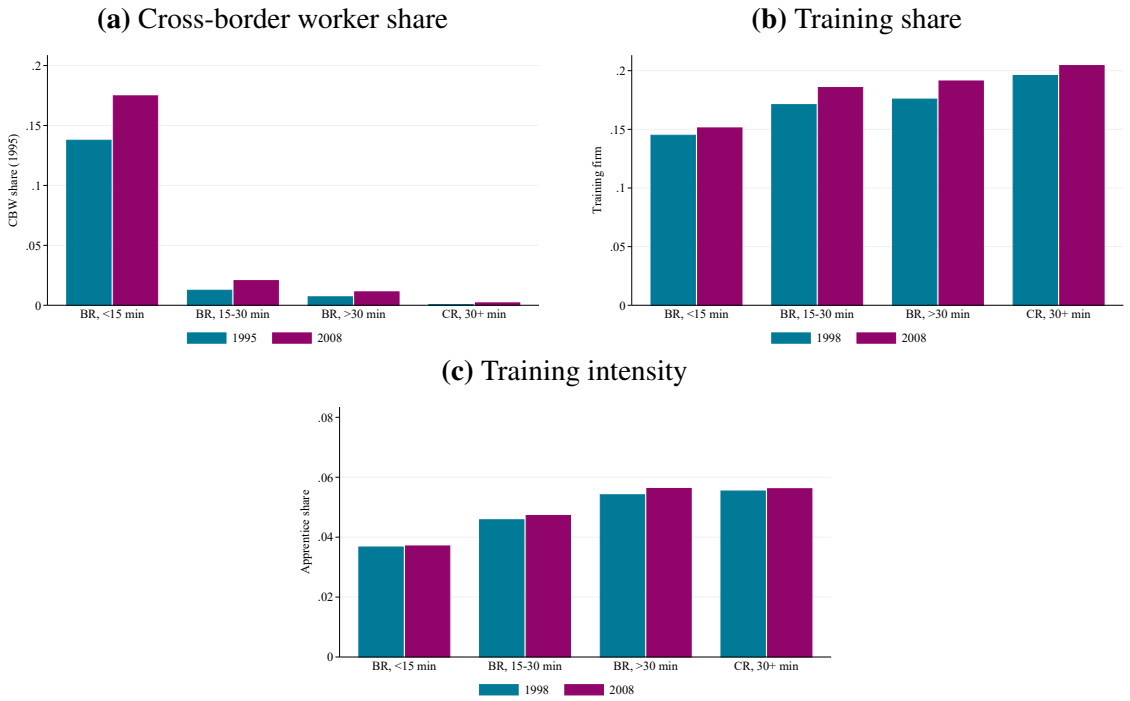
Travel time to border	**Border region**						**Central region**	
	$\leq$ 15 min		15–30 min		>30 min			
	mean	sd	mean	sd	mean	sd	mean	sd
A. Balanced sample								
FTE employment	11.46	(57.24)	12.14	(78.40)	9.53	(43.41)	9.89	(38.43)
Share of other foreigners (1995)	0.17	(0.27)	0.15	(0.25)	0.13	(0.24)	0.10	(0.21)
CBW share (1995)	0.08	(0.17)	0.01	(0.05)	0.00	(0.04)	0.00	(0.01)
Training (0/1)	0.21	(0.41)	0.25	(0.43)	0.25	(0.43)	0.28	(0.45)
Apprentice share	0.04	(0.11)	0.05	(0.12)	0.06	(0.13)	0.06	(0.13)
Manufacturer (0/1)	0.12	(0.32)	0.11	(0.32)	0.12	(0.33)	0.13	(0.33)
High-tech manufacturing (0/1)	0.03	(0.18)	0.03	(0.17)	0.03	(0.18)	0.03	(0.17)
Construction (0/1)	0.09	(0.28)	0.09	(0.29)	0.10	(0.30)	0.11	(0.31)
Publicly owned firm (0/1)	0.12	(0.33)	0.13	(0.33)	0.14	(0.34)	0.14	(0.35)
Exporter (0/1, 1995)	0.16	(0.37)	0.15	(0.35)	0.12	(0.33)	0.11	(0.31)
Importer (0/1, 1995)	0.26	(0.44)	0.26	(0.44)	0.22	(0.41)	0.21	(0.41)
Travel minutes to border	7.13	(3.54)	23.36	(4.07)	39.25	(9.92)	53.64	(13.58)
Observations	42623		55500		26905		55952	
B. Training establ. only								
FTE employment	23.08	(95.26)	23.11	(124.41)	18.00	(68.52)	17.64	(58.07)
Share of resident immigrants (1995)	0.17	(0.22)	0.16	(0.23)	0.14	(0.22)	0.10	(0.19)
Training firm (0/1)	0.61	(0.49)	0.64	(0.48)	0.66	(0.48)	0.68	(0.47)
Manufacturer (0/1)	0.14	(0.35)	0.14	(0.34)	0.15	(0.36)	0.15	(0.36)
Publicly owned firm (0/1)	0.09	(0.29)	0.09	(0.29)	0.10	(0.29)	0.09	(0.29)
Observations	14575		21315		10330		22796	

Notes: The table shows descriptive statistics of establishments in the border and non-border region (central region) using the business census (BC) in 1998. The data on CBW and other foreign workers refer to 1995 since the census in 1998 does not provide a breakdown of foreign employment in these two groups. The 'balanced sample' used in panel A comprises of all establishments existing throughout 1995–2008. The sample in panel B is additionally restricted to establishments that train at least one apprentice throughout 1995–2008. The border region is split into three groups depending on the travel duration to the nearest border crossing.

baseline approach in this chapter is to pool the two control groups and to show the robustness of the results to using the control groups separately.

Figure 3.2 shows the foreign employment percentage and the training provision of establishments in 1998 and 2008 using the business census data. We differentiate highly treated establishments, slightly treated establishments and establishments in the two control groups. Panel (a) of Figure 3.2 shows that CBWs are almost exclusively employed near the border. While CBWs make up more than a sixth of the workforce in border region establishments up to 15 minutes of the border in 2008, their employment percentage is very low more than 30 minutes from the border, both before and after the policy. The figure also reveals that the employment of CBWs increased substantially between 1995 and 2008. However, as holds for the stock of CBWs, the increase was concentrated in the regions nearest to the border. BRSP also show that this increase in CBWs between 1995 and 2008 occurred mainly after 2004, that is, after the complete lifting of border restrictions in the Swiss labour market for CBWs from the EU.

Figure 3.2: Employment of CBWs and apprentices in 1998 and 2008, by region of interest



Notes: Using data from the 1998 and 2008 business census, this figure shows the foreign employment share and the training provision of establishments. We differentiate highly treated establishments (establishments within 15 minutes of the border), slightly treated firms (establishments within 15–30 minutes of the border), and firms in the two control groups (establishments more than 30 minutes of the border a) within the border region and (b) in the central region). Panel (a) shows the employment percentage of CBWs. This is 1995 data, because the 1998 census provides no information on CBWs. Panel (b) shows the fraction of establishments training apprentices. Panel (c) shows the employment percentage of apprentices. The fractions in panels (a) and (c) are employment-weighted.

Panel (b) of Figure 3.2 shows the fraction of establishments engaged in training of apprentices in the four regions, and panel (c) shows the percentage of apprentices in total employment. The two figures yield two main insights. First, they demonstrate that the establishments' provision of apprenticeships has increased despite the introduction of the free movement policy within the 10-year period. While the percentage of apprentices remained constant between 1998 and 2008 in all regions, the percentage of establishments that train apprentices increased. Second, the figures demonstrate that establishments near the border provide remarkably fewer training positions than establishments located farther from the border.

These results are consistent with similar evidence in Aepli & Kuhn (2019), who argue that CBWs displace apprentices. However, other differences between regions near and farther from the border could explain the lower incidence and intensity of apprenticeship

training near the border. For example, the difference could result from the higher percentage of importers and exporters near the border (see table 3.3) because Swiss firms with international exposure tend to have a lower propensity to train apprentices (Muehlemann, 2014). Our DiD approach controls for such time-invariant differences between firms and labour markets across regions by focusing solely on *changes* in firms' propensity to train as a response to a large exogenous change in the availability of CBWs.

Figure 3.3 provides information on firms' training behaviour when we use the cost-benefit data. Given that the data represents a sample of the population, we also provide confidence intervals. Comparing Figures 3.2 and 3.3 reveals that the data of both datasets show similar patterns regarding the levels, regional distribution, and changes in training activities. The cost-benefit data, therefore too, suggests that firms nearer to the border train fewer apprentices than firms farther away (panels (a) and (b) of figure 3.3). Except for firms farther than 30 minutes from the border within the border region, the cost-benefit data also suggests that firms' participation in training apprentices increased from 2000 to 2009.

Panel (c) of Figure 3.3 exploits that the cost-benefit surveys provide a direct monetary measure of the costs that firms save by hiring a former apprentice instead of an external skilled worker. The panel suggests that the recrutive opportunity benefits are lower for firms near the border, consistent with their lower provision of training. Moreover, between 2000 and 2009, we observe a decrease in these costs for highly treated firms but an increase for firms in the two control groups. If we interpret the difference in costs from 2000 to 2009 between firms near and farther from the border as a DiD estimate, the results thus suggest that the opening of the border had a negative effect on recrutive opportunity benefits.

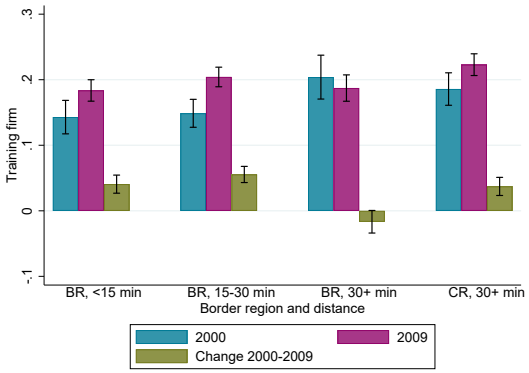
3.6.2 Effect on the employment of immigrant workers

Using the DiD framework explained in section 3.5.2, this section extends BRSP analyses to show that the policy led to a larger increase, in establishments training apprentices, in the hiring of immigrant workers in the two treated groups than in the two control groups.

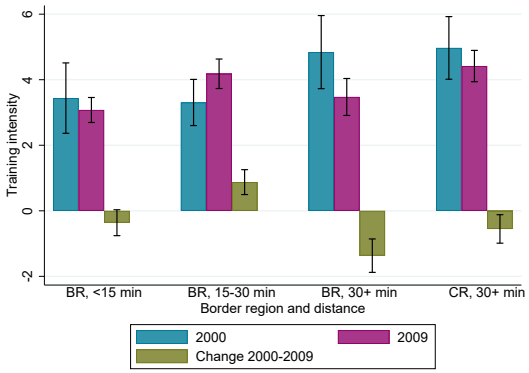
Using data from the business census 1995–2008, Figure 3.4 shows the dynamics of changes in the employment of foreign workers in establishments near the Swiss border compared to those farther away. Using a generalization of our main DiD model (equation (3.17)) that estimates separate effects for each census year, the figure plots the estimated policy effects and associated 95% confidence intervals. We standardize the 1998

Figure 3.3: Firms' training behaviour in the cost-benefit data, by region of interest

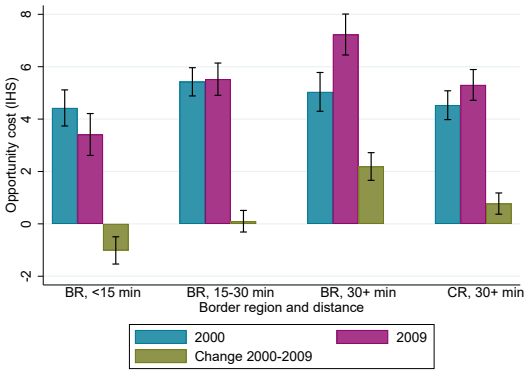
(a) Training share



(b) Training intensity



(c) Recrutive opportunity benefit (training firms only)



Notes: Using the cost-benefit data this figure shows (a) the training behaviour of all firms in 2000 (blue) and 2009 (teal), and (b) the change between 2000 and 2009 (green) by region of interest. We differentiate highly treated establishments (establishments within 15 minutes of the border), slightly treated firms (establishments within 15–30 minutes of the border), and firms in the two control groups (establishments more than 30 minutes of the border a) within the border region and (b) in the central region). Panel (a) shows the percentage of firms participating in training. Panel (b) shows firms' training intensity (the percentage of apprentices per regular worker). Panel (c) shows the recrutive opportunity benefits of training firms (IHS), that is, costs that training firms save by hiring a former apprentice instead of an external skilled worker in the external labour market. The data contains sample weights. The black lines show the standard errors.

effects to zero by excluding the indicator for that year from the regression. Our main dependent variable is the total number of foreign workers – CBWs plus resident immigrant workers in Switzerland – relative to an establishment's total employment in 1998.[29]

[29] As we expect that skilled immigration may affect the size of firms through the scale effect discussed in the theoretical section, we standardize the number of immigrant workers by total employment (native and foreign workers) in 1998, the last year before the free movement policy.

In panel (a), we estimate effects for all highly and slightly treated establishments. Panel (b) presents the same results focusing only on establishments that train at least one apprentice throughout the sample period. Following BRSP, our baseline sample with the census data is a balanced panel of establishments throughout 1995–2008. Balancing the sample is one way to ensure that our results are not driven by compositional biases, which could arise because the free movement policy led to the entry of new firms in the highly treated region.[30] To allow for arbitrary dependence between units within the same commuting zone (both cross-sectional dependence and over time), we cluster standard errors at the level of commuting zones.

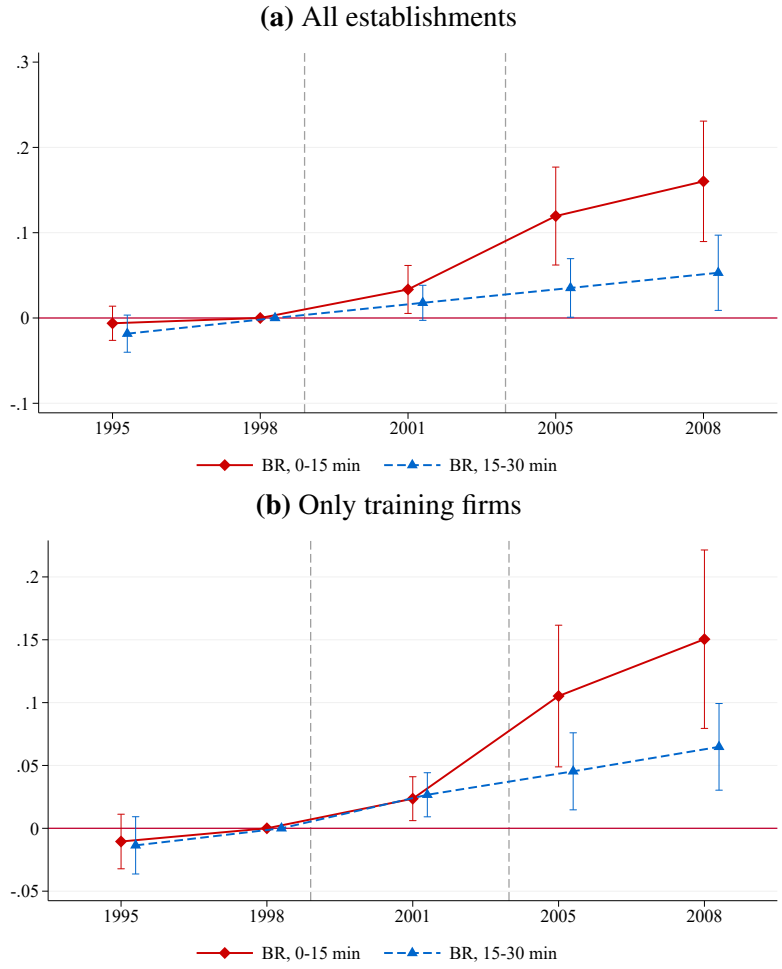
The two panels of Figure 3.4 and the corresponding DiD regressions presented in the columns 1–3 of Table 3.4 clearly show that the free movement policy had a disproportionate effect on the hiring of foreign workers in the regions nearest to the border. The number of immigrant workers as a percentage of 1998 employment grows consistently more in highly treated establishments after 1998, and to a lesser extent in slightly treated establishments, compared to establishments in the control regions. By 2008, the policy led to an increase in the percentage by about 15%-points in highly treated establishments. Importantly, the estimated effect is very similar in establishments that employ at least one apprentice throughout 1995–2008 (panel (b)), suggesting that the opening of the border had an important effect on the hiring behaviour of establishments that train apprentices. As expected, we find a smaller, but still highly statistically significant policy effect on slightly treated establishments.

Finally, none of the estimates for pre-trends is significantly different from zero at the 95% confidence level, suggesting that the trends in the employment of immigrant workers were similar in establishments near the border and either control group in the 1995–1998 period. BRSP show that this holds for a range of additional firm-level outcomes such as firm size, productivity, and innovation activities. They also show that it holds for a longer pre-treatment period than the three-year period covered in the used data. Estimating the effect of the border opening on the employment of foreign workers by highest educational attainment and occupation, BRSP also show the policy primarily caused the additional hiring of *skilled* workers.

Overall, the results presented in this section thus suggest that the opening of the Swiss labour market to CBWs had a strong and disproportionate impact on the employment of (skilled) foreign workers among firms that provide apprenticeships near the border.

[30]For example, new firms are likely to be smaller on average than incumbent firms, because they are just setting up. Smaller firms have a lower probability to train apprentices than larger firms (Muehlemann & Wolter, 2007b). The entry of new firms thus likely reduces the percentage of firms that train in the highly treated region. This effect might lead us to overstate a possible negative effect of the free movement policy on the training of apprentices.

Figure 3.4: Effect of free movement policy on immigrant employment in establishments



Notes: The figure shows the effect of the free movement policy on the employment of immigrant workers in establishments using data from the Swiss business censuses 1995–2008. It plots the estimated policy effects and associated 95% confidence intervals using a generalization of our main DiD model (equation (3.17)) that estimates separate effects for each census year. We standardize the effects to 0 in 1998 by dropping the indicator for that year from the regression. The estimation sample comprises all establishments existing throughout 1995–2008. The dependent variable is the number of immigrant workers (CBWs plus foreign resident immigrant workers) relative to total employment in 1998. In Panel (a), we estimate effects for all highly treated establishments (establishments within 15 minutes of the border) and slightly treated establishments (establishments within 15–30 minutes of the border) in the balanced sample. Panel (b) presents the same regression results focusing on establishments that train at least one apprentice throughout the sample period. The control group in both panels is establishments more than 30 minutes from the border. Regressions are weighted using establishments' average employment in the estimation period as weight. All regressions account for establishment and period fixed effects. Standard errors are clustered on the level of commuting zones.

Table 3.4: Effect of free movement policy on immigrant employment and provision of apprenticeships

VARIABLES	(1) OLS Immigrants/ workers in 1998	(2) FE Immigrants/ workers in 1998	(3) FE Immigrants/ workers in 1998	(4) OLS Training prov. 0/1	(5) FE Training prov. 0/1	(6) OLS Appr/ workers in 1998	(7) FE Appr/ workers in 1998	(8) FE Appr/ workers in 1998
$Transition_t * I(d_i \leq 15)$	0.051***	0.037***	0.029***	-0.000	-0.006	-0.003	-0.006	-0.007
	(0.017)	(0.012)	(0.009)	(0.002)	(0.004)	(0.004)	(0.005)	(0.007)
$Transition_t * I(15 < d_i \leq 30)$	0.019	0.027***	0.033***	0.003	0.002	-0.001	-0.004	-0.005
	(0.012)	(0.010)	(0.009)	(0.002)	(0.002)	(0.005)	(0.005)	(0.007)
$Free_t * I(d_i \leq 15)$	0.135***	0.143***	0.133***	-0.006	-0.007	-0.014**	-0.014**	-0.018*
	(0.031)	(0.030)	(0.031)	(0.005)	(0.006)	(0.005)	(0.007)	(0.009)
$Free_t * I(15 < d_i \leq 30)$	0.056**	0.053**	0.062***	0.003	0.004	-0.002	-0.007	-0.010
	(0.025)	(0.021)	(0.016)	(0.003)	(0.003)	(0.007)	(0.005)	(0.008)
Observations	1,442,654	904,900	345,080	1,878,844	904,900	1,442,654	904,900	345,080
R-squared	0.008	0.528	0.494	0.004	0.716	0.003	0.567	0.559
Balanced sample	No	Yes	Yes	No	Yes	No	Yes	Yes
Establishment FE	No	Yes	Yes	No	Yes	No	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weights	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Training establ. only	No	No	Yes	No	No	No	No	Yes
Mean dep. variable	.221	.210	.218	.171	.243	.058	.069	.180

Notes: This table shows the effect of the free movement policy on immigrant employment and the provision of apprenticeships using our main DiD model (equation (3.17)). The regressions are based on data from the business censuses (BC) 1995–2008. $Transition_t$ captures the effect of the transition period of the reform and is a dummy variable equal to one in the census year 2001. $Free_t$ captures the effect of the free movement period of the reform and is a dummy variable equal to one in the census years 2005 and 2008. The sample in column 1, 4 and 6 is all establishments in the BC. The 'balanced sample' used in the remaining columns comprises of all establishments existing throughout 1995–2008. The sample in columns 3 and 8 is additionally restricted to establishments that train at least once throughout 1995–2008. The dependent variable in columns 1–3 is the number of immigrants (CBW plus foreign resident immigrants) relative to total employment in 1998. The dependent variable in columns 4 and 5 is a dummy variable equal to 1 if an establishment trains apprentices in a given census year. The dependent variable in columns 5–7 is the number of apprentices relative to total employment in 1998. Regressions in columns 1–3, and 6–8 are weighted using establishments average employment in the estimation period as weight. ***, **, *, denote statistical significance at the 1%, 5% and 10% level, respectively.

3.6.3 Effect on the firms' provision of training

The essential question of this chapter is whether the substantial hiring of foreign workers affected firms' provision of apprenticeships. We analyse this question in this section primarily using the census data on establishments.

Columns 4 and 5 of Table 3.4 analyse whether the free movement policy affected the probability that firms provide at least one training position. We do this for an OLS specification using all establishments in each census, hence the entire universe of establishments in Switzerland, without including establishment fixed-effects (column 4), and for our baseline fixed effects specification that uses the balanced sample of establishments existing throughout 1995–2008 (column 5). Neither regression provides evidence that the policy affected establishments' propensity to train apprentices. The estimated effects are statistically insignificantly different from zero and are precisely estimated. Indeed, the estimated effect of the policy on the propensity to train is positive, albeit not statistically significant for *slightly* treated establishments.

Did the free movement policy affect the number of apprenticeships that establishments provide? Our main outcome variable to study this question is the number of apprentices relative to establishments' total employment in 1998, consistent with the specification of the outcome used in the previous section. Column 7 of Table 3.4 shows the effect of the free movement policy on this outcome for our baseline specification. We weight the estimates using establishments' average employment. Panel (a) of Figure 3.5 shows the corresponding event study results by plotting the estimated policy effects in each census year both for highly treated and slightly treated establishments.

The regressions suggest that the greater availability of skilled foreign workers due to the free movement policy may have slightly reduced the firms' provision of apprenticeships. Relative to the two control groups, the number of apprenticeships as a percentage of total employment in 1998 in highly treated establishments begins to decline gradually after 1998. By 2008, the negative point estimate becomes statistically significant at the 5% level. The estimated effects are also negative for slightly treated establishments after 1998 but never statistically significant.

Panel (b) shows that establishments in the construction and service sectors drive the negative effect of the policy on highly treated establishments primarily. In manufacturing firms, which also hired many additional cross-border workers (as shown in BRSP), we find no evidence for displacement of apprenticeships. Importantly, both figures suggest that establishments displayed parallel trends in the number of apprentices in the three-year period in each sector before the policy, consistent with our assumption that establishments would display parallel trends in the outcome had there been no policy change.

In panel (c) of Figure 3.5, we compare the estimated impact of the free movement policy on the number of apprenticeships in highly treated establishments to the effect on the hiring of foreign workers. The comparison reveals that the reduction in apprentices is orders of magnitude smaller than the increase in foreign employment. Taken at face value, the estimates suggest that each foreign worker hired by highly treated firms displaces roughly 0.1 apprenticeships. However, in contrast to the large and sharp increase in the employment of foreign workers within the same establishments, the policy effects emerge gradually over an extended period. On one hand, the reduction in apprenticeships in highly treated establishments may thus represent a change in the training behaviour of firms as a consequence of the policy. On the other hand, our DiD estimates may at least partly capture a continuation of a general trend decline in the training provision of firms near the border, a trend that started before the policy.

It is therefore not surprising that the estimate of the effect of the free movement policy on the number of apprenticeships is sensitive to the inclusion of more demanding sets of fixed effects and to variations in the specification of the regression model. In particular, panel (c) of Table 3.5 shows that the policy effect on the number of apprentices becomes statistically insignificant, smaller or both if we use border region establishments more

than 30 minutes of the border as the sole control group (columns 1), if we do not weight observations by establishment size (column 3), and if we control for period fixed effects by two-digit industry (column 4) or by NUTS-II region (column 5).[31] Moreover, the effect disappears when we control for canton-period fixed effects and compare changes only in the outcomes of establishments located in the same Swiss canton (column 6), or when we restrict the sample to two-digit industries unaffected by either of the other bilateral agreements that were introduced along with the policy.[32]

Similarly, we obtain no evidence for displacement effects if we use the cost-benefit surveys conducted in 2000, 2004, and 2009 to estimate the effect of the free movement policy. This holds, both for all firms, as shown in columns 1–3 of Table 3.6, and for training firms only, as shown in columns 4–6 of Table 3.6. In fact, in slightly treated firms, we find evidence that the training intensity *increased* significantly in 2009 with this data. We obtain similar regression results with this data when we use the two control regions separately, do not control for firm size, or cluster standard errors by canton (see appendix tables C.12 through C.14).[33] In contrast, the estimates of the policy effect on immigrant employment (panel (a) of Table 3.5) and of the dummy whether firms provide apprenticeship training (panel (b)) are much more robust to variations in the regression model.

Taken together, these findings suggest that the greater availability of CBWs may have had no impact or at worst, may have slightly reduced firms' willingness to provide apprenticeships. In general, however, the results rule out strong displacement effects. In turn, they also suggest that apprentices did not profit from the free movement policy, in contrast to tertiary-qualified workers (see BRSP).

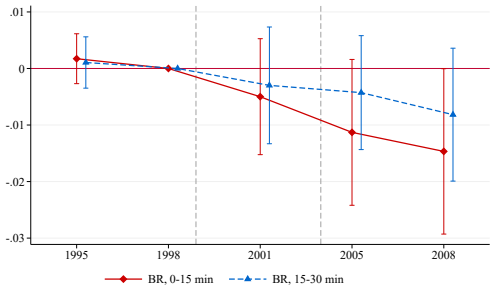
[31] The only exception is that the estimated effects on immigrant employment becomes smaller when we do not use employment weights (column 3). This finding suggests that the free movement policy effect on the hiring of foreign workers was larger in large firms. However, the estimated effect on the number of apprentices (panel (c)) is also comparatively smaller in this specification, so that the relative effect on foreign workers and apprentices is very similar to that in our baseline specification.

[32] As discussed by BRSP, the free movement policy was part of a package of bilateral agreements between the EU and negotiated at the same time as the AFMP. One of these agreements, for example, reduced non-tariff barriers to trade between Switzerland and the EU. This trade liberalization may have affected regions near the border more than the regions farther away. BRSP thus use a proxy for exposure to these other agreements based on a classification by Buehler et al. (2011) who study how the trade liberalization caused by the bilateral agreements affected establishment growth in Switzerland. BRSP carefully assess the extent to which a specific two-digit industry was affected by the six other bilateral agreements next to the free movement policy. BRSP assign industries to three categories: not affected, affected, and strongly affected. In column 7 of Table 3.5, we use only non-affected industries.

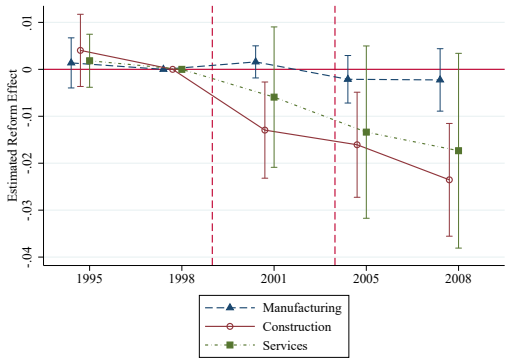
[33] The alternative clustering in Table C.14 suggests that our heteroscedasticity-robust standard errors in Table 3.6 may actually be conservative.

Figure 3.5: Effect of free movement policy on apprentices

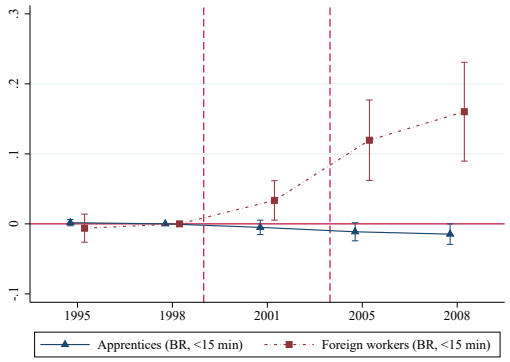
(a) Apprentices / total workers in 1998: by distance to border



(b) Apprentices / total workers in 1998: by broad sector



(c) Comparison of effect size



Notes: The figure shows the effect of the free movement policy on the establishments' provision of apprenticeships using data from the Swiss business censuses 1995–2008. It plots the estimated policy effects and associated 95% confidence intervals using a generalization of our main DiD model (equation (3.17)) that estimates separate effects for each census year. We standardize the effects to 0 in 1998 by dropping the indicator for that year from the regression. The estimation sample comprises all establishments existing throughout 1995–2008. The dependent variable is the number of apprentices relative to total employment in 1998. In Panel (a), we estimate effects for highly treated establishments (establishments within 15 minutes of the border) and slightly treated establishments (establishments within 15–30 minutes of the border). In Panel (b), we focus on highly treated establishments and present DiD coefficients estimated separately by the broad sector of economic activity. The control group in all panels is establishments more than 30 minutes from the border. Panel (c) compares the estimated policy effect on the number of apprenticeships in highly treated establishments with the effect on the hiring of foreign workers (Figure 3.4). The regressions are weighted using establishments average employment in the estimation period as weight. All regressions account for establishment and period fixed effects. Standard errors are clustered on the level of commuting zones.

Table 3.5: Main robustness checks

VARIABLES	(1) FE Control: BR, 30+	(2) FE Control CR	(3) FE Unweighted	(4) FE Industry-period FE	(5) FE NUTS-II-period FE	(6) FE Canton-period FE	(7) FE No exposure to bilaterals
			A. Immigrants / total workers in 1998				
$Transition_t * I(d_i \leq 15)$	0.035**	0.037***	0.012***	0.031**	0.041***	0.048***	0.033**
	(0.015)	(0.014)	(0.004)	(0.012)	(0.011)	(0.018)	(0.013)
$Transition_t * I(15 < d_i \leq 30)$	0.026**	0.028**	0.005	0.024**	0.028***	0.024**	0.032**
	(0.012)	(0.011)	(0.004)	(0.010)	(0.009)	(0.011)	(0.014)
$Free_t * I(d_i \leq 15)$	0.122***	0.152***	0.060***	0.125***	0.125***	0.140**	0.127***
	(0.040)	(0.029)	(0.013)	(0.026)	(0.034)	(0.062)	(0.034)
$Free_t * I(15 < d_i \leq 30)$	0.033	0.063***	0.018***	0.043**	0.041	0.035	0.058**
	(0.036)	(0.018)	(0.005)	(0.019)	(0.026)	(0.036)	(0.026)
Observations	625,140	770,375	904,900	904,896	904,495	904,900	582,068
			B. Training provision (0/1)				
$Transition_t * I(d_i \leq 15)$	-0.006	-0.006*	-0.006	-0.006	-0.003	-0.000	-0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)
$Transition_t * I(15 < d_i \leq 30)$	0.002	0.002	0.002	0.002	0.002	0.003	0.003
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$Free_t * I(d_i \leq 15)$	-0.007	-0.007	-0.007	-0.005	-0.003	0.003	0.001
	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)	(0.003)	(0.005)
$Free_t * I(15 < d_i \leq 30)$	0.004	0.004	0.004	0.005*	0.003	0.003	0.007**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)
Observations	625,140	770,375	904,900	904,896	904,495	904,900	582,068
			C. Apprentices / total workers in 1998				
$Transition_t * I(d_i \leq 15)$	-0.001	-0.008	-0.002	-0.006	-0.005	0.000	-0.000
	(0.002)	(0.007)	(0.002)	(0.005)	(0.004)	(0.002)	(0.003)
$Transition_t * I(15 < d_i \leq 30)$	0.002	-0.006	0.000	-0.004	-0.003	0.002	0.000
	(0.002)	(0.007)	(0.001)	(0.005)	(0.004)	(0.002)	(0.002)
$Free_t * I(d_i \leq 15)$	-0.007	-0.017*	-0.007**	-0.012*	-0.012***	-0.001	-0.005
	(0.005)	(0.009)	(0.003)	(0.007)	(0.004)	(0.004)	(0.005)
$Free_t * I(15 < d_i \leq 30)$	0.000	-0.010	-0.001	-0.005	-0.007*	-0.001	-0.002
	(0.003)	(0.008)	(0.002)	(0.006)	(0.004)	(0.002)	(0.003)
Observations	625,140	770,375	904,900	904,896	904,495	904,900	582,068
Establishment FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-period FE	No	No	No	Yes	No	No	No
Nuts-II-period FE	No	No	No	No	Yes	No	No
Canton-period FE	No	No	No	No	No	Yes	No

Notes: This table shows the robustness of the effect of the free movement policy on immigrant employment and training using our main DiD model (equation (3.17)). The regressions are based on data from the business censuses 1995–2008. The estimation sample comprises all establishments existing throughout 1995–2008. All regressions account for establishment fixed effects and period fixed effects. $Transition_t$ captures the effect of the transition period of the reform and is a dummy variable equal to one in the census year 2001. $Free_t$ captures the effect of the free movement period of the reform and is a dummy variable equal to one in the census years 2005 and 2008. The dependent variable in panel (a) is the number of immigrants (CBW plus foreign resident immigrants) relative to total employment in 1998. The dependent variable in panel (b) is a dummy variable equal to 1 if an establishment trains apprentices in a given census year. The dependent variable in panel (c) is the number of apprentices relative to total employment in 1998. Regressions in panels (a) and (c) (except those in column 3) are weighted using establishments average employment in the estimation period as weight. The regression in column 1 restricts the control group to firms in the border region located more than 30 minutes away from the border. The regression in column 2 restricts the control group to firms in the border region located outside the border region. Column 3 presents unweighted regressions. In columns 4–6, we control for (NACE rev. 1.1 two-digit) industry-period fixed effects (FE), NUTS-II-period FE, and canton-period FE, respectively. The regressions in column 7 are restricted to two-digit industries that are unaffected by the bilateral agreements according to the classification by Buehler et al. (2011). Standard errors are clustered by commuting zone. ***, **, *, denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 3.6: Effect of the free movement policy on firms' training behavior

	All firms			Training firms		
	(1) trfirm Coef./SE	(2) noappr Coef./SE	(3) trintens Coef./SE	(4) noappr Coef./SE	(5) trintens Coef./SE	(6) recopp Coef./SE
$I(d_i \leq 15)$	-0.060***	-0.092***	-1.403**	-0.043	-0.325	-0.497
	(0.018)	(0.026)	(0.649)	(0.053)	(2.696)	(0.623)
$I(d_i \leq 15) * I(t = 2004)$	0.005	0.016	-0.452	-0.000	0.194	1.662*
	(0.028)	(0.040)	(1.029)	(0.076)	(3.479)	(0.982)
$I(d_i \leq 15) * I(t = 2009)$	0.040	0.072	0.972	0.137	-2.231	-1.856
	(0.038)	(0.062)	(0.941)	(0.090)	(3.066)	(1.142)
$I(15 < d_i < 30)$	-0.046***	-0.064***	-1.343**	-0.022	-1.731	0.428
	(0.016)	(0.023)	(0.530)	(0.048)	(1.809)	(0.579)
$I(15 < d_i \leq 30) * I(t = 2004)$	0.028	0.048	1.232	0.069	3.086	0.381
	(0.026)	(0.039)	(0.989)	(0.066)	(2.813)	(0.847)
$I(15 < d_i \leq 30) * I(t = 2009)$	0.038	0.054	1.796**	0.106	1.824	-0.797
	(0.029)	(0.046)	(0.803)	(0.067)	(2.353)	(0.979)
Observations	14644	14644	14644	4018	4018	2448
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm size FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents the estimation results of the free movement policy on the training behavior of firms in the cost-benefit data. The first three DiD estimations are based on OLS regressions of aggregate cross-sections for all firms in 2000, 2004 and 2009. The latter three DiD estimations are based on OLS regressions of aggregate cross-sections for training firms in 2000, 2004 and 2009. The dependent variable training firm (trfirm) is 0 for firms not training apprentices and 1 otherwise. The dependent variable number of apprentices (noappr) is 0 for firms not training apprentices and IHS of the number of apprentices otherwise. The dependent variable training intensity (trintens) is 0 for firms not training apprentices and else the fraction of apprentices among all workers. The dependent variable recrutive opportunity benefits (recopp) is the IHS of the amount of Swiss francs a training firm saves from hiring a former apprentice instead of recruiting on the external labor market. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

3.6.4 Effect on the training motives of firms

Consistent with our theoretical considerations, the evidence presented in the prior section provides mixed evidence whether a greater availability of skilled workers reduces the firms' provision of apprenticeship training. In contrast, the theoretical framework clearly suggests that a larger supply of skilled immigrant workers lowers the future savings in terms of hiring costs associated with training. This mechanism, in itself, lowers firms' motives to train apprentices. In this section, we study the importance of this mechanism by exploiting the unique qualitative and quantitative questions on firms' training motives and training costs contained in the cost-benefit surveys (see section 3.5.1).

We start by examining how firms' motives to provide apprenticeships changed between 2000 and 2009. To this end, Figure 3.6 shows the importance of each training motive covered in the dataset per region of interest. In line with our model, the figure

first suggests that attracting skilled workers is an important reason why firms provide apprenticeship training. If we focus on the changes in training motives between 2000 and 2009, panel (a), (h), and (i) of the figure suggest that attract skilled workers, train junior workers into skilled workers, and secure a talent pipeline in the sector/region became less important training motives over time.

Consistent with an effect of the policy on the importance of these motives, the reductions are most pronounced for firms situated near the border. Similarly, panels (b), (c) and (g) indicate that the training motives to save hiring costs, to avoid the risk of a poor hiring decisions, and to avoid turnover became less important for firms near the border while they became more important for firms located farther away. It is conceivable that the policy played a role in driving these trends by making it easier for firms to find skilled workers in the external labour market.

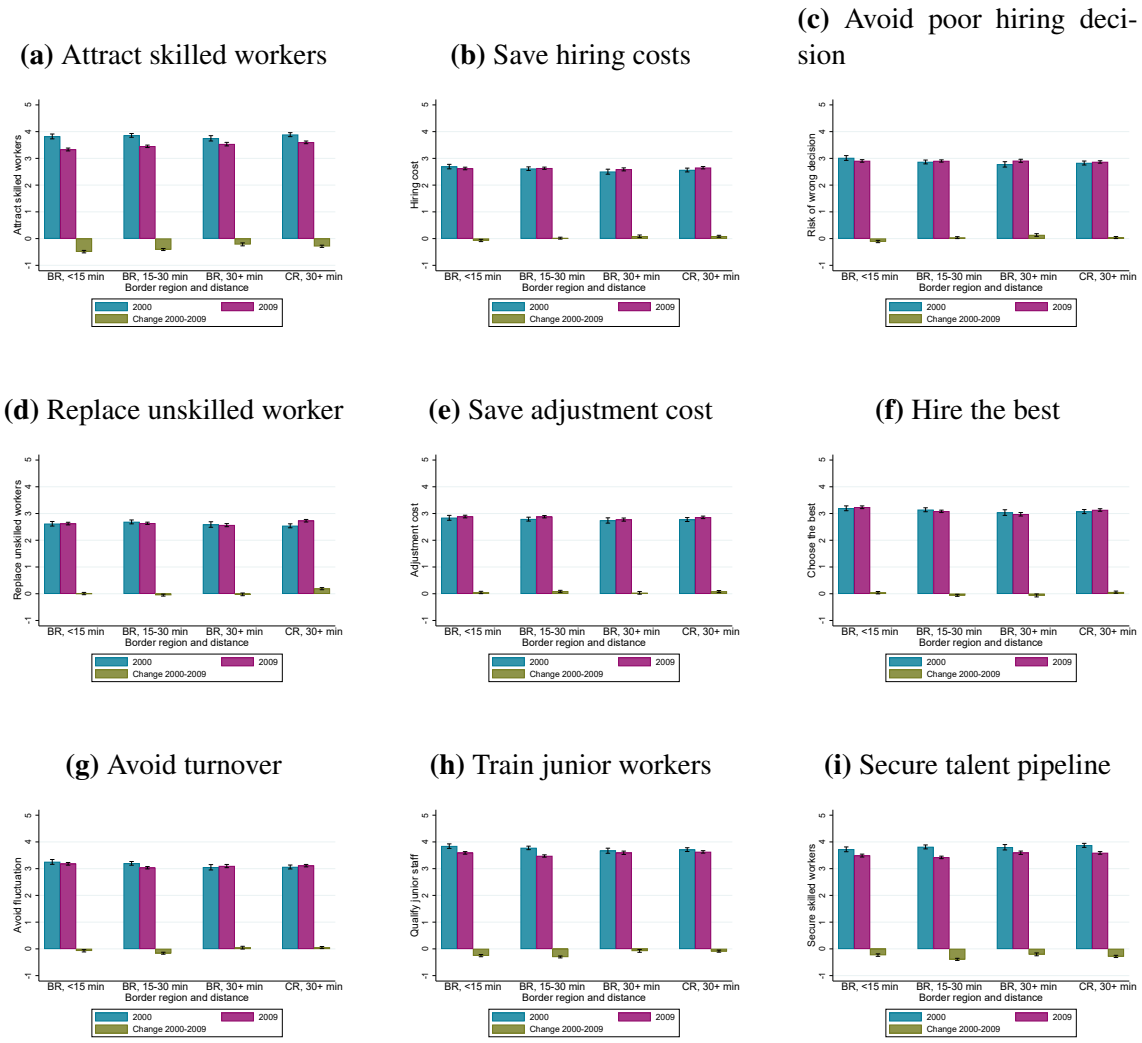
Using an ordered probit regression model based on our DiD model (equation (3.17)), Table 3.7 formally analyses whether the greater availability of skilled workers affected firms' training motives by reducing problems to find and thus the financial consequences to hire them.[34] Although the statistical precision varies, the table overall provides robust evidence that the free movement policy indeed influenced firms' training motives. In particular, the regressions confirm that the policy made it less important for highly treated firms to train apprentices to attract skilled workers (column 1), to save hiring costs (column 2), to avoid the risk of poor hiring decisions (column 3), and to train junior workers into skilled workers (column 8). We also find evidence that free movement policy reduced the importance of the training motives to attract skilled workers, to avoid turnover and to train junior workers into skilled workers among slightly treated firms.

To allow an assessment of the size of these effects, we compute predictive margins for each of the five possible values of survey items. We find, for example, that the policy increased the probability that highly treated firms think that having skilled worker is a less important training motive by about 2.4%-points. The probability that it is a very important motive decreased by 6.5%-points (see Table C.3). Similarly, we find that the policy increased the probability that saving hiring costs is no important training motive at all by 4%-points (see Table C.4). We find no effect of the policy on the motives to replace *un*skilled workers (Table C.6), save on adjustment costs (Table C.7), hire the best young person (Table C.8) and secure a talent pipeline in the sector/region (Table C.11).

These results raise the possibility that the free movement policy reduced the costs that firms save due to hiring a former apprentice instead of a worker from the external labour market. We study how the policy affected the recrutive opportunity benefits (IHS) in column 6 of Table 3.6. The regression provides no statistically significant evidence that

[34] Appendix table C.15 shows that the results are similar if we use a linear probability model where the outcome is 1 if the firms consider the respective motive as important or very important and zero otherwise.

Figure 3.6: Importance of firms' training motives, by region of interest



Notes: This figure shows firms' motives to provide apprenticeships according to the cost benefit surveys in 2000 (blue) and 2009 (teal), as well as the change between 2000 and 2009 (green). We differentiate highly treated firms (firms within the border region within 15 minutes to the border), slightly treated firms (firms within the border region 15–30 minutes away from the border) and firms in the two control groups (firms within the border region more than 30 minutes away from the border and firms outside the border region). The motives shown in each panel are the following: (a) train to attract skilled workers; (b) train to save hiring costs; (c) train to avoid the risk of poor hiring decisions; (d) train to replace unskilled workers; (e) train to save adjustment costs; (f) train to hire the best young person; (g) train to avoid turnover; (h) train to train junior workers into skilled workers; (i) train to secure a talent pipeline in the sector or region.

the policy affected these costs. The larger decline in the recrutive opportunity benefits between 2000–2009 in highly treated firms compared to the control groups evidenced in

panel (c) of Figure 3.3 is thus not statistically significant once we control for various firm characteristics. Importantly, however, if we differentiate the effect by the broad sector of economic activity (construction, manufacturing, traded services, knowledge-intensive services and the public sector, see Tables C.1 and C.2 in the appendix), we find relatively strong evidence that the opening of the border significantly reduced recrutive opportunity benefits for highly treated manufacturers.

Table 3.7: Effect of the free movement policy on firms' training motives

	(1) skillw Coef./SE	(2) hirecost Coef./SE	(3) poor Coef./SE	(4) uskillw Coef./SE	(5) adjucost Coef./SE	(6) choice Coef./SE	(7) turn Coef./SE	(8) train Coef./SE	(9) secur Coef./SE
main									
$I(d_i \leq 15)$	0.021	0.131**	0.181***	0.049	0.058	0.103	0.171**	0.169**	-0.092
	(0.068)	(0.066)	(0.069)	(0.067)	(0.068)	(0.067)	(0.069)	(0.069)	(0.068)
$I(d_i \leq 15) * I(t = 2004)$	0.046	-0.016	-0.190*	0.053	0.013	-0.077	-0.108	-0.202**	0.102
	(0.103)	(0.099)	(0.101)	(0.098)	(0.100)	(0.101)	(0.102)	(0.101)	(0.102)
$I(d_i \leq 15) * I(t = 2009)$	-0.195**	-0.155*	-0.168**	-0.088	-0.020	0.024	-0.101	-0.199**	0.058
	(0.090)	(0.085)	(0.080)	(0.098)	(0.091)	(0.088)	(0.088)	(0.090)	(0.102)
$I(15 < d_i < 30)$	0.025	0.055	0.050	0.110*	0.020	0.065	0.118**	0.084	-0.019
	(0.059)	(0.058)	(0.060)	(0.061)	(0.059)	(0.059)	(0.057)	(0.059)	(0.061)
$I(15 < d_i \leq 30) * I(t = 2004)$	-0.178**	0.041	-0.034	-0.062	0.021	-0.090	-0.121	-0.198**	-0.081
	(0.089)	(0.089)	(0.089)	(0.088)	(0.087)	(0.088)	(0.086)	(0.089)	(0.089)
$I(15 < d_i \leq 30) * I(t = 2009)$	-0.107	-0.056	-0.036	-0.137	0.011	-0.062	-0.171**	-0.210**	-0.093
	(0.083)	(0.072)	(0.071)	(0.088)	(0.074)	(0.081)	(0.074)	(0.083)	(0.084)
Observations	14644	14644	14644	14644	14644	14644	14644	14644	14644
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm size FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents the estimation results of the free movement policy on the training motives of firms in the cost-benefit data. All DiD estimations are based on ordered probit regressions of aggregate cross-sections for all firms in 2000, 2004 and 2009. The dependent variables attract skilled workers (skillw), save hiring cost (hirecost), avoid the risk of poor hiring decision (poor), replace unskilled workers (uskillw), save adjustment costs (adjucost), hire the best young person (choice), avoid turnover (turn), train junior workers into skilled workers (train), and secure talent pipeline (secur) come from qualitative survey questions on the importance of these training motives (5-point Likert scale, where 1 is not important and 5 is very important). We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Similarly, when differentiating between firms that train according to the investment approach, that is, to hire the apprentice after training, and firms that train according to the production approach, that is, to use the apprentice for production during training, we find that the policy significantly decreased the recrutive opportunity benefits for highly treated training firms that follow an investment approach (see Table C.16 in the Appendix). The intertemporal considerations when training apprentices that we highlight in our theoretical model are likely to be particularly important for firms that follow an investment approach.

Overall, the results in this section support our view that the opening of the Swiss labour market, by increasing firms' access to the pool of skilled CBWs, reduced firms' motive to train apprentices to secure a talent pipeline that fit their firm-specific needs. The

qualitative survey evidence suggests that the free movement policy likely reduced firms' hiring costs through this channel.

3.7 Conclusion

This chapter analyses the effect of opening the Swiss labour market to CBWs on the employment of (skilled) foreign workers, the firms' provision of apprenticeships to unskilled native workers, and the training motives of firms. We exploit the step-wise implementation of the agreement on the free movement of persons (free movement policy), which affected the mobility of CBWs near the Swiss border earlier and stronger than the central region of Switzerland.

We find that the free movement policy increased the number of (skilled) foreign workers in the firms situated near the border that provide apprenticeships. However, this increase in CBWs did not, or at most slightly, displace apprentices. The estimates suggest that ten additional CBWs replace between zero and one apprentices. In addition, we find a significant reduction on firms' motive to train apprentices to secure a talent pipeline that fit the firm-specific requirements, which indicates that the policy most likely reduced the hiring costs of firms. We also find direct evidence that the policy decreased the importance of training apprentices to reduce hiring costs for skilled workers. Overall, our findings are consistent with our theoretical framework, in which skilled foreign workers and skilled native workers are imperfect substitutes.

For policymakers our results underline that restricting the influx of skilled foreign workers is unnecessary to secure training of unskilled native workers. This finding is especially important for countries suffering from skills shortage and thinking about importing skilled foreign workers.

Our findings might suffer from two limitations. First, our estimates do not capture possible general equilibrium effects. The far-reaching reform might have affected all firms in Switzerland, but our estimates only capture the differences of the effect between firms that were more and less exposed to the policy. Second, unfortunately our data is limited to the period after 1995 so that we are not able to show pre-trends for a long pre-treatment period. While the number of immigrant employed at highly treated firms exhibits a clear break at the time the policy takes place, the evidence is less clear for the number of apprentices, where we only observe a gradual excess decline in the employment of apprentices in highly treated firms after the policy. This evidence cautions us from drawing strong conclusions from the marginally significant negative effects on the training of apprentices in the baseline regression model.

Chapter 4

Meet the need: The role of vocational education and training for the youth labour market[1]

4.1 Introduction

Due to spectacularly high youth unemployment rates in many countries since the 2008 financial crisis, the media has drawn great attention to the labour market of young people. However, not all countries experienced a decline in their youth labour market during that time (e.g. Renold et al., 2014). While some countries (e.g. Germany) managed to lower their youth unemployment rates, others (e.g. France and Switzerland) have kept it relatively constant. One possible explanation for these different trends lies in the variation between national education systems, as they are responsible for providing young people with the skills they need on the labour market. This function of forming human capital is also called the human capital function of education (Klieme et al., 2007).

According to a report by the Organisation for Economic Co-operation and Development (OECD) and the International Labour Organization (ILO; OECD & ILO, 2014) promoting vocational education and training (VET) can improve the youth labour market by better satisfying its needs. Indeed, studies on the outcome of education theorize that VET programmes, which teach vocational skills and prepare for specific occupations or types of occupations[2], should meet the requirements of the labour market better

[1] This chapter is joined work with Thomas Bolli and Ladina Rageth. This version is forthcoming in KYKLOS - International Review of Social Sciences.

[2] In this chapter the term 'occupation' describes the profession for which a young person receives training. We take a generic approach, in which occupation is synonymous with vocation or trade.

than purely general education programmes, i.e. programmes teaching general skills (e.g. Mueller & Shavit, 1998; Wolbers, 2007; Bol et al., 2013). They argue that through these VET programmes, students learn occupation-specific skills that are directly applicable in the workplace when entering the labour market (Correa, 1965). Critics argue that VET might be an advantage only in the short-run, while in the long-run, occupation-specific skills might restrict employees' mobility and become obsolete before adapting to new technologies (e.g. Hampf & Woessmann, 2017; Hanushek et al., 2017). However, the empirical evidence on the long-run effects of VET remains inconclusive (e.g. Oosterbeek & Webbink, 2007; Malamud & Pop-Eleches, 2010; Hall, 2016; Forster et al., 2016; Choi et al., 2019; Korber & Oesch, 2019; Korber, 2019; Middeldorp et al., 2019; Roezer & Bol, 2019).

In addition, an institutional link between the education system and the labour market is necessary if an education system is to best fulfil its human capital function (e.g. Eichmann, 1989; Hannan et al., 1996; Mueller & Shavit, 1998; Rageth & Renold, 2019). Scholars argue that programmes with a high amount of workplace training enhance such an institutional link (e.g. van de Werfhorst, 2011; Bol et al., 2013; Levels et al., 2014). VET programmes fall into one of two categories: school-based VET programmes (where instruction mostly takes place in a school environment) and dual VET programmes (where the skills are taught both at school and in the workplace). As the high amount of workplace training in dual VET programmes facilitates such an institutional link, these programmes are most likely to provide human capital needed to successfully enter the labour market (e.g. van de Werfhorst, 2011; Bol et al., 2013; Levels et al., 2014).

To analyse the role of the education system in shaping the youth labour market, this chapter focuses on the relation between different upper-secondary education programmes (general education, school-based VET and dual VET; OECD, 2004) and the youth labour market for the 20- to 24-year-olds. We measure the extent of the different upper-secondary education programmes by their enrolment rates, provided by the OECD. We expect both school-based and dual VET programmes to have a positive impact on the youth labour market, in comparison to general education, whereas dual VET should outperform school-based VET. However, with higher enrolment rates, we expect diminishing advantages for both kinds of VET programmes for two reasons. First, general equilibrium effects change the labour market value of an educational degree depending on the number of people having the same degree (Heckman et al., 1999). Second, Lazear (1999) argues that diversity in skills and knowledge is beneficial for the performance of firms.

A great amount of studies explore the individual labour market outcomes of education (for an overview see, e.g. Wolter & Ryan, 2011, Cedefop, 2013, Zimmermann et al., 2013, or Eichhorst et al., 2015). Some of these studies apply a multilevel approach, considering institutional differences between national education systems (e.g. van der Velden

& Wolbers, 2001; Gangl, 2003; Bol et al., 2013; Levels et al., 2014) and are comparable to the studies at the country level (e.g. OECD, 1998; Breen, 2005; Noelke, 2011). In line with our argument that the advantages of VET are diminishing, i.e. VET effects the labour market situation differently depending on the fraction of students enrolled in a VET programme, some studies take into account a possible non-linear effect (Gangl, 2003; Wolbers, 2007; van de Werfhorst, 2011; Levels et al., 2014; Hanushek et al., 2017; Forster et al., 2016).

The majority of these studies find that higher enrolment rates in school-based VET and dual VET, respectively, are advantageous for the labour market of young people with a VET degree. Although these studies confirm the importance of considering non-linearity, the majority exhibit unexpected findings of increasing advantages or disadvantages for VET programmes. These findings' inconsistency with theoretical predictions could be the result of limitations in the unobserved heterogeneity treatment of these studies and of the different labour market indicators. We contribute to this literature by using country-level panel data, which improves the identification strategy through increasing the reliability of our estimations, and by considering a broad set of outcome indicators.

In this chapter, the sample includes an unbalanced panel of 36 countries for 2004 through 2014. We apply generalized method of moments (GMM) regressions to investigate the effects of the education programmes on the youth labour market and the possible non-linear general equilibrium effects. Using the first-difference GMM approach accounts for autocorrelation, reversed causality and time-invariant unobserved heterogeneity. Including the data of adults for each dependent variable further tackles unobserved heterogeneity in labour market developments. In addition, we consider the temporal structure of the effect by lagging the enrolment rates by three years.

To ensure that our outcome indicator is not driving our findings we include 10 youth labour market indicators: four measures of labour market integration; six of job quality. The indicators for labour market integration are the unemployment rate, the relaxed unemployment rate, the neither-in-employment-or-education-or-training (NEET) rate and incidence of long-term unemployment. The indicators measuring job quality are the temporary contract rate, the involuntary part-time work rate, the atypical working hours rate, the skills mismatch rate, the in-work at-risk-of-poverty rate and the average hourly earnings.

In addition, as previous studies compare the impact of total VET, including both school-based VET and dual VET programmes, or solely dual VET, to general education, the literature might not sufficiently account for all upper-secondary education programmes. We therefore differentiate between the impact of school-based VET and dual VET, and compare them both to one another and to general education.

We find that the effects of school-based VET and dual VET are significantly different for seven out of ten outcome indicators. School-based VET significantly worsens the

incidence of long-term unemployment and temporary contract rate indicating a negative effect on the youth labour market. In contrast, our results confirm that dual VET significantly improves the youth labour market, i.e. integration and job quality. Most of these effects decrease with higher enrolment rates, highlighting that accounting for their non-linearity is important. In sum, our findings for dual VET align with theoretical prediction: dual VET appears to better meet the needs of the youth labour market than school-based VET or general education, but at a decreasing rate. In contrast, our findings for school-based VET are unexpected: higher enrolment rates in school-based VET have a negative effect on the youth labour market situation, though at a decreasing rate eventually leading to a better labour market situation. Importantly, therefore, when enrolment rates in school-based VET are low, these programmes might be worse than general education, for both labour market integration and job quality.

One explanation for this unexpected result could be the heterogeneity of school-based VET programmes in terms of quality and labour market orientation, since, for example, the consideration of 21st century skills, such as social skills, critical thinking or problem solving, might differ. If this heterogeneity correlates with the extent of school-based VET programmes, higher enrolment rates could result in a stronger commitment of politicians and employers. Another explanation is that the availability of other education programmes may influence students' quality and composition in a programme (Muehlemann & Wolter, 2007a; van de Werfhorst, 2011). With a higher fraction of students enrolled in school-based VET programmes, more able students enter these programmes since there is no better alternative.

This chapter proceeds as follows: Section 4.2 summarises the theoretical background from which we derive our hypotheses and reviews the empirical literature. Section 4.3 presents our empirical design, including the description of the data and the methodology, and section 4.4 describes our results. Section 4.5 concludes and discusses the implications of the empirical findings.

4.2 Literature review and hypotheses

4.2.1 Theoretical background

Education has several functions in societies (e.g. Fend, 2006), including the human capital function. This function states that education has to form young people's human capital by providing them with necessary skills and knowledge to prepare them for entering the labour market (Klieme et al., 2007). To be able to fulfil this human capital function and help students achieve a favourable skills match, education programmes need to both know and meet the requirements of the labour market.

Throughout the world countries show considerable variation in their education systems, particularly at the upper-secondary level (Zimmermann et al., 2013). In most countries, this level corresponds to the final stage of secondary education and has a typical entry age of 15 or 16. Using the amount of vocational content and the education and training locations, the OECD (2004) divides formal upper-secondary education into general education programmes and VET programmes.[3] Whereas general education programmes typically prepare students for further academic education, VET programmes prepare them for direct entry into a particular occupation or a range of occupations by combining practical training with occupation-specific theory and some general education. These VET programmes either take place mainly at school (school-based VET programmes) or they can combine school and workplace education and training (dual VET programmes; OECD, 2004).[4]

Many scholars argue that VET programmes ought to fulfil the human capital function better than general education programmes. They emphasize that VET programmes entail occupation-specific elements that align content closely to particular occupations and to the labour market demand, thereby reducing the problem of education-to-job mismatch or the training costs of employers (van der Velden & Wolbers, 2001; Wolbers, 2003; Levels et al., 2014). In addition, the workplace training in VET programmes strengthens the institutional link between the education system and the labour market (e.g. van de Werfhorst, 2011; Bol et al., 2013; Levels et al., 2014). This link is stronger in dual VET programmes, which include a significantly higher amount of workplace training. Especially in countries with extensive VET programmes, employers are already involved in the curriculum set-up (van de Werfhorst, 2011). In addition, the workplace training allows students to apply theoretical learning in a practical setting (Wolter & Ryan, 2011), so that the knowledge they acquire at school becomes productivity relevant (Mauro & Carmeci, 2003).

As dual VET entails a high amount of both occupation-specific elements and workplace training, we could argue that a national education system could best fulfil the human capital function if it had only dual VET programmes. However, Hong & Page (2004) develop a formal model showing that groups with members of diverse abilities find better solutions than groups with only high ability members. Furthermore, Lazear (1999) argues that firms gain from a varied workforce, because it brings diverse sets of skills and knowledge. This gain is largest when groups of employees have disparate skill sets, e.g. general

[3] We consider VET programmes as formal and part of the education system if they are 'explicitly deemed to be part of the education system and an education authority has oversight of them' (OECD, 2004, p. 39).

[4] In some of the previous literature, dual VET programmes are also called 'apprenticeship programmes' (e.g. Wolter & Ryan, 2011). However, as apprenticeship can also be purely on-the-job training, it does not always refer to dual VET programmes.

and vocational skills. Thus a workforce diversified in terms of academic and VET degrees increases productivity (Backes-Gellner et al., 2017). Moreover, general equilibrium effects change the value of educational degrees on the labour market (Heckman et al., 1999), a value that depends on the fraction of people with the same educational degree on the labour market. Thus an educational degree has a higher value if fewer people graduated from the programme and a lower value if a great many people did. We therefore expect the advantage of an education programme to diminish with higher enrolment rates.[5]

Given this theoretical background we derive our hypotheses on the relation between VET and the youth labour market. We measure the extent of VET in a country by the enrolment rates in school-based VET and dual VET. In our first two hypotheses, we argue that these two VET programmes, which ensure both the occupation-specific skills that the labour market demands and an institutional link between the education system and the labour market through workplace training, should improve the youth labour market more than general education programmes. However, as a mixture of education programmes is likely to best serve the labour market, we can expect a non-linear relation between enrolment rates in education programmes and youth labour market outcomes, as the following two hypotheses make clear:

H1: Increasing the enrolment rates of students in school-based VET programmes improves the youth labour market but at a decreasing rate.

H2: Increasing the enrolment rates of students in dual VET programmes improves the youth labour market but at a decreasing rate.

Moreover, the higher amount of workplace training implies an advantage of dual VET over school-based VET on the youth labour market. We therefore formulate our third hypothesis as follows:

H3: Increasing the enrolment rate of students in dual VET programmes improves the youth labour market more than increasing the enrolment rate of students in school-based VET programmes.

4.2.2 Empirical evidence

Many studies focus on the individual labour market outcomes of VET, especially in comparison to general education (for an overview see, e.g. Wolter & Ryan, 2011, Eichhorst et al., 2015, Cedefop, 2013, Zimmermann et al., 2013, or Kriesi & Schweri, 2019). These studies, however, do not report consistent results (e.g. Shavit & Mueller, 2000; Ryan, 2001; Iannelli & Raffe, 2007). Nevertheless, they indicate that the effect of VET is more likely positive if the indicator for the labour market outcome is employment rather than

[5]This argument assumes that the heterogeneity within dual VET and school-based VET programmes, respectively, remains constant over time within countries.

income or occupational level (Ryan, 2001; Iannelli & Raffe, 2007). The literature provides three possible explanations for this inconsistent empirical evidence on the impact of VET on the labour market outcomes of young people. First, Wolter & Ryan (2011) argue that the challenge of finding convincing methods for determining the effects of VET on individuals – for example due to self-selection into the programme – might be one reason for this inconsistency.

Second, some scholars suggest that country-level differences in the institutional setting of VET could also explain why findings differ between studies (e.g. Gangl, 2003; Bol et al., 2013; Cedefop, 2013). Some studies therefore take this institutional effect into account by controlling for differences in the institutionalisation of VET or in the vocational specificity mostly measured by the fraction of students enrolled in VET programmes (e.g. van der Velden & Wolbers, 2001; Wolbers, 2003; De Lange et al., 2014; Barbieri et al., 2018). These studies find that education systems with high enrolment rates in VET programmes – especially in dual VET – result in better integration of young people into the labour market (OECD, 1998; van der Velden & Wolbers, 2001; Breen & Buchmann, 2002; Gangl, 2003; Breen, 2005; Wolbers, 2007; Noelke, 2011; Bol et al., 2013; De Lange et al., 2014; Busemeyer & Thelen, 2015). However, the evidence for the relation between high enrolment rates in VET and young people's job quality remains mixed (van der Velden & Wolbers, 2001; Gangl, 2003; Wolbers, 2003; van de Werfhorst, 2011; Levels et al., 2014; Busemeyer & Thelen, 2015).

Third, Wolter & Ryan (2011) argue that differences between countries in the scale of VET, especially of dual VET programmes, might be an explanation for this heterogeneity. Thus a few studies include the interaction of an individual's VET degree with a country's fraction of students enrolled in VET programmes (Gangl, 2003; Wolbers, 2007; van de Werfhorst, 2011; Levels et al., 2014; Forster et al., 2016), or investigate individual educational outcomes for different country groups based on their VET enrolment rates (Hanushek et al., 2017). In doing so these scholars consider a possible non-linear effect of VET on youth labour market outcomes and thus account for the argument that a mixture of education programmes should best serve the youth labour market.

Table 4.1 provides an overview of these non-linear studies about the impact of VET on the youth labour market. While all studies use cross-sectional micro data, they differ in terms of the estimation method. Taken together, they use three approaches to account for unobserved heterogeneity between countries. First, one study separately analyses different country clusters based on their fraction of upper-secondary VET students, thereby including country fixed effects (Hanushek et al., 2017). Second, some studies use multilevel analyses including observable variables on both the individual and country level, and random effects at the country level (e.g. Gangl, 2003; Wolbers, 2007; van de Werfhorst, 2011; Levels et al., 2014), whereas one study includes country fixed effects (Forster et al., 2016). Third, some studies control for the general labour market, i.e. they include the

adult unemployment rate (Wolbers, 2007; Gangl, 2003). While four studies use either labour market integration or job quality indicators to measure the youth labour market, two studies use both. Most studies compare the impact of total VET or dual VET to general education; only Levels et al. (2014) compares the impact of school-based VET to general education by investigating the impact of total VET conditional on dual VET.

For the effect of total VET enrolment on youth labour market integration, Forster et al. (2016) and Hanushek et al. (2017) show that the positive effect of VET on initial employment is even stronger with higher enrolment in both total VET and dual VET. Regarding the effect of total VET on young people's job quality, the literature provides inconsistent findings. Van de Werfhorst (2011) finds that the negative effect of having a VET degree on earnings increases with higher VET enrolment rates. In contrast, Levels et al. (2014) show that with increasing school-based VET enrolment rates[6], the positive effect of having a VET degree on the match of young people's job to the level of their VET degree (vertical education-to-job match) decreases.

For dual VET, Hanushek et al. (2017) find that with higher enrolment rates in dual VET relatively more young people with a VET degree are employed. In contrast, Wolbers (2007) shows that having more dual VET increases the negative effect of VET on being inactive and decreases the positive effect on entry speed to the first significant job[7] (Wolbers, 2007). A look at job quality reveals that higher enrolment rates in dual VET increase the education-to-job match for the field of study (horizontal match) and the level of education (vertical match) for young people with a VET degree (Levels et al., 2014). In addition, the negative effect of having a VET degree on the occupational status[8] decreases with increasing dual VET enrolment (Wolbers, 2007).

In sum, thus far we find only little evidence for a non-linear effect of dual VET and school-based VET on the youth labour market. Moreover, the majority of this evidence is not in line with our hypotheses, as they find that higher enrolment rates in dual VET and school-based VET is beneficial for youth labour market integration and the quality of jobs for young people with a VET degree (Hanushek et al., 2017; Forster et al., 2016; Levels et al., 2014; Wolbers, 2007). The exceptions are Wolbers (2007) on labour entry speed and Levels et al. (2014) on vertical education-to-job match. Two possible reasons for the unexpected and inconsistent findings are as follows: first, the estimation methods of these studies come with certain limitations. Whereas the multilevel analysis accounts for unobserved heterogeneity between countries, the sample split does so only to a limited extent. However, multilevel analyses have the drawback of assuming the unobservable

[6]Levels et al. (2014) looks at the effect of total VET conditional on the one of dual VET.

[7]The first significant job 'includes all non-marginal jobs of at least about 20 hours per week that have lasted for at least 6 months' (Wolbers, 2007, p. 194)

[8]The occupational status is determined by the International Socio-Economic Index ISEI.

variables to be uncorrelated with all observed variables. Second, a substantial difference between both outcome indicators and in the impact of dual VET and school-based VET may exist, a difference that many of these studies do not take into account. The following section describes the data and methodology we use to tackle this inconsistency in earlier results and to test our hypotheses.

4.3 Empirical design

4.3.1 Data

Our data set consists of unbalanced panel data for 2004 through 2014, covering 36 countries[9] depending on data availability[10].

[9] Those countries are Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Czechia, Denmark, Finland, France, Germany, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Japan, Korea (Republic of), Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States of America. Table D.1 in the appendix shows the average values of the years 2004 to 2014 for the explanatory and dependent variables per country.

[10] We eliminate countries with unreliable data, such as unreasonable jumps or fractions that do not add up properly, as with enrolment rates. In addition, we have to exclude countries with too few data points and with missing data for our main control variables. For the remaining dataset we linearly interpolated all variables across time within a country to replace missing values for no more than four consecutive years. This interpolation does not drive the results, as we can show upon request.

Table 4.1: Overview of studies investigating the non-linear impact of VET fractions

Data source	Data type	Sample	Unobserved heterogeneity treatment	Dependent variables		Explanatory variables	Results		Hypotheses
Hanushek et al. (2017)									
International Adult Literacy Survey (IALS), 1994-1998	Cross-sectional micro data	15,218 males (aged 16-65) in 18 countries (mostly European)	Individual controls; Country fixed effects	Employment	Integration	VET degree in VET country sample[1]	Stronger positive effect[2]	X	H1/H2
			Individual controls; Country fixed effects	Employment	Integration	VET degree in dual VET country sample[1]	Stronger positive effect[2]	X	H2
Forster et al. (2016)									
International Assessment of Adult Competencies (PIAAC), 2012	Cross-sectional micro data	110,632 individuals (aged 16-65) in 22 OECD countries	Individual controls; Country fixed effects	Employment	Integration	VET degree x VET fraction	Increasing positive effect[3]	X	H1/H2
			Individual controls; Country fixed effects	Employment	Integration	Dual VET degree x VET fraction	Increasing positive effect	X	H2
Levels et al. (2014)									
Ad hoc-module of European Union Labour Force Surveys (EU LFS), 2009	Cross-sectional micro data	30,805 school leavers (aged 15-34) in 20 European countries	Individual controls; Random effects	Horizontal match (field of education)	Job quality	VET degree x VET fraction	No significant effect	?	H1/H2
						VET degree x dual VET fraction	Increasing positive effect	X	H2
			Individual controls; Random effects	Vertical match (level of education)	Job quality	VET degree x VET fraction	Decreasing positive effect	✓	H1/H2
						VET degree x dual VET fraction	Increasing positive effect	X	H2
van de Werfhorst (2011)									
International Adult Literacy Survey (IALS), 1994/1998	Cross-sectional micro data	29,224 individuals (aged 25-65) in 18 countries (mostly European)	Individual controls; Random effects	Earnings	Job quality	VET degree x VET fraction	Increasing negative effect	X	H1/H2
Wolbers (2007)									
Ad hoc-module of European Union Labour Force Surveys (EU LFS), 2000	Cross-sectional micro data	52,651 school leavers (aged 15-35) in 11 European countries	Individual controls; General labour market; Random effects	Unemployed (vs. employed)	Integration	VET degree x dual VET fraction	No significant effect	?	H2
			Individual controls; General labour market; Random effects	Inactive (vs. employed)	Integration	VET degree x dual VET fraction	Increasing negative effect	X	H2
			Individual controls; General labour market	Entry speed	Integration	VET degree x dual VET fraction	Decreasing positive effect	✓	H2
			Individual controls; General labour market	Occupational status (ISEI[4])	Job quality	VET degree x dual VET fraction	Decreasing negative effect	X	H2
Gangl (2003)									
European Union Labour Force Surveys (EU LFS); 1992-1997	Repeated cross-sectional micro data	Micro data on 78,955 labour market entrants in 12 European countries	General labour market; Random effects	Unemployment	Integration	Dual VET degree x VET system dummy	No significant effect	?	H1/H2
						VET degree x VET system dummy	No significant effect	?	
			General labour market; Random effects	Occupational status (ISEI[4])	Job quality	Dual VET degree x VET system dummy	No significant effect	?	H1/H2
						VET degree x VET system dummy	No significant effect	?	
			General labour market; Random effects	Low-skilled employment	Job quality	Dual VET degree x VET system dummy	No significant effect	?	H1/H2
						VET degree x VET system dummy	No significant effect	?	
			General labour market; Random effects	Professional employment[5]	Job quality	Dual VET degree x VET system dummy	No significant effect	?	H1/H2
						VET degree x VET system dummy	No significant effect	?	

Notes: This table summarizes the literature on the non-linear effects of VET programmes on various labour market outcomes. (✓) hypothesis confirmed; (X) hypothesis rejected; (?) hypothesis neither rejected nor confirmed (insignificant); [1] Hanushek et al. (2017) repeat their analysis for different subsamples, whereat countries are grouped based on their shares of upper-secondary-school students in VET programmes, school-based VET programmes and dual VET programmes; [2] Stronger positive effect than in other country samples; [3] Significant effect only for men and not for women; [4] Occupational status measured by the International Socio-Economic Index (ISEI); [5] The identification of professional employment positions is based on the International Standard Classification of Occupations (ISCO). These positions require a comparably high skill level and include for example teaching and scientific professionals, managers, architects, health professionals, or technicians (Gangl, 2003).

As dependent variables, we consider 10 labour market indicators for young people aged 20 to 24[11]. While four of them capture the integration of young people in the labour market, the other six measure the quality of their jobs. By choosing these dependent variables, we account for the complex situation of young people in the labour market, in line with Freeman & Wise (1982), O'Higgins (2003), Dewan & Peek (2007), Renold et al. (2014) and others.

The indicators for capturing youth labour market integration include the youth unemployment rate, the relaxed youth unemployment rate, the neither-in-employment-or-education-or-training (NEET) rate and the youth incidence of long-term unemployment. The unemployment rate is the standard labour market indicator for measuring the unutilized labour supply, i.e. the proportion of those in the youth labour force without a job but actively looking for one (ILO, 2016). To avoid this narrow definition of being unemployed, we also include the relaxed unemployment rate[12], which accounts for discouraged workers who want to work but are not actively searching due to negative experience. To take into account that part of the cohort in this age-range that is still studying, we include the NEET rate instead of the employment rate, which is another frequent labour market indicator. This indicator measures the overall situation of young people in a country, though not their labour market situation itself. To capture the difficulty of (re-)entering the labour market after being unemployed, we consider the youth incidence of long-term unemployment, i.e. the rate of the unemployed that have been unemployed for more than one year out of the total unemployed.

The indicators for measuring young people's job quality are the youth temporary contract rate, the youth involuntary part-time work rate, the youth atypical working hours rate, the youth skills mismatch rate, the youth in-work at-risk-of-poverty rate and the youth average hourly earnings. We use the temporary contract rate[13] to measure young people's job and income insecurity, with the involuntary part-time work rate[14] indicating their dissatisfaction with the workload. The atypical working hours rate captures employees

[11] We chose this age group for two reasons. First, comparable data for this age group is widely available. Second, there is a time lag between changes in enrolment rates and labour market outcomes, but lagging enrolment rates reduces the sample size. Changes in enrolment rates affect labour market outcomes after about three years because an average upper-secondary education programme lasts about three years. Therefore, changes in the enrolment rate three years ago affect the age group of the 20- to 24-year-olds most strongly. If we use the age group of the 20- to 29-year-olds, we would have to lag enrolment rates even longer reducing the sample substantially. However, using data for the age group of the 15- to 24-year-olds yields qualitatively similar results that are available upon request.

[12] This indicator is available only for the 15- to 24-year-olds.

[13] To avoid that this indicator also includes apprenticeship contracts for dual VET, we restrict the temporary contract rate to considering only contracts up to 18 months.

[14] This indicator is available only for the 15- to 24-year-olds.

working shifts, on Sundays or at night, making the coordination of their personal, social and working life more challenging. The skills mismatch rate captures the mismatch of the workers' qualification for the job. The last two indicators cover job quality in a monetary way, which according to Jencks et al. (1988) is an important determinant of labour market outcomes. One of these indicators captures the average hourly earnings[15], which indicate someone's financial situation, while the other one, the in-work at-risk-of-poverty rate, measures whether the job pays enough to cover living expenses.

The main explanatory variables capture the enrolment rates in upper-secondary education programmes, which belong to either general education, school-based VET, or dual VET. According to the OECD (2004), general education programmes have less than 25 per cent vocational content. Thus they do not prepare students for a specific occupation but mainly teach general knowledge. In contrast, VET programmes contain more than 25 per cent of vocational content and prepare students for direct entry into specific occupations (OECD, 2004). The OECD further divides VET programmes into school-based VET and dual VET programmes. In school-based VET programmes, students learn more than 75 per cent of the curriculum in the school environment, while in dual VET programmes, between 10 and 75 per cent of the curriculum is presented in the school environment (OECD, 2004). As the impact of enrolment patterns takes place after students complete their education, we lag the explanatory variables by three years, which is the average duration of upper-secondary education programmes (OECD, 2014).[16]

As control variables, we additionally include the indicators mentioned in the literature as having an effect on the youth labour market (e.g. OECD, 1998; Bol et al., 2013; De Lange et al., 2014; Levels et al., 2014). The main controls are the adult data for the dependent variables, the youth labour force participation rate, the gross domestic product (GDP) per capita, the GDP growth, the employment protection legislation (EPL, Feldmann, 2003) and the Programme for International Student Assessment (PISA) scores. The adult variables[17] capture the general circumstances of the labour market. The youth labour force participation rate measures the fraction of the cohort being employed or seeking employment. The GDP per capita controls for the relative economic strength of a country and the GDP growth captures a country's economic cycle, population growth and immigration. EPL indicates employers' difficulty with terminating a working contract, and the PISA scores[18] consider young people's average skills and knowledge, thereby

[15]This indicator is available only for the 15- to 29-year-olds.

[16]To test for reverse causality, we also lag the explanatory variables by four years in the non-linear GMM model, leading to similar but less significant findings. More details are available upon request.

[17]The age range for adults is variously given as 25 to 54, 25 to 64 and 30 to 64. As the NEET rate is only for young people, we instead use its adult complement, the adult labour force participation.

[18]We compute the PISA scores as the country's average of the literacy, maths and science scores for the waves 2000, 2003, 2006, 2009 and 2012. We construct the years in between by interpolating the data.

capturing the quality of primary and lower-secondary education levels. We exclude the variables trade union density, unemployment insurance, economic sectors, KOF Globalisation Index and the interactions of GDP with each VET programme from our main model, as they are not available for the entire data set. However, we use them as additional controls[19].

4.3.2 Regression models

We apply the generalized method of moments (GMM) as it is suitable for small datasets with few periods in relation to the number of individuals (Wooldridge, 2001; Roodman, 2009). By using the first-difference GMM specification (Roodman, 2009), we consider time-invariant unobserved heterogeneity (Baert et al., 2016). GMM further accounts for our dependent variable's being dynamic, i.e. depending on their past values, thereby dealing with autocorrelation without triggering the dynamic panel bias.[20] To tackle reverse causality, the independent variables are instrumented by their past values. To reduce time-varying heterogeneity, we include control variables.[21] Thus for our first specification, the equation for the first-difference GMM reads as follows:

$$\Delta y_{i,t}^{youth} = \beta_1 \Delta P_{i,\text{t-3}} + \beta_3 \Delta X_{i,t} + \beta_4 \Delta y_{i,\text{t-1}}^{youth} + \Delta \gamma_t + \Delta \nu_{i,t} \tag{4.1}$$

The first term, $y_{i,t}^{youth}$, denotes the dependent variable being one of the youth labour market indicators.[22] The delta (Δ) always stands for the change and the indices i and t refer to country and time, respectively. $P_{i,\text{t-3}}$ is a matrix, which stands for our two explanatory variables, the enrolment rate into school-based VET programmes and the enrolment rate into dual VET programmes, with the enrolment rate into general education programmes serving as the baseline.[23] We lag the explanatory variables by three years to consider the average duration of these education programmes. $X_{i,t}$ denotes a matrix of additional time-varying observable control variables: the youth labour force participation

Furthermore, to include the skills and knowledge of the cohort entering the labour market, we lag the PISA scores by four years.

[19] Table D.2 in the appendix summarizes all variables including a short description, source and age range.

[20] Using standard estimation models, such as OLS, with autocorrelated panel data and individual fixed effects, results in the dynamic panel bias (Nickell, 1981).

[21] We never include the main control variable youth labour force participation rate when the dependent variable is the NEET rate.

[22] In line with the Mincer equation (Mincer, 1974), we logarithm the average hourly earnings and its corresponding adult control.

[23] Including just one programme as explanatory variable does not qualitatively change our findings. More details are available upon request.

rate, GDP per capita, GDP growth, EPL and PISA score. The variable $y_{i,\text{t-1}}^{youth}$ is the past value of the dependent variable. γ_t are year fixed effects dummies, whereas the error term, $\nu_{i,t}$, captures the idiosyncratic shocks.

To capture time-varying unobserved heterogeneity in the development of the labour market, the second specification additionally includes the adult control variable for each youth labour market indicator[24]. Since these adults are older than 25, these variables capture unobserved changes in the labour market, but remain unaffected by changes in the enrolment rates of the most recent cohorts. In the third specification, we include additional control variables.

In addition, as we hypothesise a non-linear relation between the enrolment rates and the youth labour market, we include the quadratic terms of the two explanatory variables in the specifications above for the non-linear models. Thus in the non-linear specifications, the matrix $P_{i,\text{t-3}}$ additionally includes a quadratic term for each enrolment rate.[25]

To compare the labour market effects of our two explanatory variables, the enrolment rates into school-based VET and into dual VET, we test the coefficients of the two VET programmes with Wald tests in the linear specifications. For the non-linear specifications, we jointly test the two VET coefficients and their quadratic coefficients with joint F-tests (e.g. Baum, 2006).

4.3.3 Descriptive statistics

Table 4.2 presents the summary statistics. Contingent on the data availability for the dependent variables, the data set covers between 119 and 201 observations, whereby we have the least observations for the relaxed unemployment rate and the most for the unemployment rate. The enrolment rate into general education programmes varies between 20 and 100 per cent; the one into school-based VET programmes between 0 and 72 per cent; and the one for dual VET programmes, between 0 and 61 per cent. Hence, we require additional assumptions to interpret our results for values outside those ranges. The control variables are available for the entire dataset, but not the additional control variables.

[24] The NEET rate is an exception. The reason is that we do not have the NEET rate for adults, therefore we use the labour force participation of adults.

[25] Other possible ways of analysing non-linearity are to logarithm the explanatory variable, to include an interaction term for low and high levels, or to do a sample split. However, these alternatives have major drawbacks. First, our explanatory variables contain zero as values, thus logarithm requires adding a constant. Second, there are no theoretical or empirical suggestions for where the cut-off for the threshold of the interaction dummy should be. Third, the sample split has the same problem and additionally makes the interpretation of the results circuitous.

Table 4.2: Summary statistics

Variable	Obs	Mean	SD	Min	Max
Dependent variables: Labour market integration					
Youth unemployment rate (%)	201	15.14	8.03	6.07	51.78
Youth relaxed unemployment rate (%)	119	28.53	13.37	10.27	72.91
NEET rate (%)	189	16.55	6.11	5.86	37.41
Youth incidence of long-term unemployment (%)	150	24.29	15.75	1.14	65.96
Dependent variables: Job quality					
Youth temporary contract rate (%)	146	20.70	11.49	2.02	54.51
Youth involuntary part-time work rate (%)	173	7.28	4.64	0.20	23.42
Youth atypical working hours rate (%)	146	24.04	6.98	13.30	44.37
Youth skills mismatch rate (%)	146	12.90	5.93	0.57	27.13
Youth in-work at-risk-of-poverty rate (%)	139	10.04	5.14	1.50	26.20
Youth average hourly earnings	133	15.53	5.02	4.29	23.28
Explanatory variables					
General education (%; t-3)	201	53.29	20.89	20.48	100
sVET: School-based VET (%; t-3)	201	34.20	19.68	0.00	72.23
dVET: Dual VET (%; t-3)	201	12.51	17.60	0.00	60.65
Control variables					
Youth labour force participation rate (%)	201	47.94	14.14	24.62	73.39
GDP per capita	201	34.97	10.51	8.43	65.58
GDP growth (%)	201	1.47	2.80	-8.27	7.53
Employment protection legislation index	201	2.42	0.52	1.00	3.98
PISA score (t-4)	201	494.54	34.99	384.33	552.67
Additional control variables					
Trade union density (%)	157	29.86	21.33	7.55	85.46
Unemployment insurance (%)	157	33.12	20.45	0.00	83.27
Sector: Agriculture (%)	157	2.06	1.19	0.62	7.76
Sector: Industry (%)	157	27.91	4.99	19.60	38.38
Sector: Services (%)	157	70.02	5.47	59.10	78.65
KOF Globalisation Index	157	82.78	7.99	60.65	92.63
GDP x school-based VET	157	36.36	116.71	-450.68	342.17
GDP x dual VET	157	14.17	62.61	-245.84	255.90

Notes: The table presents the number of observations (Obs), mean, standard deviation (SD), minimum value (Min), maximum value (Max) of the main variables we use in the empirical estimation. The data is from different sources as TableD.2 in the appendix shows. In our analysis we include as dependent variables four indicators for the youth labour market integration and six indicators for the quality of jobs. The explanatory variables are the enrolment rates into the upper secondary education programmes – general education, school-based vocational education and training (VET) and dual VET as defined by the OECD (2004) – programmes in general education contain less than 25 per cent vocational content, whereas programmes in VET contain 25 per cent or more vocational content; school-based VET takes place to 75 per cent or more at school, whereas dual VET takes place from 25 to 90 per cent at a company – and lagged by three years. As control variables we include the youth labour force participation rate, GDP per capita, GDP growth, employment protection legislation index and PISA scores lagged by four years in each estimation. Further control variables not displayed in the table are the adult data of the dependent variables. Finally, we have additional control variables – trade union density, unemployment insurance, sectors, KOF Globalisation Index, interaction between GDP and the two VET programmes – which we include only in certain specifications, because their availability is strongly limited.

4.4 Results

In this section, we present the results of our regressions on the effect of VET on the youth labour market. First, we describe the results of school-based VET, followed by the ones of dual VET. Second, we compare the results for school-based VET and dual VET for all labour market indicators. Third, we examine the non-linear results more closely.

Table 4.3 on the following page displays the results for the effect of VET on the indicators of youth labour market integration, while Tables 4.4 and 4.5 show the results for the quality of young peoples' jobs. In all three tables, the first three columns present the linear estimations (M1-M3) and the last three columns show the results of the non-linear estimations including the squared enrolment rates (M4-M6). Furthermore, the estimation models differ by the included control variables. M1 and M4 include only the controls and time fixed effects, M2 and M5 control additionally for the adult dependent variable (main estimations), M3 and M6 also cover the additional controls.

4.4.1 The influence of school-based VET on the youth labour market

For the youth labour market integration we find no significant school-based VET coefficient for any of the four indicators in the linear estimations. Thus we conclude that there is no significant linear effect of school-based VET on the labour market integration.

In the non-linear estimations, the result for the incidence of long-term unemployment is positive and significant in M4 and M5. The negative coefficient of the school-based VET enrolment rates' quadratic term shows that the positive relation diminishes with increasing enrolment rates. The unemployment rate shows a similar pattern, but the significance of the coefficients is not robust over the three models. The significant positive coefficient for the relaxed unemployment rate in M4 is stable but not significant anymore in the other two models. The quadratic term shows that this effect diminishes with higher enrolment rates though in none of the three models is this coefficient significant. For the NEET rate, the results are neither stable nor significant. Taken together we find some evidence for significant non-linear negative effects of school-based VET on labour market integration.

For the job quality indicators involuntary part-time work rate, atypical working hours rate and average hourly earnings, we find no significant coefficients in the linear estimations. We find significant positive coefficients for the temporary contract rate, skills mismatch rate and in-work at-risk-of-poverty rate, though their significance does not persist over all three estimation models. Only for the temporary contract rate, the positive coefficient of school-based VET is significant in M4 and M5. Taken together we find some evidence that school-based VET linearly worsens the quality of young people's jobs. This

Table 4.3: Estimation results on the linear and non-linear effects of the VET programmes on youth labour market integration

		Linear			Non-linear		
		M1	**M2**	**M3**	**M4**	**M5**	**M6**
Dependent variable: Labour market integration							
Unemployment rate	School-based VET	0.046	-0.012	0.020	0.121*	0.060	0.108**
Observations = 201 (157)		(0.039)	(0.013)	(0.016)	(0.063)	(0.048)	(0.044)
Countries = 33 (26)	School-based VET^2				-0.001	-0.001	-0.001**
					(0.001)	(0.001)	(0.000)
	Dual VET	0.013	-0.212**	-0.113*	-1.246***	-0.548***	-0.397**
		(0.098)	(0.099)	(0.058)	(0.395)	(0.166)	(0.162)
	Dual VET^2				0.016***	0.005*	0.004*
					(0.005)	(0.003)	(0.002)
	Difference in VET	0.745	0.049**	0.039**	0.005***	0.000***	0.002***
Relaxed unemployment rate	School-based VET	0.067	-0.019	0.013	0.161*	0.056	0.140
Observations = 119 (108)		(0.041)	(0.020)	(0.023)	(0.090)	(0.088)	(0.101)
Countries = 21 (20)	School-based VET^2				-0.001	-0.001	-0.001
					(0.001)	(0.001)	(0.001)
	Dual VET	0.017	-0.219**	-0.307***	-1.245**	-0.443*	-0.450
		(0.187)	(0.095)	(0.101)	(0.499)	(0.247)	(0.299)
	Dual VET^2				0.018**	0.002	0.003
					(0.007)	(0.003)	(0.003)
	Difference in VET	0.793	0.046**	0.004***	0.032**	0.003***	0.020**
NEET rate	School-based VET	0.019	0.019	0.026	-0.037	-0.038	0.049
Observations = 189 (153)		(0.032)	(0.032)	(0.018)	(0.061)	(0.067)	(0.044)
Countries = 30 (26)	School-based VET^2				0.001	0.001	0.000
					(0.001)	(0.001)	(0.001)
	Dual VET	-0.020	-0.019	-0.144	-0.040	-0.042	-0.197
		(0.147)	(0.146)	(0.129)	(0.367)	(0.360)	(0.289)
	Dual VET^2				0.000	0.000	0.001
					(0.005)	(0.005)	(0.004)
	Difference in VET	0.784	0.786	0.174	0.892	0.896	0.328
Incidence of long-term unemployment	School-based VET	-0.005	-0.003	-0.059	0.212*	0.248**	0.111
Observations = 150 (124)		(0.067)	(0.065)	(0.048)	(0.109)	(0.110)	(0.100)
Countries = 24 (21)	School-based VET^2				-0.002**	-0.003***	-0.002**
					(0.001)	(0.001)	(0.001)
	Dual VET	-0.204	-0.204	-0.586*	-1.740**	-1.402***	-2.035***
		(0.341)	(0.314)	(0.324)	(0.767)	(0.516)	(0.421)
	Dual VET^2				0.022**	0.018***	0.022***
					(0.009)	(0.005)	(0.005)
	Difference in VET	0.566	0.517	0.091*	0.018**	0.000***	0.000***
Controls							
Time fixed effects & controls		YES	YES	YES	YES	YES	YES
Adult control for dependent variable		NO	YES	YES	NO	YES	YES
Additional controls		NO	NO	YES	NO	NO	YES

Notes: The table displays the effect of school-based VET and dual VET on labour market integration indicators; We report first-difference GMM coefficients and standard errors in parentheses (clustered at country level); ***,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent level, respectively; Difference in VET reports the p-values for the null hypothesis that the coefficients of school-based and dual VET are equal; Observations describes the sample size for M1&M2 and M4&M5 and in brackets for M3&M6; Countries stands for the number of countries for M1&M2 and M4&M5 and in brackets for M3&M6; School-based VET contains 25 per cent or more vocational content, which students learn to 75 per cent or more at school; Dual VET contains 25 per cent or more vocational content, which students learn from 25 up to 90 per cent at a company; Controls are the youth labour force participation rate, GDP per capita, GDP growth, employment protection legislation index, PISA scores and time fixed effects; Additional controls are trade union density, unemployment insurance, sectors (agriculture, industry, services), KOF Globalisation Index, GDP x school-based VET, GDP x dual VET

Table 4.4: Estimation results of the linear and non-linear effect of the VET programmes on the job quality of young people I

		Linear			Non-linear		
		M1	**M2**	**M3**	**M4**	**M5**	**M6**
Dependent variable: Job quality							
Temporary contract rate	School-based VET	0.020	0.048**	0.065**	0.008	0.084*	-0.025
Observations = 146 (130)		(0.046)	(0.022)	(0.029)	(0.090)	(0.046)	(0.059)
Countries = 22 (21)	School-based VET^2				0.000	0.000	0.001
					(0.001)	(0.001)	(0.001)
	Dual VET	0.216**	-0.068	-0.195	0.354	-0.734***	-0.814***
		(0.097)	(0.131)	(0.128)	(0.459)	(0.272)	(0.278)
	Dual VET^2				-0.002	0.009***	0.008**
					(0.006)	(0.003)	(0.003)
	Difference in VET	0.076*	0.393	0.037**	0.327	0.011**	0.004***
Involuntary part-time work rate	School-based VET	-0.001	-0.004	-0.010	0.052	0.012	-0.024
Observations = 173 (147)		(0.015)	(0.013)	(0.010)	(0.034)	(0.035)	(0.032)
Countries = 28 (24)	School-based VET^2				-0.001	0.000	0.000
					(0.000)	(0.000)	(0.000)
	Dual VET	0.035	0.032	-0.024	-0.307**	-0.331**	-0.370***
		(0.090)	(0.077)	(0.070)	(0.129)	(0.148)	(0.128)
	Dual VET^2				0.005***	0.005***	0.005***
					(0.002)	(0.002)	(0.001)
	Difference in VET	0.687	0.641	0.836	0.000***	0.001***	0.012**
Atypical working hours rate	School-based VET	0.015	-0.025	-0.015	-0.062	-0.002	0.033
Observations = 146 (130)		(0.022)	(0.017)	(0.018)	(0.061)	(0.042)	(0.061)
Countries = 22 (21)	School-based VET^2				0.001	0.000	-0.001
					(0.001)	(0.000)	(0.001)
	Dual VET	-0.116	-0.093	-0.067	-0.640***	-0.413**	-0.493**
		(0.109)	(0.093)	(0.098)	(0.221)	(0.192)	(0.213)
	Dual VET^2				0.007***	0.005**	0.006**
					(0.002)	(0.002)	(0.002)
	Difference in VET	0.243	0.451	0.580	0.028**	0.111	0.036**
Skills mismatch rate	School-based VET	0.061*	0.050	0.034	-0.104	-0.129	-0.278**
Observations = 146 (130)		(0.036)	(0.033)	(0.024)	(0.108)	(0.106)	(0.118)
Countries = 22 (21)	School-based VET^2				0.002	0.002	0.003**
					(0.001)	(0.001)	(0.001)
	Dual VET	-0.357**	-0.408**	-0.346	-1.115**	-1.080**	-1.245***
		(0.144)	(0.169)	(0.236)	(0.510)	(0.479)	(0.451)
	Dual VET^2				0.010	0.009	0.010*
					(0.006)	(0.006)	(0.006)
	Difference in VET	0.009***	0.011**	0.110	0.011**	0.007***	0.014**
Controls							
Time fixed effects & controls		YES	YES	YES	YES	YES	YES
Adult control for dependent variable		NO	YES	YES	NO	YES	YES
Additional controls		NO	NO	YES	NO	NO	YES

Notes: The table displays the effect of school-based VET and dual VET on job quality indicators; We report first-difference GMM coefficients and standard errors in parentheses (clustered at country level); ***,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent level, respectively; Difference in VET reports the p-values for the null hypothesis that the coefficients of school-based and dual VET are equal; Observations describes the sample size for M1&M2 and M4&M5 and in brackets for M3&M6; Countries stands for the number of countries for M1&M2 and M4&M5 and in brackets for M3&M6; School-based VET contains 25 per cent or more vocational content, which students learn to 75 per cent or more at school; Dual VET contains 25 per cent or more vocational content, which students learn from 25 up to 90 per cent at a company; Controls are the youth labour force participation rate, GDP per capita, GDP growth, employment protection legislation index, PISA scores and time fixed effects; Additional controls are trade union density, unemployment insurance, sectors (agriculture, industry, services), KOF Globalisation Index, GDP x school-based VET, GDP x dual VET

Table 4.5: Estimation results of the linear and non-linear effect of the VET programmes on the job quality of young people II

		Linear			Non-linear		
		M1	**M2**	**M3**	**M4**	**M5**	**M6**
Dependent variable: Job quality							
In-work at-risk-of-poverty rate	School-based VET	0.032	0.039	0.059**	-0.040	-0.047	-0.011
Observations = 139 (126)		(0.039)	(0.037)	(0.026)	(0.134)	(0.100)	(0.090)
Countries = 22 (21)	School-based VET^2				0.001	0.001	0.001
					(0.002)	(0.001)	(0.001)
	Dual VET	-0.079	0.001	-0.033	-0.930***	-0.799***	-1.279***
		(0.187)	(0.172)	(0.162)	(0.330)	(0.274)	(0.265)
	Dual VET^2				0.012***	0.011***	0.017***
					(0.004)	(0.003)	(0.003)
	Difference in VET	0.517	0.813	0.566	0.024**	0.012**	0.000***
Average hourly earnings (ln)	School-based VET	0.000	0.000	0.000	0.001	-0.001	-0.001
Observations = 133 (122)		(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
Countries = 26 (25)	School-based VET^2				0.000	0.000	0.000
					(0.000)	(0.000)	(0.000)
	Dual VET	0.001	0.003	-0.001	-0.012*	-0.002	-0.001
		(0.003)	(0.004)	(0.003)	(0.007)	(0.004)	(0.006)
	Dual VET^2				0.000*	0.000	0.000
					(0.000)	(0.000)	(0.000)
	Difference in VET	0.966	0.402	0.814	0.159	0.981	0.634
Controls							
Time fixed effects & controls		YES	YES	YES	YES	YES	YES
Adult control for dependent variable		NO	YES	YES	NO	YES	YES
Additional controls		NO	NO	YES	NO	NO	YES

Notes: The table displays the effect of school-based VET and dual VET on job quality indicators; We report first-difference GMM coefficients and standard errors in parentheses (clustered at country level); ***,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent level, respectively; Difference in VET reports the p-values for the null hypothesis that the coefficients of school-based and dual VET are equal; Observations describes the sample size for M1&M2 and M4&M5 and in brackets for M3&M6; Countries stands for the number of countries for M1&M2 and M4&M5 and in brackets for M3&M6; School-based VET contains 25 per cent or more vocational content, which students learn to 75 per cent or more at school; Dual VET contains 25 per cent or more vocational content, which students learn from 25 up to 90 per cent at a company; Controls are the youth labour force participation rate, GDP per capita, GDP growth, employment protection legislation index, PISA scores and time fixed effects; Additional controls are trade union density, unemployment insurance, sectors (agriculture, industry, services), KOF Globalisation Index, GDP x school-based VET, GDP x dual VET

finding is in line with Wolbers (2003) results, who finds a negative effect of school-based VET on job quality (i.e. increasing education-to-job mismatch).

Focusing on the non-linear results for the job quality indicators, we find no effects for the temporary contract rate, involuntary part-time work rate, atypical working hours rate, in-work at-risk-of-poverty rate and average hourly earnings. For the skills mismatch rate we find a significant negative coefficient – which diminishes with higher enrolment into school-based VET – but only when including the additional controls (M6). Taking together there is no clear non-linear effect of school-based VET on job quality.

The results show that higher enrolment rates in school-based VET significantly increase the youth incidence of long-term unemployment and potentially unemployment at

a decreasing rate. In addition, school-based VET linearly increases the temporary contracts rate and potentially the in-work at-risk-of-poverty rate. There is also some evidence on a decreasing negative effect on the skills mismatch rate. These results contradict both, the previous literature and the theoretical argument, that school-based VET improves the youth labour market but at a decreasing rate (H1). Instead, for some indicators school-based VET worsens the youth labour market at a decreasing rate.

4.4.2 The influence of dual VET on the youth labour market

Tables 4.3 to 4.5 also present the results for dual VET. Looking at the linear estimations for the labour market integration, we find negative dual VET coefficients for the unemployment rate, the relaxed unemployment rate, the NEET rate and the incidence of long-term unemployment. However, these results are neither stable nor consistently significant over all three models. They also change from being positive to negative for the unemployment rate and the relaxed unemployment rate though being significantly negative in M2 and M3. In addition they are not significant in any models for the NEET rate and only when all control variables are included (M3) for the incidence of long-term unemployment. Thus we find some support for the many previous studies showing a positive linear effect of dual VET on youth labour market integration (OECD, 1998; van der Velden & Wolbers, 2001; Breen & Buchmann, 2002; Breen, 2005; Wolbers, 2007; Noelke, 2011; Bol et al., 2013; De Lange et al., 2014; Busemeyer & Thelen, 2015).

Focusing on the non-linear effect of dual VET on youth labour market integration, we find a significant negative but decreasing effect on the unemployment rate, the relaxed unemployment rate and the incidence of long-term unemployment. For the unemployment rate and the incidence of long-term unemployment these results persist when including the adult controls (M5) and the additional control variables (M6). We conclude that higher enrolment rates into dual VET improve youth labour market integration – but at a decreasing rate for the unemployment rate and the incidence of long-term unemployment.

For the quality of young people's jobs, we find mixed results for the linear estimations. The coefficient for the temporary contract rate is significantly positive, but does not persist when including the adult variable as control (M2). In contrast, for the skills mismatch rate we find significant negative coefficients except when including the additional controls (M3). Therefore, we find no clear evidence that higher dual VET enrolment rates linearly improves job quality and can thus not support the results of van der Velden & Wolbers (2001), De Lange et al. (2014) and Levels et al. (2014) but in line with those of Wolbers (2007).

The dual VET coefficients for job quality in the non-linear estimations are significantly negative for all job quality indicators. However, only the results for the involuntary

part-time rate, atypical working hours rate and the in-work at-risk-of-poverty rate are stable and significant in all models. The results for the temporary contract rate are negative and significant only when including the control variables (M5 and M6). The skills mismatch rate only has a non-linear effect when including the additional controls (M6) and for the average hourly earnings rate the results are only significant in the first specification (M4). Thus we conclude that dual VET improves young people's job quality but at a decreasing rate.

Taken together the findings show that dual VET has a positive effect on the youth labour market integration and young people's job quality, but some of these effects diminish with higher enrolment rates. These findings support H2 that increasing the enrolment rates of students in dual VET programmes improves the youth labour market but at a decreasing rate. However, these results contradict the previous literature providing evidence for a non-linear effect of VET on the youth labour market. These studies mostly find that higher enrolment rates in VET and especially in dual VET are beneficial for the labour market integration of young people with a VET degree and the quality of their jobs (Hanushek et al., 2017; Forster et al., 2016; Levels et al., 2014; van de Werfhorst, 2011). The only exceptions are Levels et al. (2014) and Wolbers (2007) who find a decreasing positive effect of VET on the vertical education-to-job match and the entry speed, respectively.

4.4.3 The difference between the influences of school-based VET and dual VET

To test hypothesis H3, we compare the coefficients of school-based VET and dual VET for each youth labour market indicator (labelled 'Difference in VET' in tables 4.3 to 4.5). In the linear estimations on the youth labour market integration, the coefficients are significantly different for the unemployment rate, the relaxed unemployment rate (in M2 and M3) and the incidence of long-term unemployment (only in M3). In the non-linear estimations we find significantly different coefficients for the unemployment rate, the relaxed unemployment rate and the incidence of long-term unemployment in all three models.

For job quality, the coefficients for the temporary contract rate and the skills mismatch rate in the linear estimations are significantly different but turn insignificant when controlling for the adult variable and the additional controls, respectively. In the non-linear estimations the coefficients for the temporary contract rate, involuntary part-time work rate, atypical working hours rate, skills mismatch rate and in-work at-risk-of-poverty rate are significantly different. These differences are unstable for the temporary contract rate, where they only turn significant when including the adult and additional controls, and for the atypical working hours rate, where they are insignificant when including the adult control. We find no significant differences for the average hourly earnings. Thus for

most of the labour market indicators we find evidence supporting H3 that dual VET has a significantly better effect than school-based VET on labour market integration and job quality, a finding in line with the literature (van der Velden & Wolbers, 2001; Bol et al., 2013; Levels et al., 2014).

4.4.4 In-depth analysis of the non-linear results

The results show both linear and non-linear relations between the enrolment rates in VET and the youth labour market. Thus far, we assumed a quadratic functional form for the estimations of the non-linear effects. However, we do not yet know where the turning point of this function is. We therefore take a closer look at the significant non-linear effects identified in the previous section (in the main non-linear model M5) and calculate their marginal effects as a function of the enrolment rates that vary between 0 and 100. Doing so shows us how the dependent variables behave depending on the level of enrolment in VET.

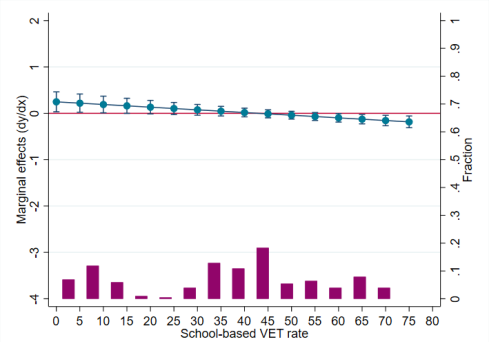
Figure 4.1 displays on the top left the marginal effects of school-based VET on long-term unemployment. The y-axis on the left indicates the predicted change in the incidence of long-term unemployment depending on the enrolment rate in school-based VET (x-axis). For example, at the level of 30 per cent enrolment in school-based VET, an increase of one per cent in that rate would increase – all else equal – the incidence of long-term unemployment from 4.74 to 4.80 (marginal effect of 0.06), whereas an increase in school-based VET from 60 to 61 per cent would decrease the incidence of long-term unemployment from 4.08 to 3.97 (marginal effect of -0.11). In addition, the y-axis on the right-hand side of the figures displays the amount of data on which the results are based as a fraction of the entire dataset. The confidence intervals around the marginal effects display whether they are significant or not at the 5 per cent level. Hence, marginal effects are significant when the confidence interval does not cross the horizontal line at zero.

For school-based VET the results show significant non-linear effects for the incidence of long-term unemployment. The margins plot shows that the marginal effect of school-based VET is significantly positive up to 15 per cent enrolment and turns significantly negative when the enrolment rate is above 60 per cent, providing evidence for a turning point.

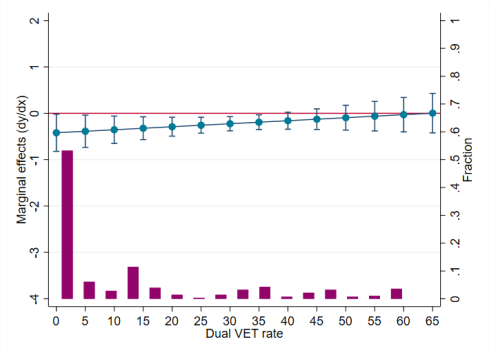
For dual VET we find significant negative non-linear coefficients for the unemployment rate, the incidence of long-term unemployment, the temporary contract rate, the involuntary part-time work rate, atypical working hours rate and the in-work at-risk-of-poverty rate. The margins plots show that initially dual VET significantly reduces all of the rates but at a decreasing rate, until becoming insignificant between 10 per cent and 35 per cent (depending on the indicator). These marginal effects are significantly positive

Figure 4.1: Marginal effects of significant non-linear regression results

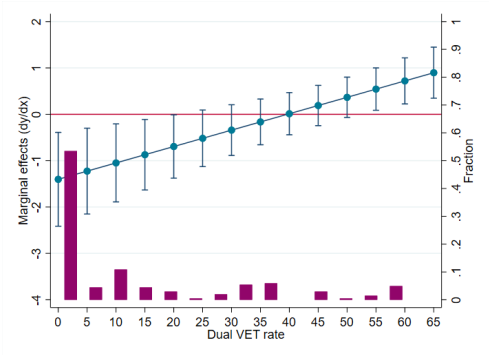
School-based VET on the incidence of long-term unemployment



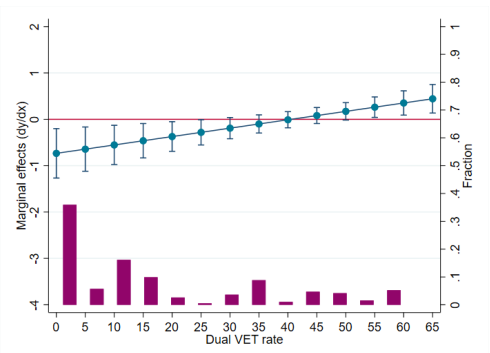
Dual VET on the unemployment rate



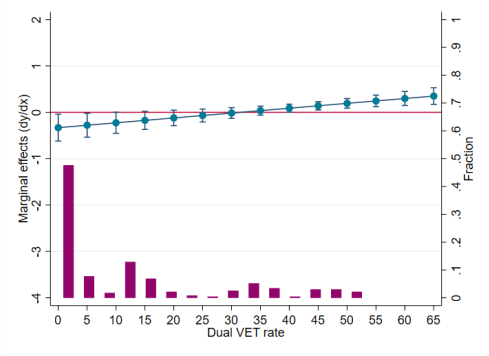
Dual VET on the incidence of long-term unemployment



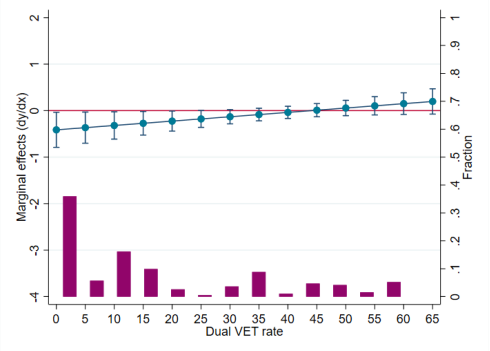
Dual VET on the temporary contract rate



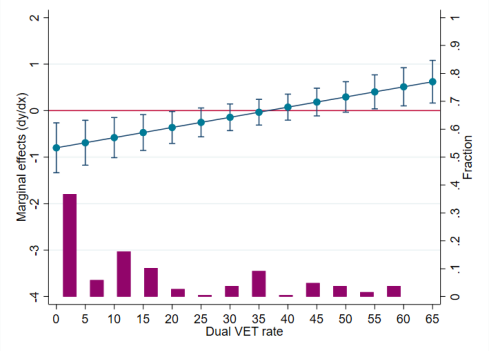
Dual VET on the involuntary part-time work rate



Dual VET on the atypical working hours rate



Dual VET on the in-work at-risk-of-poverty rate



Notes: Plots show on the left axis the marginal effects of school-based VET or dual VET for all dependent variables with a significant quadratic relation (in M5). The marginal effects are significant at the 5% level if their confidence interval does not cross the reference line at 0. On the right axis (fraction), we display the data density for different levels of enrolment.

for high enrolment rates in dual VET (roughly above 40 per cent to 55 per cent, depending on the indicator) for long-term unemployment, temporary contracts, involuntary part-time work and in-work at-risk-of-poverty, but not for unemployment and atypical working hours. Thus the findings provide some evidence for a turning point, which is in line with our theoretical predictions.

4.4.5 Robustness checks

To check whether a specific situation or event drives our estimation results we vary our sample by the included countries. The first variation accounts that our results may be driven by few countries that have well-established dual VET systems and also good youth labour market outcomes, so we drop Austria, Denmark, Germany and Switzerland from the sample (Chatzichristou et al., 2014; Eichhorst et al., 2015). Excluding these countries from the sample intensifies the previously indicated negative – but diminishing – effect of school-based VET on the youth labour market integration. However, the effect of school-based VET on job quality remains unclear. For dual VET, we still find a positive effect on youth labour market integration and job quality, though the non-linearity is less pronounced. Tables D.3 to D.5 in the appendix display the coefficients for the adapted sample for the estimation models M2 and M5 under the heading 'Labour market'.

The second variation splits countries into high- and low-income countries according to their gross national income[26]. The estimations show that for low-income countries

[26]To split the sample, we calculate the median gross national income of the countries in the sample of the unemployment rate. Then we calculate the country means of the gross national income over all the years

school-based VET has a negative effect on the youth labour market integration. This effect is significantly non-linear for the unemployment rate and significantly linear for the relaxed unemployment rate. For dual VET in low-income countries we still find a positive effect of dual VET on labour market integration, except for the NEET rate. However, this positive effect is only significant for the incidence of long-term unemployment. Thus the tendencies of the main results that school-based VET worsens and dual VET improves the labour market integration persist for the sample of low-income countries.

The evidence for the effect of school-based VET on the quality of jobs for low-income countries is mixed. On the one hand, school-based VET in low-income countries significantly increases the temporary contract rate (M5) and the in-work at-risk-of-poverty rate (M2) but on the other hand it significantly decreases the atypical working hours rate (M5) and skills mismatch rate (M5). For dual VET the effect on job quality in low-income countries is still significantly negative for temporary contract rate (M2), involuntary part-time work rate (M5) and skills mismatch rate (M2). Although for some indicators we find significant estimation results for school-based VET in low-income countries, the overall effect on the quality of young people's jobs remains unclear. For dual VET we still find that higher enrolment rates improve the quality of jobs but to a lesser extent. Tables D.3 to D.5 in the appendix display the coefficients for this subsample for the estimation models M2 and M5 under the heading 'Low income'.

Regarding the high-income countries, we find that school-based VET significantly improves the labour market integration of young people. The effect is linear for the unemployment rate and the incidence of long-term unemployment but non-linear and decreasing for the relaxed unemployment rate. The effect of dual VET on labour market integration in high-income countries is still significantly and linearly negative for the unemployment rate and the relaxed unemployment rate.

School-based VET both worsens and improves the quality of jobs in high-income countries, depending on the outcome indicator. For dual VET we also find mixed evidence as it linearly increases involuntary part-time work rate but decreases the skills mismatch rate. Taken together we find evidence of school-based VET and dual VET improving the youth labour market integration in high-income countries but mixed evidence for the job quality. Considering our main results this finding is unexpected, especially for the effect of school-based VET. Tables D.3 to D.5 in the appendix display the coefficients for this subsample for the estimation models M2 and M5 under the heading 'High income'.

The third variation accounts for the financial crisis having a potential impact on our estimations (Kadek Dian Sutrisna Artha & de Haan, 2011). Therefore, we exclude countries

included in the sample and compare it with the gross national income median. We classify countries with a larger or equal gross national income mean to the overall median as high-income countries and the countries with a smaller gross national income mean as low income countries.

that were strongly affected by the financial crisis. To identify these countries we follow the approach of Dietrich (2012), who looks at the change in youth unemployment rates between 2007 and 2010. However, because a value in one year can be unreliable we take the mean of the youth unemployment rates in 2006, 2007 and 2008 and compare it with the mean of the youth unemployment rates in 2009, 2010 and 2011. In our dataset, the countries with an absolute change of 5 per cent and more in the youth unemployment rate are Denmark, Hungary, Ireland, Italy, Poland, Portugal, Slovakia and Spain. We therefore exclude those countries from our sample as an additional robustness check.

Estimating the results without the countries strongly affected by the financial crisis finds school-based VET to improve the labour market integration of young people. The effect of dual VET is mixed, whereas only the linear coefficients of the unemployment rate and relaxed unemployment rate are significantly negative and the NEET rate is significantly positive. For the quality of young people's jobs in countries less affected by the financial crisis we find school-based VET to significantly increase both the temporary contract rate and the average hourly earnings, but to significantly decrease the atypical working hours rate. Dual VET significantly reduces the temporary contract rate at a decreasing rate, whereby most of the other job quality indicators are also negative but not significant. Thus for countries not affected by the financial crisis, school-based VET improves the youth labour market integration and ambiguously affects job quality, whereas the effect of dual VET is inconclusive for the labour market integration and weakly positive for the job quality. Tables D.3 to D.5 in the appendix display the coefficients for this subsample for the estimation models M2 and M5 under the heading 'Financial crisis'.

Taken together the three sample variations show some heterogeneity in the results especially with regard to school-based VET. Depending on the sample, school-based VET may have a positive or negative effect on the labour market integration of young people and the quality of their jobs, though this result is less clear for job quality. For dual VET we find significantly negative coefficients for the labour market integration indicators and job quality, except for two cases. One case is the sample of high-income countries in which we find a positive coefficient for the involuntary part-time work rate; the other case is the sample where we exclude countries strongly affected by the financial crisis, where we also find significantly positive coefficients for the NEET rate.

4.5 Conclusion

This chapter explores the extent to which VET improves the labour market for young people. We investigate whether increased enrolment rates in dual VET and school-based VET have the same effect on youth labour market outcomes, and explore how those effects change as enrolment rates in these programmes expand. We analyse these relations

using GMM estimations on an unbalanced panel of 36 countries from 2004 through 2014. Previous studies indicate that the effect of VET also depends on scholars' choice of youth labour market indicator, so we consider a broad set of indicators for youth labour market integration and job quality.

Our significant linear and non-linear results reveal that the effects of school-based VET and dual VET are significantly different for seven out of ten indicators; we find significant difference for unemployment rate, relaxed unemployment rate, incidence of long-term unemployment, temporary contract rate, involuntary part-time work rate, skills mismatch rate and in-work at-risk-of-poverty rate. School-based VET increases the incidence of long-term unemployment and the temporary contract rate, but these effects decrease with higher enrolment rates for the indicator of labour market integration. Dual VET both significantly and linearly decreases rates of relaxed unemployment and skills mismatch. Moreover, dual VET decreases the incidence of long-term unemployment and the rates of unemployment, temporary contracts, involuntary part-time work, atypical working hours and in-work at-risk-of-poverty. In line with our theoretical predictions, these effects decrease with higher enrolment rates in dual VET. We conclude that school-based VET potentially worsens the youth labour market situation, whereas dual VET improves both labour market integration and job quality.

To improve the situation of young people on the labour market, a large number of countries are introducing or expanding VET programmes, particularly dual VET (Chatzichristou et al., 2014). As our results indicate that introduction or expansion of school-based VET will most likely have very different effects from dual VET, this chapter encourages policymakers to carefully consider which kind of programmes they support. Moreover, we do not find an effect of higher VET enrolment rates on the NEET rate, thus VET may not affect the fraction of young people neither in education nor in employment. We conclude that VET programmes only affect the situation of the 20- to 24-year-olds in the labour force but not the one of this entire age group. Even though both kind of VET programmes offer more vocational content than general education does, the negative effects of school-based VET on the incidence of long-term unemployment and temporary contracts indicate that such programmes do not meet the needs of the labour market. Van der Velden and Wolbers (2001) argue that dual VET always imparts occupation-specific skills and therefore has a strong vocational specificity, while school-based VET may not. Moreover, school-based VET programmes do not include much workplace training where the curriculum allows students to apply the skills they learned at school, gain valuable experience, and acquire 21th century skills. Furthermore, the institutional link between the education system and the labour market is often weak in school-based VET, possibly leading to outdated training standards (Zimmermann et al., 2013). The problems of school-based VET may be less severe or even remedied in countries with enough financial resources to support such programmes as the results from the robustness checks indicate.

Overall, dual VET programmes better prepare young people for the labour market entry thanks to their skills' occupational specificity and extensive workplace training. According to our robustness checks, these benefits are stronger for countries in difficult economic situations. Countries with a generally good labour market situation profit less from dual VET. An explanation for that finding could be that firms in a good situation are stronger in need of workers and therefore give jobs also to less fitting applicants. Policy strategies and research in the future should carefully consider the different effects of school-based and dual VET on the youth labour market.

This chapter also finds that both programmes' effects – the expected positive effects of dual VET and some of the unexpected negative effects of school-based VET – diminish with increasing enrolment rates. One possible explanation for the startling non-linear effects of school-based VET is that such programmes might be of better quality or attracting more able students in the case of high enrolment rates (Muehlemann & Wolter, 2007a; van de Werfhorst, 2011). Moreover, with a higher proportion of school-based VET graduates, employers might more depend on them for recruiting and might therefore engage more actively in these programmes, i.e. in the curriculum development. With employers' and politicians' commitments, school-based VET might become more like dual VET, and thus VET certificates send clearer, more positive signals to employers (Levels et al., 2014). As school-based VET is more favourable in high-income countries, our robustness checks support such an explanation. The decreasing effect of dual VET is in line with our argument that a mix of different education programmes best meets labour market demand. Policymakers and researchers will need to consider these non-linear effects: while the positive effect of dual VET is strongest for low enrolment rates in these programmes, school-based VET might only be beneficial for the youth labour market with high enrolment rates.

This chapter analyses private benefits of different education programmes. However, determining the optimal mix of education programmes further depends on their benefits for the society, the costs of education and the development of private benefits over time (e.g. Corazzini & Bartell, 1965; Wunsch & Lechner, 2008). The economic benefits for the society include the spillover effects of education and the additional benefits for companies, such as the value of goods and services produced by dual VET students, or the saved recruitment and adjustment costs when keeping these students after training (e.g. Muehlemann & Wolter, 2014). In addition to these economic benefits, education further creates non-economic benefits such as increased social cohesion, increased health and reduced crime rates (e.g. Griffin, 2016). However, little evidence exists regarding the relative benefits of different education programmes due to the challenges of estimating these additional benefits. Similarly, estimates of different education programmes' private benefits over the life cycle vary substantially. While Hanushek et al. (2017) and Golsteyn

& Stenberg (2017) argue that private benefits of education decrease with age, other authors exploiting policy changes do not find such effects (Oosterbeek & Webbink, 2007; Malamud & Pop-Eleches, 2010; Hall, 2012;)

For education programmes, an aggregate cost-benefit analysis that allows general conclusions across OECD countries is also difficult due to the heterogeneity in programmes, financing approaches, data gathering processes and potential interactions with other country characteristics (Hoeckel, 2008). In general, as VET requires special equipment, teachers and small classes, the literature argues that VET is more expensive than general education (e.g. Klein, 2001; Lerman, 2014). However, the costs of VET are higher in school-based VET than in dual VET. The reason is that the necessary resources are more readily available in companies, which provide substantial parts of the practical training in dual VET. Furthermore, dual VET students spend less time in the school and companies pay for some of the training costs. Thus the costs for the government are lower for dual VET than for school-based VET (e.g. Reed et al., 2012; Wolter et al., 2018). Accordingly, Hanhart & Bossio (1998) find that government costs are highest for school-based VET, followed by general education and dual VET.

This chapter has some limitations in the data and identification strategy, which yield great potential for future research. First is data availability: the number of countries and periods restricts the data set, leading to limited variation in the enrolment rates of upper-secondary education programmes. Thus the effect sizes and curvatures of the non-linear results must be interpreted cautiously.

Second, the data itself limits our results' external validity. The countries in the data set have upper bounds on VET enrolment rates at 80 percent for school-based VET and 60 percent for dual VET. Thus, to apply our results to enrolment rates outside these bounds, we require stronger assumptions. Next, we differentiate VET programmes based on a definition that only accounts for the amounts of vocational content and of workplace training. We analyse neither the heterogeneity in quality of education programmes nor the difference in occupational structure nor the occupational specificity of content nor the institutional link between the education system and the labour market. Finally, this chapter focuses on young people's labour market outcomes and does not consider the longer-lasting outcomes of various programmes. Despite these data limitations, our data set is the best currently available.

Third, the internal validity of our results is limited as we do not account for time-variant unobserved heterogeneity that are specific to the youth labour market and we can hence not control for with the adult data for the dependent variables.

To conclude, this chapter indicates that in-depth analyses of the non-linear effects of VET are necessary for a thorough understanding of education programmes' labour market outcomes. Future research should explore the optimal mix of enrolment rates in upper-secondary education programmes and whether this mix depends on the national context.

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Appendix A

Additional material of chapter 1

A.1 Descriptive statistics

Table A.1: Correlation matrix

	No. of occupations (Y)	Registration date (X)	Eligibility (T)	Occupation finder (D)
Registration date (X)	0.03			
Eligibility (T)	0.03	0.76		
Occupation finder (D)	0.13	0.13	0.15	
Gender	-0.03	0.03	0.03	0.02
Urban	0.04	-0.03	-0.04	-0.01
Age	-0.04	-0.04	-0.05	-0.02
Bridge year	0.02	-0.04	-0.01	0.01
Secondary school C	0.01	-0.02	-0.01	0.00
Secondary school B	0.02	0.03	0.01	-0.00
Secondary school A	-0.02	-0.00	-0.00	0.00
Pre-baccalaureate	-0.03	0.02	0.00	-0.00
AG	0.00	0.00	0.02	0.02
AI	-0.01	-0.01	-0.00	-0.01
AR	-0.01	0.01	0.02	0.00
BE	-0.02	0.02	0.04	0.01
BL	-0.01	0.00	-0.01	0.01
BS	-0.02	0.01	-0.00	-0.00
GL	-0.02	-0.01	-0.00	-0.00
GR	-0.00	0.02	0.02	-0.02
LU	0.00	0.01	0.03	0.00
NW	-0.01	0.02	0.01	0.00
OW	-0.01	0.00	-0.01	0.01
SG	-0.01	0.03	0.03	-0.01
SH	-0.01	0.02	0.01	0.01
SO	-0.01	0.01	0.01	-0.01
SZ	-0.03	0.00	0.00	-0.02
TG	0.00	0.04	0.04	0.01
UR	-0.00	0.01	0.00	-0.01
ZG	0.01	0.00	-0.00	0.01
ZH	0.04	-0.07	-0.09	-0.01
Monday	0.00	-0.01	-0.03	-0.02
Tuesday	-0.01	-0.00	-0.00	-0.00
Wednesday	-0.01	-0.02	-0.02	0.01
Thursday	0.01	0.02	0.03	0.01
Friday	0.01	0.03	0.03	-0.00
Saturday	0.01	-0.02	-0.01	0.01
Sunday	-0.01	-0.01	0.01	0.00

Notes: The table shows the correlation matrix for all variables with the number of occupations (Y), registration date (X), eligibility for occupation finder (T) and take up of occupation finder (D).

A.2 Results from robustness checks

Figure A.1: Covariate balance

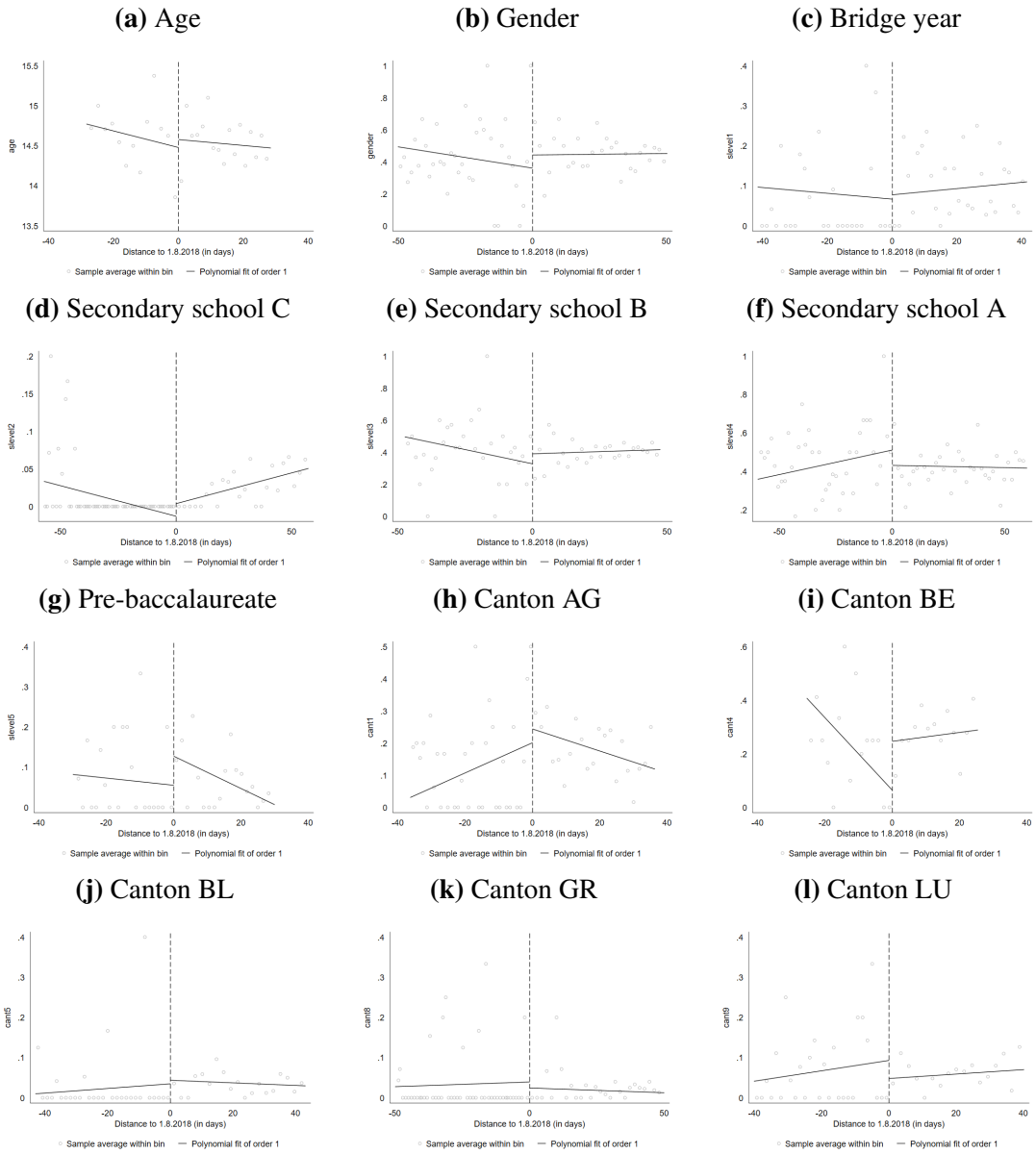
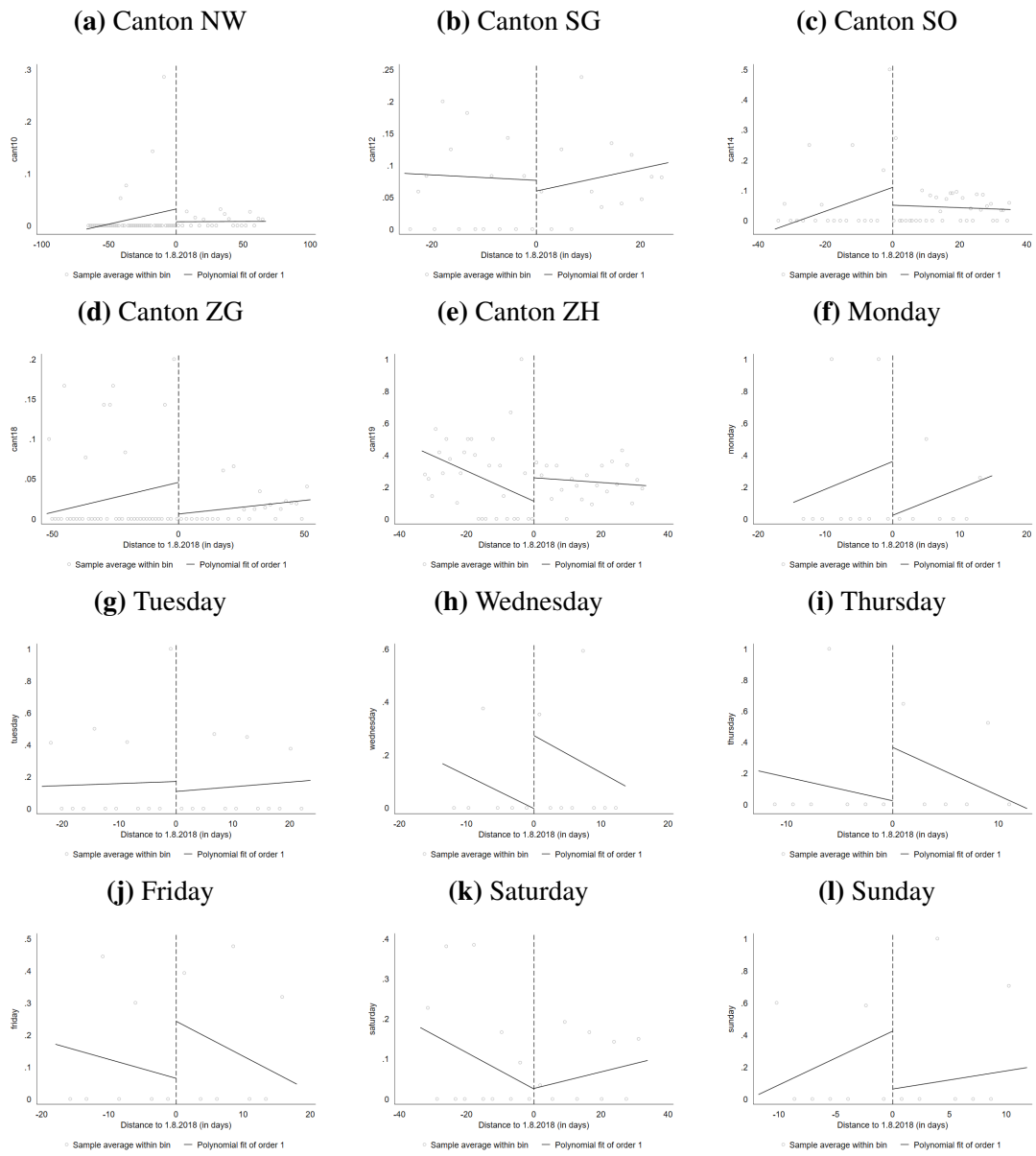
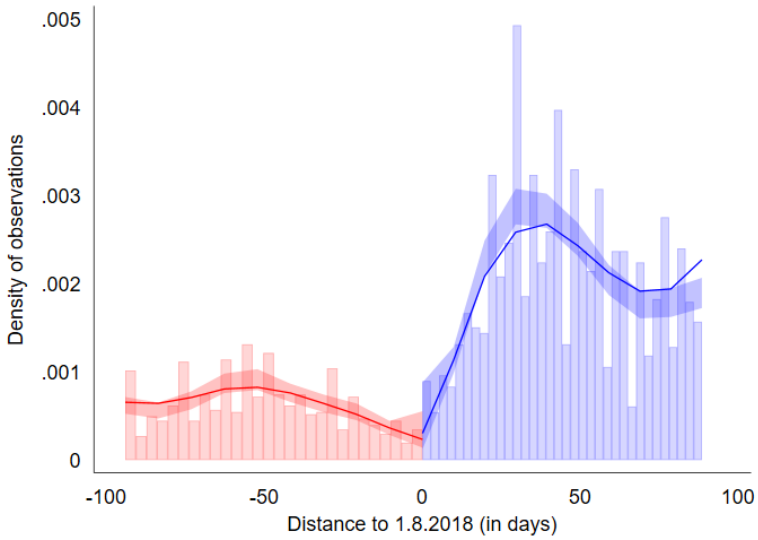


Figure A.1 (continued)



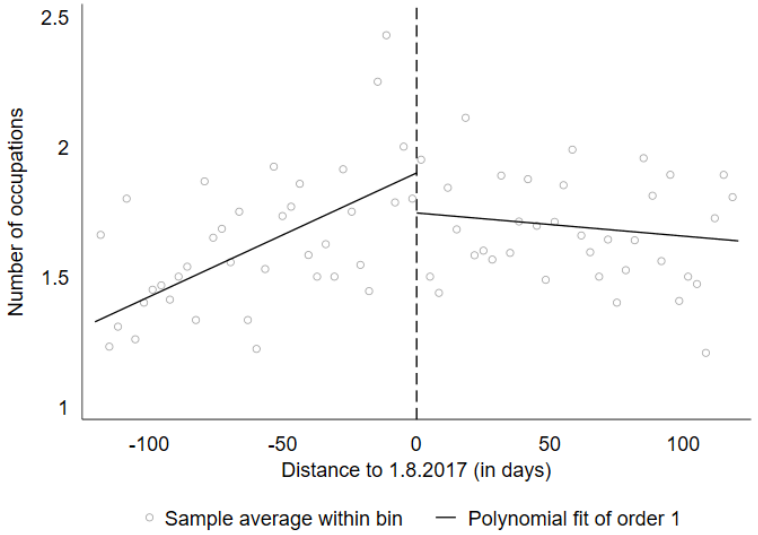
Notes: The figure shows the ITT for all the control variables – age, gender, school programme, canton of residence and weekday of registration – except for the cantons AI, AR, BS, GL, OW, SH, TG and UR due to scarce data or missing values. The y-axis shows the according covariate. The x-axis shows the number of days away from the introduction of the occupation finder. The dots indicate the sample means of number of occupations within a bin and the solid line is the corresponding fitted line. The estimation uses a triangular kernel, a one MSE-optimal bandwidth selector, a first order polynomial fitting and a mimicking variance evenly-spaced method for bin selection.

Figure A.2: Density of the running variable



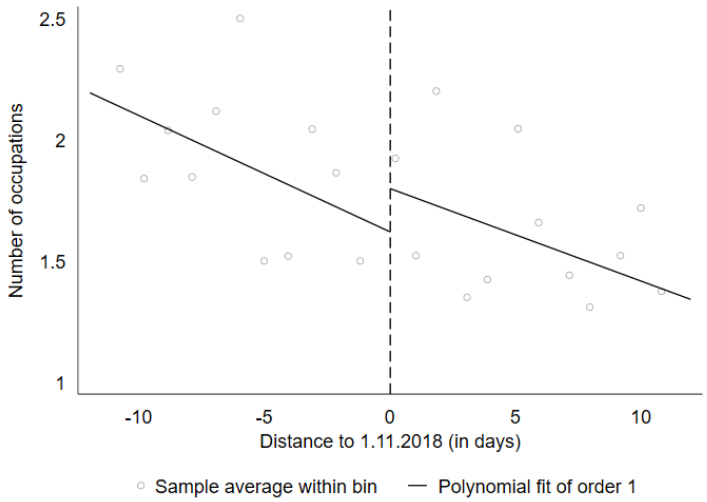
Notes: This figure shows the density for the registration date of students to the Yousty platform. I use the 'rddensity' in Stata by Cattaneo et al. (2018) with the default options.

Figure A.3: Alternative threshold (August 1, 2017)



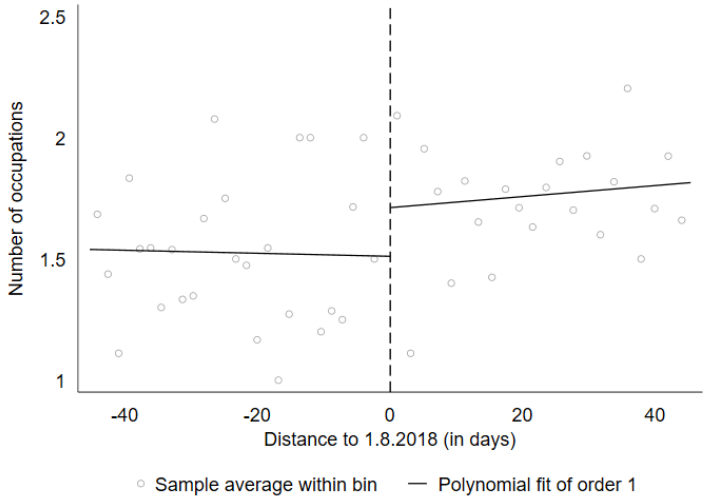
Notes: This figure shows the ITT without control variables for the alternative threshold value August 1, 2017. The data contains only students registering before August 1, 2018. The y-axis shows the number of occupations students apply for job shadowing. The x-axis shows the number of days away from the alternative threshold. The dots indicate the sample means of number of occupations within a bin and the solid line is the corresponding fitted line. The estimation uses a triangular kernel, a one MSE-optimal bandwidth selector, a first order polynomial fitting and a mimicking variance evenly-spaced method for bin selection.

Figure A.4: Alternative threshold (November 1, 2018)



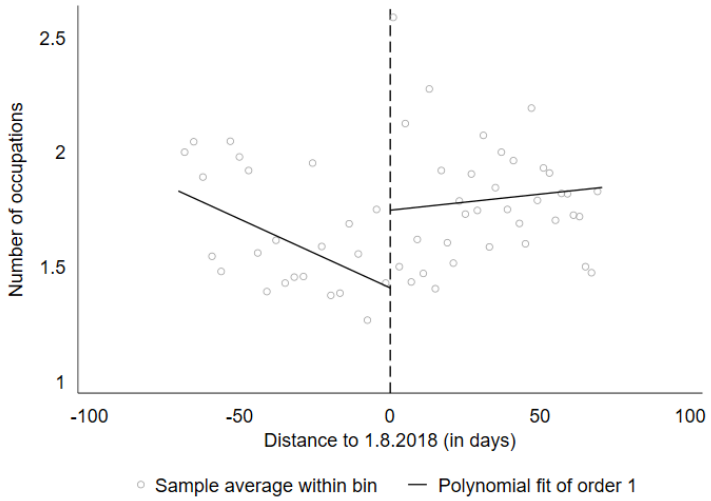
Notes: This figure shows the ITT without control variables for the alternative threshold value November 1, 2018. The data contains only students registering after August 1, 2018. The y-axis shows the number of occupations students apply for job shadowing. The x-axis shows the number of days away from the alternative threshold. The dots indicate the sample means of number of occupations within a bin and the solid line is the corresponding fitted line. The estimation uses a triangular kernel, a one MSE-optimal bandwidth selector, a first order polynomial fitting and a mimicking variance evenly-spaced method for bin selection.

Figure A.5: Donut hole approach (one day to each side of the threshold)



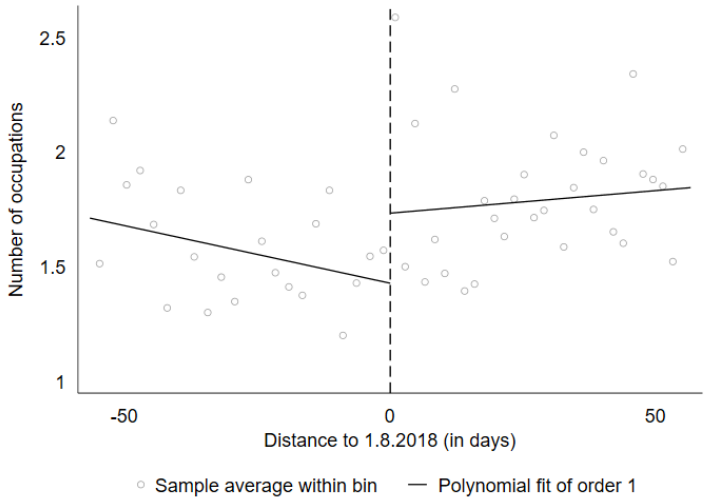
Notes: This figure shows the ITT without control variables excluding the observations of students registering on July 31, 2018 and August 1, 2018. The y-axis shows the number of occupations students apply for job shadowing. The x-axis shows the number of days away from the alternative threshold. The dots indicate the sample means of number of occupations within a bin and the solid line is the corresponding fitted line. The estimation uses a triangular kernel, a one MSE-optimal bandwidth selector, a first order polynomial fitting and a mimicking variance evenly-spaced method for bin selection.

Figure A.6: Alternative bandwidth (plus seven days for each side)



Notes: This figure shows the ITT without control variables. The y-axis shows the number of occupations students apply for job shadowing. The x-axis shows the number of days away from the alternative threshold. The dots indicate the sample means of number of occupations within a bin and the solid line is the corresponding fitted line. The estimation uses a triangular kernel, a one MSE-optimal bandwidth selector adding seven days to each side, a first order polynomial fitting and a mimicking variance evenly-spaced method for bin selection.

Figure A.7: Alternative bandwidth (minus seven days for each side)



Notes: This figure shows the ITT without control variables. The y-axis shows the number of occupations students apply for job shadowing. The x-axis shows the number of days away from the alternative threshold. The dots indicate the sample means of number of occupations within a bin and the solid line is the corresponding fitted line. The estimation uses a triangular kernel, a one MSE-optimal bandwidth selector subtracting seven days to each side, a first order polynomial fitting and a mimicking variance evenly-spaced method for bin selection.

Appendix B

Additional material of chapter 2

B.1 Descriptive statistics

Table B.1: Correlation matrix 1 year post-graduation

	wage	sear	inta	VET	rVET	Age	fem	faedu	moedu	mars	child	UAS	mast	inst	subj	sem	grad	wave	prewe	ints	stuwe	wbe	ex	publ	size	noga	empr	rlVET	net	screen
wage	1.00																													
sear	-0.17	1.00																												
inta	-0.26	0.11	1.00																											
VET	0.20	-0.07	-0.16	1.00																										
rVET	0.17	-0.05	-0.04	0.23	1.00																									
Age	0.13	-0.04	-0.06	0.08	0.15	1.00																								
fem	-0.23	0.05	0.08	-0.25	-0.06	-0.16	1.00																							
faedu	0.02	-0.01	0.03	-0.08	0.07	0.01	-0.02	1.00																						
moedu	-0.03	-0.01	0.04	-0.12	-0.03	0.00	0.01	0.47	1.00																					
mars	0.01	0.00	-0.06	0.02	0.01	0.10	0.01	-0.02	-0.03	1.00																				
child	-0.02	0.00	-0.04	0.03	0.01	0.11	-0.04	-0.01	-0.02	0.33	1.00																			
UAS	0.03	-0.05	-0.20	0.54	0.12	-0.09	-0.03	-0.12	-0.12	0.04	0.04	1.00																		
mast	0.07	0.01	0.10	-0.43	-0.11	0.26	-0.02	0.12	0.11	-0.02	-0.02	-0.76	1.00																	
inst	0.11	-0.08	-0.21	0.49	0.23	-0.04	-0.09	-0.06	-0.08	0.02	0.03	0.83	-0.59	1.00																
subj	0.22	-0.08	-0.19	0.29	0.07	-0.03	-0.32	-0.00	-0.02	-0.01	-0.00	0.21	-0.10	0.31	1.00															
sem	-0.04	0.02	-0.09	0.14	0.05	0.02	0.03	-0.05	-0.04	0.04	0.04	0.28	-0.45	0.20	-0.02	1.00														
grad	0.01	-0.02	-0.00	-0.18	-0.06	0.00	0.08	0.05	0.07	0.01	-0.01	-0.21	0.30	-0.19	-0.03	-0.17	1.00													
wave	-0.04	-0.00	0.00	-0.03	-0.07	0.27	0.02	-0.00	0.05	0.03	0.04	0.01	0.04	0.00	-0.02	0.03	0.05	1.00												
prewe	0.03	-0.03	-0.02	0.09	0.09	0.13	0.00	0.01	-0.01	0.02	0.02	0.11	-0.11	0.09	-0.05	0.05	-0.03	0.02	1.00											
ints	-0.09	0.01	-0.05	-0.32	-0.13	-0.05	0.25	0.03	0.07	0.02	0.00	-0.18	0.16	-0.16	-0.07	-0.03	0.15	0.00	-0.04	1.00										
stuwe	0.01	0.01	0.02	0.02	0.07	0.06	0.08	0.01	-0.00	0.01	0.01	0.01	-0.01	-0.02	-0.13	0.07	0.00	-0.00	0.22	-0.01	1.00									
wbe	0.17	-0.05	-0.13	0.25	0.12	0.22	-0.05	-0.05	-0.06	0.07	0.06	0.27	-0.16	0.25	-0.04	0.26	-0.07	0.08	0.10	-0.25	0.14	1.00								
ex	0.01	0.00	0.08	-0.07	-0.02	0.01	0.02	0.03	0.04	-0.03	-0.01	-0.09	0.09	-0.05	-0.10	-0.03	0.07	-0.01	0.01	-0.01	0.03	-0.06	1.00							
publ	-0.17	0.05	0.00	-0.10	-0.06	-0.04	0.23	-0.06	-0.03	0.03	0.02	0.03	-0.02	-0.05	-0.11	0.02	0.10	0.04	-0.02	0.18	0.00	-0.06	-0.06	1.00						
size	0.22	-0.03	0.00	0.02	0.04	0.01	-0.04	0.01	-0.00	-0.01	-0.00	0.01	0.01	0.02	0.03	-0.03	0.01	0.02	0.00	0.01	0.01	0.05	0.03	0.12	1.00					
noga	-0.25	0.05	0.03	-0.21	-0.11	-0.04	0.29	-0.03	0.02	0.03	0.01	-0.03	0.00	-0.09	-0.27	0.04	0.11	0.05	0.00	0.23	0.02	-0.05	-0.01	0.37	-0.15	1.00				
empr	0.06	-0.02	-0.00	0.12	0.47	0.07	-0.04	0.04	-0.01	-0.02	-0.02	0.05	-0.06	0.23	0.04	0.00	-0.06	-0.03	0.02	-0.10	-0.02	0.05	-0.00	-0.08	0.01	-0.10	1.00			
rlVET	0.20	-0.07	-0.15	0.78	0.17	-0.01	-0.23	-0.07	-0.10	0.01	0.02	0.43	-0.33	0.38	0.28	0.10	-0.13	-0.04	0.07	-0.32	0.02	0.24	-0.05	-0.11	0.03	-0.20	0.09	1.00		
net	-0.03	0.03	-0.04	-0.04	-0.03	0.01	0.02	0.02	0.02	-0.00	0.01	-0.02	0.01	-0.02	-0.02	0.01	-0.00	-0.01	0.01	0.06	0.02	-0.01	-0.01	-0.01	-0.05	0.05	-0.01	-0.04	1.00	
screen	0.09	-0.31	-0.12	0.11	0.02	0.09	-0.08	-0.03	-0.02	0.03	0.03	0.10	-0.08	0.10	0.03	0.11	-0.02	0.04	0.05	-0.08	0.04	0.30	-0.04	-0.02	-0.03	-0.02	0.02	0.11	0.00	1.00

Notes: The table shows the correlation matrix for the data of the one-year post-graduation surveys. The abbreviations stand for the variables wage (wage), search time (sear), internship after graduation (inta), vocational education and training diploma (VET), regional enrolment rate in VET (rVET), female (fem), education of father (faedu), education of mother (moedu), marital status (mars), child (child), type of education being university of applied science (UAS), education level being master level (mast), institution (inst), subject (subj), number of semesters (sem), grade (grad), cohort (wave), work experience gained before higher education (prewe), student internship (ints), student job (stuwe), workbased education (wbe), exchange during studies (ex), public employment (publ), size (size), noga1 (noga), region of employer (empr), VET related to studies and/or employer (rlVET), employment found through social network (net), employment found at previous employer (screen).

Table B.2: Correlation matrix 5 year post-graduation

	wage	unemp	pos	VET	rVET	Age	fem	faedu	moedu	mars	child	UAS	mast	inst	subj	wave	constud	addstud	conedu	publ	size	noga	empr
wage	1.00																						
unemp	-0.10	1.00																					
pos	0.26	-0.10	1.00																				
VET	0.10	-0.07	0.06	1.00																			
rVET	0.10	-0.21	0.09	0.21	1.00																		
Age	0.15	0.04	0.08	0.01	0.14	1.00																	
fem	-0.29	0.03	-0.09	-0.30	-0.02	-0.10	1.00																
faedu	0.05	-0.06	0.03	-0.06	0.07	0.03	-0.01	1.00															
moedu	-0.01	-0.02	0.01	-0.12	-0.04	-0.02	0.06	0.44	1.00														
mars	-0.06	-0.03	0.02	0.02	-0.01	0.12	0.01	-0.01	-0.01	1.00													
child	-0.11	-0.03	-0.00	0.02	-0.03	0.14	0.01	-0.03	-0.02	0.56	1.00												
UAS	-0.10	-0.08	-0.00	0.58	0.16	-0.11	-0.06	-0.10	-0.09	0.02	0.05	1.00											
mast	0.18	0.07	0.06	-0.46	-0.14	0.25	0.01	0.10	0.08	0.01	-0.02	-0.79	1.00										
inst	0.00	-0.11	0.02	0.51	0.24	-0.06	-0.12	-0.04	-0.06	0.02	0.03	0.83	-0.62	1.00									
subj	0.13	-0.13	0.02	0.32	0.06	-0.04	-0.38	0.02	-0.04	0.01	0.01	0.26	-0.11	0.34	1.00								
wave	-0.02	0.02	-0.02	-0.09	0.01	0.28	0.00	0.04	0.04	0.06	0.06	-0.01	0.04	-0.01	-0.02	1.00							
constud	-0.12	-0.02	-0.05	0.02	0.04	-0.10	-0.02	0.02	0.01	-0.08	-0.07	0.00	-0.13	0.00	-0.05	-0.00	1.00						
addstud	0.01	-0.01	0.01	-0.04	-0.03	-0.01	0.07	0.01	0.01	-0.01	-0.02	-0.03	0.03	-0.05	-0.05	-0.01	-0.09	1.00					
conedu	0.01	-0.05	0.06	0.00	0.07	0.01	0.06	0.04	0.01	-0.01	-0.02	0.06	-0.05	0.04	-0.07	0.02	-0.11	-0.06	1.00				
publ	-0.22	-0.02	-0.13	-0.14	-0.06	-0.06	0.26	-0.03	0.01	0.05	0.07	0.04	-0.07	-0.04	-0.13	0.01	-0.00	0.08	0.09	1.00			
size	0.19	-0.03	-0.16	0.00	0.03	-0.00	-0.03	0.02	0.01	0.00	-0.00	0.00	0.01	0.01	0.05	-0.01	0.03	0.04	0.01	0.13	1.00		
noga	-0.27	0.00	-0.09	-0.25	-0.12	-0.06	0.33	-0.03	0.02	0.04	0.05	-0.04	-0.01	-0.11	-0.32	-0.01	0.05	0.10	0.07	0.38	-0.17	1.00	
empr	0.07	-0.12	0.08	0.14	0.51	0.07	-0.02	0.03	-0.04	-0.03	-0.06	0.08	-0.10	0.24	0.04	0.00	0.04	-0.05	0.03	-0.10	0.01	-0.12	1.00

Notes: The table shows the correlation matrix for the data of the five-year post-graduation surveys. The abbreviations stand for the variables wage (wage), unemployment (unemp), position (pos), vocational education and training diploma (VET), regional enrolment rate in VET (rVET), female (fem), education of father (faedu), education of mother (moedu), marital status (mars), child (child), type of education being university of applied science (UAS), education level being master level (mast), institution (inst), subject (subj), wave (wave), continuing studies (constud), additional studies (conadd), continuing education (conedu), work experience gained before higher education (prewe), student internship (ints), student job (stuwe), workbased education (wbe), exchange during studies (ex), public employment (publ), size (size), noga1 (noga), region of employer (empr).

Table B.3: Summary statistics 1 year post-graduation

	ACC			VET		
	Mean	SD	Obs	Mean	SD	Obs
Dependent variables						
Wage in KCHF	69.03	25.07	8558	78.70	20.67	5341
Search time	4.74	5.41	8558	3.98	4.80	5341
Internship	0.22	0.41	8558	0.09	0.29	5341
Instrumental variable						
Regional enrolment rate in VET	0.70	0.12	8558	0.75	0.09	5341
CV: Personal characteristics						
Age	26.10	1.51	8558	26.35	1.73	5341
Female	0.60	0.49	8558	0.34	0.47	5341
Education of father						
Dad: Comp.	0.08	0.26	8558	0.08	0.27	5341
Dad: Upp.-sec.	0.38	0.49	8558	0.47	0.50	5341
Dad: Post-sec.	0.54	0.50	8558	0.45	0.50	5341
Education of mother						
Mom: Comp.	0.09	0.28	8558	0.10	0.30	5341
Mom: Upp.-sec.	0.56	0.50	8558	0.68	0.47	5341
Mom: Post-sec.	0.35	0.48	8558	0.22	0.41	5341
Marital status	0.06	0.24	8558	0.07	0.26	5341
Child	0.02	0.13	8558	0.03	0.16	5341
CV: Education						
UAS	0.41	0.49	8558	0.96	0.21	5341
Master	0.51	0.50	8558	0.09	0.28	5341
Institute						
UNI 1	0.04	0.20	8558	0.00	0.05	5341
UNI 2	0.06	0.24	8558	0.01	0.08	5341
UNI 3	0.06	0.23	8558	0.00	0.06	5341
UNI 4	0.04	0.20	8558	0.00	0.05	5341
UNI 5	0.05	0.23	8558	0.00	0.06	5341
UNI 6	0.01	0.08	8558	0.00	0.02	5341
UNI 7	0.02	0.15	8558	0.00	0.05	5341
UNI 8	0.04	0.19	8558	0.00	0.07	5341
UNI 9	0.08	0.27	8558	0.01	0.08	5341
UNI 10	0.01	0.12	8558	0.00	0.02	5341
UNI 11	0.05	0.23	8558	0.00	0.07	5341
UNI 12	0.12	0.32	8558	0.01	0.08	5341
UAS 1	0.05	0.21	8558	0.12	0.32	5341
UAS 2	0.16	0.37	8558	0.17	0.38	5341
UAS 3	0.04	0.20	8558	0.13	0.34	5341
UAS 4	0.03	0.18	8558	0.11	0.32	5341
UAS 5	0.02	0.13	8558	0.02	0.15	5341
UAS 6	0.03	0.18	8558	0.13	0.34	5341
UAS 7	0.08	0.27	8558	0.26	0.44	5341
UAS 8	0.00	0.02	8558	0.01	0.08	5341
Subject						
Humanities	0.05	0.21	8558	0.01	0.08	5341
Arts	0.04	0.20	8558	0.03	0.16	5341
Edu. Sciences	0.20	0.40	8558	0.06	0.23	5341
Economics	0.27	0.44	8558	0.33	0.47	5341
Nat. Sciences	0.10	0.30	8558	0.01	0.08	5341
Medi. Sciences	0.03	0.17	8558	0.00	0.04	5341
Health	0.10	0.30	8558	0.07	0.26	5341
Engineering	0.08	0.27	8558	0.11	0.31	5341
Agri. Sciences	0.11	0.31	8558	0.39	0.49	5341
Others	0.02	0.13	8558	0.00	0.05	5341
No. of semester	5.97	2.17	8558	6.52	1.44	5341
Grade	5.14	0.39	8558	5.00	0.38	5341
Cohort						
2011	0.10	0.29	8558	0.12	0.32	5341

2013	0.24	0.43	8558	0.22	0.41	5341
2015	0.28	0.45	8558	0.32	0.47	5341
2017	0.38	0.49	8558	0.35	0.48	5341
CV: Experience						
Pre-study job	0.86	0.35	8558	0.91	0.28	5341
Student internship	0.59	0.49	8558	0.26	0.44	5341
Student job	0.87	0.34	8558	0.88	0.32	5341
Work-based high. edu.	0.06	0.24	8558	0.23	0.42	5341
Exchange	0.18	0.38	8558	0.13	0.33	5341
CV: Employer characteristics						
Public empl.	0.36	0.48	8558	0.27	0.44	5341
Company size						
Small	0.34	0.47	8558	0.32	0.47	5341
Medium	0.20	0.40	8558	0.20	0.40	5341
Large	0.46	0.50	8558	0.48	0.50	5341
NOGA1						
Agriculture ...	0.00	0.01	8558	0.00	0.04	5341
Mining ...	0.00	0.00	8558	0.00	0.02	5341
Manufacturing	0.09	0.28	8558	0.20	0.40	5341
Electricity ...	0.01	0.08	8558	0.01	0.10	5341
Water Supply ...	0.00	0.04	8558	0.00	0.04	5341
Construction	0.01	0.09	8558	0.02	0.13	5341
Wholesale ...	0.07	0.26	8558	0.06	0.23	5341
Transportation ...	0.02	0.15	8558	0.03	0.16	5341
Accommodation ...	0.01	0.12	8558	0.01	0.08	5341
Information ...	0.07	0.26	8558	0.10	0.30	5341
Financial ...	0.08	0.27	8558	0.10	0.29	5341
Real Estate	0.00	0.07	8558	0.01	0.08	5341
Scientific ...	0.22	0.42	8558	0.24	0.43	5341
Administrative ...	0.03	0.16	8558	0.02	0.15	5341
Public ...	0.06	0.23	8558	0.03	0.17	5341
Education	0.08	0.28	8558	0.05	0.22	5341
Health ...	0.18	0.38	8558	0.11	0.31	5341
Arts ...	0.03	0.17	8558	0.01	0.09	5341
Other service ...	0.03	0.17	8558	0.01	0.11	5341
Extraterritorial ...	0.01	0.07	8558	0.00	0.01	5341
Employer region						
Geneva	0.08	0.27	8558	0.02	0.15	5341
Lausanne	0.12	0.32	8558	0.06	0.23	5341
Sion	0.03	0.17	8558	0.02	0.15	5341
Fribourg	0.03	0.18	8558	0.03	0.16	5341
Neuchatel	0.03	0.16	8558	0.02	0.14	5341
Biel	0.03	0.16	8558	0.04	0.19	5341
Bern	0.11	0.32	8558	0.12	0.33	5341
Basel	0.06	0.24	8558	0.05	0.22	5341
Aarau-Olten	0.03	0.17	8558	0.05	0.21	5341
Zurich	0.29	0.45	8558	0.34	0.47	5341
Winterthur-SH	0.02	0.15	8558	0.06	0.24	5341
St. Gallen	0.03	0.17	8558	0.07	0.26	5341
Chur	0.01	0.12	8558	0.02	0.14	5341
Luzern	0.04	0.20	8558	0.06	0.25	5341
Bellinzona	0.01	0.12	8558	0.01	0.09	5341
Lugano	0.02	0.15	8558	0.01	0.10	5341
Abroad	0.04	0.19	8558	0.02	0.14	5341
Channel						
Related VET	0.00	0.00	8558	0.71	0.45	5341
Network	0.22	0.41	7461	0.19	0.39	4258
Screening	0.08	0.28	8476	0.15	0.36	5295

Notes: The table shows the unweighted summary statistics including mean, standard deviation (SD), and number of observations (Obs) for the data of the one-year post-graduation surveys. The columns under ACC display the statistics for higher education graduates with an academic diploma in upper-secondary education. The columns under VET display the statistics for higher education graduates with a VET diploma in upper-secondary education.

Table B.4: Summary statistics 5 years post-graduation

	ACC			VET		
	Mean	SD	Obs	Mean	SD	Obs
Wage in KCHF	83.90	31.97	1991	90.43	29.73	1327
Unemployment	0.20	0.40	1991	0.14	0.35	1327
Position	2.49	0.77	1991	2.60	0.81	1327
Instrumental variable						
Regional enrolment rate in VET	0.71	0.11	1991	0.75	0.09	1327
CV: Personal characteristics						
Age	29.67	1.23	1991	29.69	1.31	1327
Female	0.62	0.48	1991	0.31	0.46	1327
Education of father						
Dad: Comp.	0.07	0.25	1991	0.07	0.26	1327
Dad: Upp.-sec.	0.40	0.49	1991	0.47	0.50	1327
Dad: Post-sec.	0.53	0.50	1991	0.46	0.50	1327
Education of mother						
Mom: Comp.	0.09	0.29	1991	0.11	0.31	1327
Mom: Upp.-sec.	0.60	0.49	1991	0.70	0.46	1327
Mom: Post-sec.	0.31	0.46	1991	0.19	0.40	1327
Marital status	0.20	0.40	1991	0.22	0.41	1327
Child	0.12	0.33	1991	0.14	0.34	1327
CV: Education						
UAS	0.40	0.49	1991	0.97	0.17	1327
Master	0.49	0.50	1991	0.05	0.22	1327
Institute						
UNI 1	0.05	0.21	1991	0.00	0.03	1327
UNI 2	0.07	0.25	1991	0.00	0.06	1327
UNI 3	0.05	0.21	1991	0.00	0.05	1327
UNI 4	0.05	0.22	1991	0.00	0.05	1327
UNI 5	0.06	0.24	1991	0.01	0.07	1327
UNI 6	0.01	0.08	1991	0.00	0.00	1327
UNI 7	0.03	0.18	1991	0.00	0.07	1327
UNI 8	0.03	0.16	1991	0.00	0.03	1327
UNI 9	0.07	0.26	1991	0.00	0.07	1327
UNI 10	0.01	0.12	1991	0.00	0.00	1327
UNI 11	0.06	0.24	1991	0.00	0.05	1327
UNI 12	0.12	0.32	1991	0.00	0.04	1327
UAS 1	0.05	0.22	1991	0.12	0.33	1327
UAS 2	0.16	0.36	1991	0.19	0.39	1327
UAS 3	0.03	0.17	1991	0.13	0.34	1327
UAS 4	0.03	0.18	1991	0.11	0.31	1327
UAS 5	0.01	0.12	1991	0.03	0.17	1327
UAS 6	0.03	0.17	1991	0.15	0.36	1327
UAS 7	0.09	0.28	1991	0.23	0.42	1327
UAS 8	0.00	0.00	1991	0.00	0.06	1327
Subject						
Humanities	0.05	0.21	1991	0.01	0.09	1327
Arts	0.03	0.17	1991	0.02	0.13	1327
Edu. Sciences	0.23	0.42	1991	0.05	0.21	1327
Economics	0.24	0.43	1991	0.31	0.46	1327
Nat. Sciences	0.09	0.29	1991	0.00	0.07	1327
Medi. Sciences	0.03	0.18	1991	0.00	0.00	1327
Health	0.11	0.32	1991	0.06	0.24	1327
Engineering	0.07	0.26	1991	0.09	0.29	1327
Agri. Sciences	0.13	0.33	1991	0.45	0.50	1327
Others	0.02	0.14	1991	0.00	0.03	1327
Cohort						
2015	0.31	0.46	1991	0.39	0.49	1327
2017	0.69	0.46	1991	0.61	0.49	1327
Cont. studies	0.12	0.32	1991	0.13	0.34	1327
Add. studies	0.11	0.32	1991	0.09	0.29	1327

Cont. education	0.12	0.33	1991	0.12	0.33	1327
CV: Employer characteristics						
Public empl.	0.35	0.48	1991	0.22	0.41	1327
Company size						
Small	0.32	0.47	1991	0.30	0.46	1327
Medium	0.19	0.39	1991	0.21	0.41	1327
Large	0.50	0.50	1991	0.49	0.50	1327
NOGA1						
Manufacturing	0.10	0.30	1991	0.25	0.43	1327
Electricity ...	0.01	0.09	1991	0.01	0.12	1327
Water Supply ...	0.00	0.05	1991	0.00	0.00	1327
Construction	0.01	0.09	1991	0.01	0.12	1327
Wholesale ...	0.07	0.25	1991	0.08	0.26	1327
Transportation ...	0.03	0.16	1991	0.02	0.16	1327
Accommodation ...	0.01	0.08	1991	0.00	0.07	1327
Information ...	0.08	0.27	1991	0.11	0.32	1327
Financial ...	0.08	0.27	1991	0.09	0.28	1327
Real Estate	0.00	0.06	1991	0.01	0.08	1327
Scientific ...	0.21	0.41	1991	0.21	0.41	1327
Administrative ...	0.02	0.14	1991	0.02	0.12	1327
Public ...	0.07	0.26	1991	0.04	0.19	1327
Education	0.05	0.21	1991	0.03	0.17	1327
Health ...	0.21	0.40	1991	0.09	0.28	1327
Arts ...	0.02	0.15	1991	0.01	0.10	1327
Other service ...	0.04	0.19	1991	0.02	0.13	1327
Extraterritorial ...	0.00	0.06	1991	0.00	0.04	1327
Employer region						
Geneva	0.07	0.26	1991	0.03	0.16	1327
Lausanne	0.13	0.34	1991	0.06	0.24	1327
Sion	0.04	0.19	1991	0.03	0.17	1327
Fribourg	0.03	0.17	1991	0.03	0.16	1327
Neuchatel	0.02	0.15	1991	0.03	0.18	1327
Biel	0.03	0.18	1991	0.05	0.21	1327
Bern	0.12	0.33	1991	0.11	0.31	1327
Basel	0.06	0.23	1991	0.04	0.21	1327
Aarau-Olten	0.03	0.17	1991	0.05	0.22	1327
Zurich	0.29	0.46	1991	0.32	0.47	1327
Winterthur-SH	0.03	0.17	1991	0.06	0.24	1327
St. Gallen	0.04	0.19	1991	0.06	0.24	1327
Chur	0.02	0.12	1991	0.02	0.15	1327
Luzern	0.05	0.22	1991	0.06	0.24	1327
Bellinzona	0.01	0.12	1991	0.01	0.10	1327
Lugano	0.02	0.15	1991	0.02	0.15	1327
Abroad	0.01	0.07	1991	0.01	0.10	1327

Notes: The table shows the unweighted summary statistics including mean, standard deviation (SD), and number of observations (Obs) for the data of the five-year post-graduation surveys. The columns under ACC display the statistics for higher education graduates with an academic diploma in upper-secondary education. The columns under VET display the statistics for higher education graduates with a VET diploma in upper-secondary education.

B.2 Complete estimation results

Table B.5: Regression table for wage one year post-graduation

	Tobit1		Tobit2		IV1		IV2		IV3		IV4	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
A. First stage												
Reg. enrol. rate VET					3.222***	(0.11)	1.354***	(0.33)	3.654***	(0.71)	0.901	(1.01)
B. Second stage												
VET	0.169***	(0.01)	0.069***	(0.01)	0.407***	(0.01)	0.189***	(0.03)	0.289***	(0.01)	0.192***	(0.03)
Age			0.013***	(0.00)			0.009***	(0.00)			0.008***	(0.00)
Female			-0.052***	(0.01)			-0.041***	(0.01)			-0.040***	(0.01)
Dad: Upp.-sec.			-0.000	(0.01)			-0.004	(0.01)			-0.004	(0.01)
Dad: Post-sec.			0.001	(0.01)			-0.001	(0.01)			-0.001	(0.01)
Mom: Upp.-sec.			-0.004	(0.01)			-0.005	(0.01)			-0.005	(0.01)
Mom: Post-sec.			-0.012	(0.01)			-0.007	(0.01)			-0.007	(0.01)
Marital status			0.020*	(0.01)			0.020*	(0.01)			0.021*	(0.01)
Child			-0.077***	(0.02)			-0.076***	(0.02)			-0.076***	(0.02)
Res: BE			-0.053***	(0.02)			-0.052***	(0.02)			-0.058***	(0.02)
Res: LU			-0.018	(0.02)			-0.013	(0.02)			-0.029	(0.02)
Res: UR			-0.027	(0.05)			-0.024	(0.05)			-0.015	(0.08)
Res: SZ			-0.009	(0.02)			-0.002	(0.02)			0.003	(0.03)
Res: OW			-0.129*	(0.07)			-0.122*	(0.07)			-0.134*	(0.07)
Res: NW			-0.141**	(0.06)			-0.132**	(0.06)			-0.082	(0.07)
Res: GL			-0.035	(0.05)			-0.022	(0.05)			0.045	(0.07)
Res: ZG			0.019	(0.02)			0.018	(0.02)			0.025	(0.03)
Res: FR			-0.042*	(0.02)			-0.043*	(0.03)			-0.077***	(0.03)
Res: SO			0.014	(0.02)			0.014	(0.02)			-0.012	(0.02)
Res: BS			-0.067**	(0.03)			-0.058**	(0.03)			-0.086***	(0.03)
Res: BL			0.003	(0.03)			0.011	(0.03)			-0.045	(0.03)
Res: SH			-0.047	(0.03)			-0.050	(0.03)			-0.026	(0.04)
Res: AR			-0.034	(0.05)			-0.041	(0.05)			-0.047	(0.06)
Res: AI			0.033	(0.11)			0.031	(0.10)			-0.050	(0.16)
Res: SG			0.011	(0.02)			0.006	(0.02)			0.006	(0.02)
Res: GR			-0.046	(0.03)			-0.041	(0.03)			-0.028	(0.03)
Res: AG			-0.003	(0.01)			-0.008	(0.01)			-0.023	(0.02)
Res: TG			0.001	(0.02)			-0.004	(0.02)			-0.015	(0.02)
Res: TI			-0.092***	(0.03)			-0.087***	(0.03)			-0.052	(0.05)
Res: VD			-0.080***	(0.03)			-0.078***	(0.03)			-0.096***	(0.03)
Res: VS			-0.013	(0.03)			-0.006	(0.03)			-0.029	(0.03)
Res: NE			-0.107***	(0.04)			-0.103***	(0.04)			-0.101**	(0.04)
Res: GE			-0.135***	(0.03)			-0.123***	(0.04)			-0.166***	(0.04)
Res: JU			-0.067*	(0.03)			-0.069**	(0.03)			-0.079*	(0.05)
UAS			0.228***	(0.04)			0.165***	(0.05)			0.168***	(0.05)
Master			0.158***	(0.02)			0.173***	(0.02)			0.174***	(0.02)
UNI 2			0.006	(0.03)			0.004	(0.03)			0.007	(0.03)
UNI 3			0.101***	(0.03)			0.097***	(0.03)			0.097***	(0.03)
UNI 4			0.043	(0.04)			0.031	(0.04)			0.028	(0.04)
UNI 5			-0.080**	(0.04)			-0.084**	(0.04)			-0.084**	(0.04)
UNI 6			0.025	(0.07)			0.021	(0.07)			0.026	(0.07)
UNI 7			-0.065	(0.04)			-0.076*	(0.04)			-0.076*	(0.04)
UNI 8			0.189***	(0.03)			0.190***	(0.03)			0.193***	(0.03)
UNI 9			0.029	(0.03)			0.030	(0.03)			0.036	(0.03)
UNI 10			-0.064	(0.05)			-0.063	(0.05)			-0.057	(0.05)
UNI 11			0.032	(0.03)			0.041	(0.03)			0.038	(0.03)
UNI 12			0.077***	(0.03)			0.093***	(0.03)			0.096***	(0.03)
UAS 1			-0.075**	(0.03)			-0.063*	(0.03)			-0.065*	(0.03)
UAS 2			-0.079**	(0.03)			-0.051	(0.04)			-0.056	(0.04)
UAS 3			-0.076**	(0.03)			-0.065*	(0.04)			-0.070**	(0.04)
UAS 4			-0.069**	(0.03)			-0.063*	(0.04)			-0.066*	(0.04)
UAS 5			-0.127***	(0.04)			-0.109**	(0.05)			-0.107**	(0.05)
UAS 6			-0.100***	(0.03)			-0.089**	(0.04)			-0.086**	(0.04)
UAS 7			-0.089***	(0.03)			-0.081**	(0.03)			-0.079**	(0.03)
UAS 8			0.000	(.)								
Arts			-0.333***	(0.04)			-0.317***	(0.04)			-0.317***	(0.04)
Edu. Sciences			0.150***	(0.03)			0.142***	(0.03)			0.142***	(0.03)
Economics			0.229***	(0.03)			0.217***	(0.03)			0.215***	(0.03)
Nat. Sciences			0.147***	(0.03)			0.132***	(0.03)			0.131***	(0.03)
Medi. Sciences			0.238***	(0.04)			0.216***	(0.04)			0.216***	(0.04)
Health			0.240***	(0.03)			0.234***	(0.03)			0.231***	(0.03)
Engineering			0.209***	(0.03)			0.180***	(0.03)			0.179***	(0.03)
Agri. Sciences			0.245***	(0.03)			0.214***	(0.03)			0.213***	(0.03)
Others			0.028	(0.05)			0.011	(0.05)			0.013	(0.05)
No. of semester			0.000	(0.00)			0.002	(0.00)			0.002	(0.00)
Grade			0.054***	(0.01)			0.051***	(0.01)			0.050***	(0.01)
Cohort=2013			-0.062***	(0.01)			-0.052***	(0.01)			-0.052***	(0.01)
Cohort=2015			-0.071***	(0.01)			-0.063***	(0.01)			-0.063***	(0.01)

Cohort=2017	-0.080***	(0.01)	-0.070***	(0.01)		-0.070*** (0.01)
Pre-study job	0.004	(0.01)	0.006	(0.01)		0.007 (0.01)
Student internship	0.034***	(0.01)	0.047***	(0.01)		0.047*** (0.01)
Student job	-0.006	(0.01)	-0.008	(0.01)		-0.009 (0.01)
Work-based high. edu.	0.066***	(0.01)	0.058***	(0.01)		0.059*** (0.01)
Exchange	-0.003	(0.01)	-0.003	(0.01)		-0.003 (0.01)
Public empl.	-0.015	(0.01)	-0.016*	(0.01)		-0.016* (0.01)
Medium	0.081***	(0.01)	0.081***	(0.01)		0.081*** (0.01)
Large	0.121***	(0.01)	0.121***	(0.01)		0.120*** (0.01)
Manufacturing	0.317**	(0.16)	0.338**	(0.16)		0.338** (0.15)
Electricity ...	0.405**	(0.16)	0.424***	(0.16)		0.426*** (0.16)
Water Supply ...	0.411**	(0.16)	0.436***	(0.16)		0.433*** (0.16)
Construction	0.323**	(0.16)	0.339**	(0.16)		0.338** (0.16)
Wholesale ...	0.298*	(0.16)	0.323**	(0.16)		0.325** (0.16)
Transportation ...	0.240	(0.16)	0.273*	(0.16)		0.274* (0.16)
Accommodation ...	-0.016	(0.17)	0.021	(0.17)		0.023 (0.16)
Information ...	0.318**	(0.16)	0.341**	(0.16)		0.342** (0.16)
Financial ...	0.390**	(0.16)	0.414***	(0.16)		0.415*** (0.16)
Real Estate	0.269	(0.17)	0.291*	(0.16)		0.291* (0.16)
Scientific ...	0.321**	(0.16)	0.346**	(0.16)		0.347** (0.16)
Administrative ...	0.240	(0.16)	0.270*	(0.16)		0.272* (0.16)
Public ...	0.234	(0.16)	0.264*	(0.16)		0.264* (0.16)
Education	0.154	(0.16)	0.183	(0.16)		0.183 (0.16)
Health ...	0.204	(0.16)	0.236	(0.16)		0.238 (0.16)
Arts ...	0.087	(0.17)	0.120	(0.16)		0.120 (0.16)
Other service ...	0.088	(0.16)	0.118	(0.16)		0.120 (0.16)
Extraterritorial ...	0.088	(0.20)	0.120	(0.20)		0.128 (0.20)
Lausanne	-0.090***	(0.02)	-0.089***	(0.02)		-0.087*** (0.02)
Sion	-0.096***	(0.03)	-0.102***	(0.03)		-0.101*** (0.03)
Fribourg	-0.088***	(0.03)	-0.088***	(0.03)		-0.089*** (0.03)
Neuchatel	-0.074**	(0.04)	-0.079**	(0.04)		-0.077** (0.04)
Biel	-0.038	(0.03)	-0.043	(0.03)		-0.043 (0.03)
Bern	-0.047	(0.03)	-0.052*	(0.03)		-0.052* (0.03)
Basel	-0.096***	(0.03)	-0.094***	(0.03)		-0.093*** (0.03)
Aarau-Olten	-0.068**	(0.03)	-0.066**	(0.03)		-0.067** (0.03)
Zurich	-0.036	(0.03)	-0.036	(0.03)		-0.036 (0.03)
Winterthur-SH	-0.020	(0.03)	-0.025	(0.03)		-0.027 (0.03)
St. Gallen	-0.043	(0.04)	-0.045	(0.04)		-0.046 (0.04)
Chur	-0.027	(0.04)	-0.026	(0.04)		-0.029 (0.04)
Luzern	-0.036	(0.03)	-0.036	(0.03)		-0.036 (0.03)
Bellinzona	-0.036	(0.05)	-0.038	(0.05)		-0.040 (0.05)
Lugano	-0.184***	(0.05)	-0.181***	(0.05)		-0.183*** (0.05)
Abroad	-0.249***	(0.06)	-0.249***	(0.06)		-0.248*** (0.06)
Ori: BE					-0.061*** (0.01)	0.012 (0.02)
Ori: LU					0.030** (0.02)	0.028 (0.02)
Ori: UR					0.022 (0.04)	-0.003 (0.06)
Ori: SZ					0.049** (0.02)	0.001 (0.03)
Ori: OW					-0.052 (0.06)	0.020 (0.05)
Ori: NW					-0.120* (0.06)	-0.052 (0.06)
Ori: GL					-0.056 (0.05)	-0.075 (0.06)
Ori: ZG					0.048 (0.03)	-0.009 (0.03)
Ori: FR					-0.044** (0.02)	0.051** (0.02)
Ori: SO					0.003 (0.02)	0.040* (0.02)
Ori: BS					-0.127*** (0.04)	0.020 (0.04)
Ori: BL					0.010 (0.02)	0.075*** (0.03)
Ori: SH					-0.035 (0.03)	-0.023 (0.03)
Ori: AR					-0.030 (0.04)	0.012 (0.03)
Ori: AI					0.189*** (0.07)	0.110 (0.10)
Ori: SG					0.017 (0.02)	0.005 (0.02)
Ori: GR					-0.041* (0.02)	-0.010 (0.02)
Ori: AG					0.006 (0.01)	0.025 (0.02)
Ori: TG					0.004 (0.02)	0.017 (0.02)
Ori: TI					-0.157*** (0.02)	-0.028 (0.04)
Ori: VD					-0.092*** (0.02)	0.027 (0.02)
Ori: VS					-0.032** (0.02)	0.032 (0.03)
Ori: NE					-0.151*** (0.03)	0.003 (0.03)
Ori: GE					-0.034* (0.02)	0.059* (0.03)
Ori: JU					-0.113*** (0.03)	0.019 (0.04)
Constant	11.069***	(0.01)	9.980*** (0.19)	10.977*** (0.01)	10.030*** (0.18)	11.056*** (0.01) 10.036*** (0.18)
Observations	13571		13571	13571	13571	13571
Pseudo R^2	0.038		0.336			

Notes: The table shows the regression coefficients (Coef.) and standard errors (SE) from the tobit regressions (first two columns) and IV regressions (last four columns) on wage (ln). The data is from the one-year post-graduation surveys. Columns Tobit1 and IV1 include no controls, whereas IV3 includes region of origin fixed effects. Columns Tobit2 and IV2 include all controls, whereas IV4 additionally includes region of origin fixed effects. The estimations from the first stage include the same controls as the estimations from the second stage. Standard errors are robust and no sampling weights are used. ***,** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B.6: Regression table for search time of first post-graduation employment

	Cox1		Cox2		IV1		IV2		IV3		IV4	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
A. First stage												
Reg. enrol. rate VET					0.001	(.)	0.482*	(0.26)	0.003**	(0.00)	0.316	(0.71)
B. Second stage												
VET	0.079***	(0.02)	0.041*	(0.02)	-2.630	(.)	-1.958***	(0.04)	-2.627***	(0.01)	-1.946***	(0.04)
Age			0.012**	(0.01)			0.044***	(0.01)			0.044***	(0.01)
Female			0.009	(0.02)			-0.202***	(0.03)			-0.202***	(0.03)
Dad: Upp.-sec.			-0.007	(0.04)			0.078	(0.05)			0.078	(0.05)
Dad: Post-sec.			-0.000	(0.04)			0.026	(0.05)			0.025	(0.05)
Mom: Upp.-sec.			0.037	(0.03)			-0.041	(0.04)			-0.044	(0.04)
Mom: Post-sec.			0.065*	(0.03)			-0.177***	(0.05)			-0.182***	(0.05)
Marital status			-0.039	(0.03)			0.052	(0.05)			0.053	(0.05)
Child			-0.050	(0.05)			0.035	(0.08)			0.027	(0.08)
Res: BE			0.010	(0.04)			-0.020	(0.06)			0.075	(0.07)
Res: LU			-0.051	(0.05)			-0.020	(0.06)			0.070	(0.08)
Res: UR			-0.072	(0.15)			0.047	(0.19)			-0.042	(0.29)
Res: SZ			-0.138**	(0.06)			0.065	(0.09)			0.166	(0.12)
Res: OW			-0.054	(0.13)			0.007	(0.17)			0.185	(0.25)
Res: NW			-0.221	(0.16)			0.055	(0.22)			0.241	(0.29)
Res: GL			-0.013	(0.12)			-0.151	(0.23)			-0.172	(0.30)
Res: ZG			-0.146**	(0.07)			0.167*	(0.10)			0.286**	(0.12)
Res: FR			-0.014	(0.06)			0.034	(0.09)			0.160	(0.10)
Res: SO			-0.006	(0.05)			0.022	(0.08)			0.044	(0.09)
Res: BS			-0.085	(0.06)			-0.050	(0.09)			0.130	(0.10)
Res: BL			-0.014	(0.07)			-0.144	(0.09)			0.155	(0.11)
Res: SH			-0.118	(0.09)			0.183	(0.14)			0.314*	(0.18)
Res: AR			-0.153	(0.11)			0.320*	(0.17)			0.467***	(0.18)
Res: AI			-0.245	(0.23)			0.328	(0.30)			0.749**	(0.38)
Res: SG			-0.003	(0.05)			0.067	(0.07)			0.085	(0.08)
Res: GR			0.027	(0.07)			-0.095	(0.10)			0.038	(0.12)
Res: AG			-0.002	(0.04)			0.087*	(0.05)			0.108*	(0.06)
Res: TG			-0.099*	(0.05)			0.249***	(0.08)			0.344***	(0.10)
Res: TI			-0.099	(0.08)			0.028	(0.10)			0.068	(0.15)
Res: VD			-0.108*	(0.06)			0.059	(0.09)			0.185*	(0.10)
Res: VS			-0.033	(0.07)			-0.046	(0.09)			0.133	(0.12)
Res: NE			-0.121	(0.08)			0.001	(0.12)			0.272*	(0.14)
Res: GE			-0.195**	(0.08)			-0.020	(0.11)			0.272**	(0.14)
Res: JU			-0.182**	(0.09)			0.237*	(0.14)			0.414**	(0.19)
UAS			-0.154	(0.18)			1.133***	(0.26)			1.075***	(0.26)
Master			0.028	(0.03)			-0.246***	(0.04)			-0.238***	(0.04)
UNI 2			-0.006	(0.06)			0.012	(0.08)			-0.001	(0.08)
UNI 3			0.077	(0.07)			-0.035	(0.09)			-0.035	(0.09)
UNI 4			0.115	(0.08)			0.025	(0.10)			0.045	(0.10)
UNI 5			-0.003	(0.07)			0.058	(0.09)			0.075	(0.09)
UNI 6			0.104	(0.13)			-0.086	(0.16)			-0.112	(0.16)
UNI 7			0.053	(0.08)			0.091	(0.11)			0.117	(0.11)
UNI 8			-0.044	(0.07)			-0.009	(0.09)			-0.020	(0.09)
UNI 9			0.111*	(0.06)			-0.153**	(0.08)			-0.193**	(0.08)
UNI 10			-0.065	(0.10)			0.099	(0.14)			0.100	(0.14)
UNI 11			0.103	(0.08)			-0.316***	(0.10)			-0.288***	(0.10)
UNI 12			0.148**	(0.06)			-0.485***	(0.08)			-0.492***	(0.08)
UAS 1			0.248	(0.17)			-0.547**	(0.26)			-0.499**	(0.25)
UAS 2			0.252	(0.17)			-0.793***	(0.26)			-0.713***	(0.25)
UAS 3			0.270	(0.17)			-0.537**	(0.26)			-0.497**	(0.25)
UAS 4			0.388**	(0.17)			-0.591**	(0.26)			-0.547**	(0.25)
UAS 5			0.408**	(0.18)			-0.742***	(0.27)			-0.691**	(0.27)
UAS 6			0.344**	(0.17)			-0.615**	(0.26)			-0.588**	(0.25)
UAS 7			0.298*	(0.17)			-0.518**	(0.25)			-0.504**	(0.25)
UAS 8			0.000	(.)								
Arts			-0.124*	(0.07)			-0.142	(0.09)			-0.136	(0.09)
Edu. Sciences			0.047	(0.05)			0.059	(0.07)			0.056	(0.07)
Economics			0.098**	(0.05)			0.070	(0.07)			0.067	(0.07)
Nat. Sciences			0.019	(0.05)			0.217***	(0.07)			0.215***	(0.07)
Medi. Sciences			0.213***	(0.08)			0.037	(0.10)			0.019	(0.10)
Health			0.185***	(0.06)			-0.079	(0.08)			-0.079	(0.08)
Engineering			0.232***	(0.06)			0.218***	(0.08)			0.217***	(0.08)
Agri. Sciences			0.125**	(0.05)			0.410***	(0.07)			0.402***	(0.07)
Others			-0.165*	(0.08)			0.506***	(0.11)			0.485***	(0.11)
No. of semester			-0.026***	(0.00)			0.010	(0.01)			0.009	(0.01)
Grade			0.071***	(0.02)			-0.036	(0.03)			-0.035	(0.03)
Cohort=2013			-0.084**	(0.03)			-0.040	(0.04)			-0.036	(0.04)
Cohort=2015			-0.117***	(0.03)			0.040	(0.04)			0.041	(0.04)
Cohort=2017			-0.098***	(0.03)			-0.017	(0.04)			-0.012	(0.04)
Pre-study job			0.053**	(0.02)			-0.085**	(0.03)			-0.083**	(0.03)
Student internship			0.031*	(0.02)			-0.253***	(0.03)			-0.248***	(0.03)

Student job		-0.047*	(0.02)		0.090***	(0.03)			0.086**	(0.03)	
Work-based high. edu.		-0.176***	(0.03)		0.391***	(0.04)			0.379***	(0.04)	
Exchange		0.050**	(0.02)		-0.046	(0.03)			-0.044	(0.03)	
Public empl.		-0.029	(0.02)		0.050*	(0.03)			0.047	(0.03)	
Medium		0.053**	(0.02)		-0.052	(0.03)			-0.054*	(0.03)	
Large		0.060***	(0.02)		-0.042	(0.03)			-0.037	(0.03)	
Manufacturing		-0.729**	(0.28)		0.438	(0.42)			0.459	(0.42)	
Electricity ...		-0.694**	(0.29)		0.419	(0.44)			0.445	(0.44)	
Water Supply ...		-0.968***	(0.35)		0.636	(0.55)			0.687	(0.54)	
Construction		-0.922***	(0.29)		0.769*	(0.44)			0.784*	(0.44)	
Wholesale ...		-0.752***	(0.28)		0.377	(0.43)			0.399	(0.42)	
Transportation ...		-0.860***	(0.29)		0.378	(0.43)			0.406	(0.43)	
Accommodation ...		-1.070***	(0.29)		0.646	(0.44)			0.650	(0.44)	
Information ...		-0.748***	(0.28)		0.400	(0.42)			0.421	(0.42)	
Financial ...		-0.735***	(0.28)		0.403	(0.42)			0.427	(0.42)	
Real Estate		-0.651**	(0.30)		0.339	(0.45)			0.368	(0.45)	
Scientific ...		-0.691**	(0.28)		0.306	(0.42)			0.327	(0.42)	
Administrative ...		-0.766***	(0.29)		0.297	(0.43)			0.321	(0.43)	
Public ...		-0.813***	(0.29)		0.385	(0.43)			0.406	(0.43)	
Education		-0.846***	(0.29)		0.446	(0.43)			0.468	(0.43)	
Health ...		-0.805***	(0.29)		0.321	(0.43)			0.341	(0.43)	
Arts ...		-0.963***	(0.29)		0.529	(0.43)			0.536	(0.43)	
Other service ...		-0.861***	(0.29)		0.451	(0.43)			0.462	(0.43)	
Extraterritorial ...		-0.813***	(0.31)		0.455	(0.45)			0.420	(0.45)	
Lausanne		-0.065	(0.06)		0.058	(0.08)			0.055	(0.08)	
Sion		-0.118	(0.09)		0.169	(0.12)			0.164	(0.12)	
Fribourg		-0.133*	(0.08)		0.124	(0.10)			0.124	(0.10)	
Neuchatel		-0.146*	(0.08)		0.246**	(0.12)			0.258**	(0.12)	
Biel		-0.145*	(0.08)		0.247**	(0.11)			0.248**	(0.11)	
Bern		-0.088	(0.07)		0.161*	(0.10)			0.162*	(0.10)	
Basel		-0.094	(0.08)		0.055	(0.11)			0.056	(0.11)	
Aarau-Olten		-0.124	(0.08)		0.124	(0.11)			0.132	(0.11)	
Zurich		-0.092	(0.07)		0.086	(0.10)			0.091	(0.10)	
Winterthur-SH		-0.145*	(0.08)		0.243**	(0.11)			0.250**	(0.11)	
St. Gallen		-0.144*	(0.08)		0.184	(0.12)			0.187	(0.12)	
Chur		-0.197*	(0.10)		0.162	(0.14)			0.155	(0.14)	
Luzern		-0.086	(0.08)		0.105	(0.11)			0.115	(0.11)	
Bellinzona		-0.216*	(0.12)		0.252	(0.16)			0.260	(0.16)	
Lugano		-0.299***	(0.11)		0.237	(0.15)			0.242*	(0.15)	
Abroad		-0.359***	(0.10)		0.392**	(0.16)			0.397**	(0.16)	
Ori: BE							-0.162***	(0.05)	-0.178***	(0.06)	
Ori: LU							-0.282***	(0.05)	-0.180**	(0.07)	
Ori: UR							-0.482***	(0.05)	0.011	(0.24)	
Ori: SZ							-0.396***	(0.14)	-0.200*	(0.11)	
Ori: OW							-0.436***	(0.05)	-0.279	(0.21)	
Ori: NW							-0.358***	(0.05)	-0.282	(0.21)	
Ori: GL							-0.286***	(0.05)	-0.034	(0.25)	
Ori: ZG							-0.234***	(0.05)	-0.226*	(0.13)	
Ori: FR							-0.427***	(0.05)	-0.233***	(0.09)	
Ori: SO							-0.018	(0.11)	-0.071	(0.08)	
Ori: BS							-0.728***	(0.05)	-0.266**	(0.11)	
Ori: BL							-0.627***	(0.05)	-0.437***	(0.09)	
Ori: SH							0.222***	(0.05)	-0.221	(0.15)	
Ori: AR							-0.158***	(0.05)	-0.253*	(0.13)	
Ori: AI							-0.731***	(0.05)	-0.648*	(0.35)	
Ori: SG							0.011	(0.09)	-0.068	(0.07)	
Ori: GR							-0.373***	(0.12)	-0.224**	(0.10)	
Ori: AG							-0.016	(0.08)	-0.087	(0.06)	
Ori: TG							0.115**	(0.05)	-0.175**	(0.08)	
Ori: TI							-0.509***	(0.05)	-0.141	(0.12)	
Ori: VD							-0.642***	(0.05)	-0.222***	(0.08)	
Ori: VS							-0.582***	(0.05)	-0.289***	(0.09)	
Ori: NE							-0.557***	(0.05)	-0.414***	(0.12)	
Ori: GE							-1.060***	(0.05)	-0.430***	(0.11)	
Ori: JU							-0.259***	(0.05)	-0.300**	(0.15)	
Constant				1.531	(.)	0.319	(0.53)	1.889***	(0.05)	0.403	(0.53)
Observations	12075	12075		13571		13571		13571		13571	
Pseudo R^2	0.000	0.002									

Notes: The table shows the regression coefficients (Coef.) and standard errors (SE) from the Cox regressions (first two columns) and IV regressions (last four columns) on search time (ln). The data is from the one-year post-graduation surveys. Columns Cox1 and IV1 include no controls, whereas IV3 includes region of origin fixed effects. Columns Cox2 and IV2 include all controls, whereas IV4 additionally includes region of origin fixed effects. The estimations from the first stage include the same controls as the estimations from the second stage. Standard errors are robust and no sampling weights are used. ***,** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B.7: Regression table for internship position one year post-graduation

	Probit1		Probit2		IV1		IV2		IV3		IV4	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
A. First stage												
Reg. enrol. rate VET					2.982***	(0.11)	1.365***	(0.34)	3.219***	(0.65)	0.751	(1.04)
B. Second stage												
VET	-0.559***	(0.03)	-0.238***	(0.04)	-0.631***	(0.11)	-0.043	(0.15)	-1.701***	(0.13)	-0.110	(0.15)
Age			-0.053***	(0.01)			-0.058***	(0.01)			-0.056***	(0.01)
Female			0.184***	(0.03)			0.201***	(0.03)			0.197***	(0.04)
Dad: Upp.-sec.			0.058	(0.07)			0.052	(0.07)			0.049	(0.07)
Dad: Post-sec.			0.036	(0.07)			0.034	(0.07)			0.033	(0.07)
Mom: Upp.-sec.			-0.055	(0.06)			-0.056	(0.06)			-0.055	(0.06)
Mom: Post-sec.			-0.004	(0.06)			0.004	(0.06)			0.001	(0.06)
Marital status			-0.224***	(0.08)			-0.223***	(0.08)			-0.226***	(0.08)
Child			-0.255*	(0.14)			-0.252*	(0.14)			-0.257*	(0.14)
Res: BE			0.068	(0.08)			0.069	(0.08)			0.102	(0.09)
Res: LU			0.098	(0.08)			0.106	(0.08)			0.084	(0.11)
Res: UR			0.039	(0.25)			0.042	(0.25)			0.079	(0.41)
Res: SZ			-0.016	(0.13)			-0.007	(0.13)			-0.032	(0.15)
Res: OW			-0.013	(0.25)			-0.003	(0.25)			-0.111	(0.32)
Res: NW			0.216	(0.23)			0.231	(0.23)			0.226	(0.32)
Res: GL			-0.238	(0.36)			-0.217	(0.36)			-0.401	(0.43)
Res: ZG			-0.023	(0.14)			-0.024	(0.14)			0.073	(0.18)
Res: FR			-0.003	(0.11)			-0.004	(0.11)			0.144	(0.14)
Res: SO			0.035	(0.11)			0.035	(0.11)			0.108	(0.13)
Res: BS			-0.152	(0.12)			-0.138	(0.12)			-0.094	(0.13)
Res: BL			-0.190	(0.12)			-0.175	(0.12)			-0.142	(0.15)
Res: SH			-0.032	(0.18)			-0.039	(0.18)			0.404	(0.27)
Res: AR			0.102	(0.23)			0.090	(0.23)			-0.019	(0.27)
Res: AI			-0.002	(0.40)			-0.007	(0.40)			0.020	(0.56)
Res: SG			0.088	(0.09)			0.081	(0.09)			0.070	(0.11)
Res: GR			0.263**	(0.13)			0.270**	(0.13)			0.349**	(0.16)
Res: AG			0.046	(0.07)			0.038	(0.07)			0.107	(0.09)
Res: TG			0.024	(0.11)			0.015	(0.11)			0.076	(0.14)
Res: TI			0.416***	(0.11)			0.423***	(0.11)			0.407**	(0.20)
Res: VD			0.004	(0.11)			0.007	(0.11)			0.103	(0.13)
Res: VS			-0.126	(0.12)			-0.116	(0.13)			-0.098	(0.17)
Res: NE			0.020	(0.14)			0.027	(0.14)			0.067	(0.18)
Res: GE			0.231*	(0.14)			0.250*	(0.14)			0.471***	(0.18)
Res: JU			-0.183	(0.22)			-0.184	(0.22)			-0.124	(0.28)
UAS			-1.129**	(0.46)			-1.238***	(0.46)			-1.211***	(0.46)
Master			-0.236***	(0.06)			-0.214***	(0.06)			-0.216***	(0.06)
UNI 2			-0.163	(0.11)			-0.165	(0.11)			-0.165	(0.11)
UNI 3			-0.444***	(0.12)			-0.447***	(0.12)			-0.440***	(0.12)
UNI 4			-0.168	(0.13)			-0.186	(0.13)			-0.154	(0.14)
UNI 5			-0.043	(0.12)			-0.049	(0.12)			-0.034	(0.12)
UNI 6			-0.031	(0.20)			-0.036	(0.20)			-0.038	(0.20)
UNI 7			-0.232*	(0.14)			-0.246*	(0.14)			-0.234	(0.14)
UNI 8			-0.799***	(0.13)			-0.795***	(0.13)			-0.809***	(0.13)
UNI 9			-0.203**	(0.10)			-0.201*	(0.10)			-0.219**	(0.10)
UNI 10			-0.477***	(0.18)			-0.475***	(0.18)			-0.477***	(0.18)
UNI 11			-0.231*	(0.13)			-0.215*	(0.13)			-0.193	(0.13)
UNI 12			-0.531***	(0.11)			-0.504***	(0.11)			-0.522***	(0.11)
UAS 1			0.231	(0.45)			0.261	(0.45)			0.263	(0.45)
UAS 2			0.332	(0.45)			0.388	(0.45)			0.399	(0.45)
UAS 3			0.321	(0.45)			0.348	(0.45)			0.355	(0.45)
UAS 4			0.281	(0.45)			0.299	(0.45)			0.295	(0.45)
UAS 5			0.232	(0.47)			0.274	(0.47)			0.272	(0.47)
UAS 6			0.403	(0.45)			0.430	(0.45)			0.419	(0.45)
UAS 7			0.363	(0.44)			0.386	(0.45)			0.375	(0.45)
UAS 8			0.000	(.)								
Arts			0.195*	(0.10)			0.221**	(0.11)			0.214**	(0.11)
Edu. Sciences			-0.221***	(0.08)			-0.234***	(0.08)			-0.234***	(0.08)
Economics			-0.113	(0.08)			-0.132*	(0.08)			-0.128	(0.08)
Nat. Sciences			-0.066	(0.09)			-0.089	(0.09)			-0.081	(0.09)
Medi. Sciences			-1.390***	(0.17)			-1.416***	(0.18)			-1.414***	(0.18)
Health			-1.248***	(0.13)			-1.252***	(0.13)			-1.250***	(0.13)
Engineering			-0.732***	(0.10)			-0.776***	(0.11)			-0.762***	(0.11)
Agri. Sciences			-0.377***	(0.09)			-0.428***	(0.10)			-0.413***	(0.10)
Others			-0.115	(0.13)			-0.142	(0.13)			-0.147	(0.13)
No. of semester			-0.032***	(0.01)			-0.030***	(0.01)			-0.032***	(0.01)
Grade			-0.151***	(0.04)			-0.154***	(0.04)			-0.154***	(0.04)
Cohort=2013			0.153***	(0.05)			0.169***	(0.05)			0.164***	(0.05)
Cohort=2015			0.198***	(0.05)			0.210***	(0.05)			0.208***	(0.05)
Cohort=2017			0.239***	(0.05)			0.255***	(0.05)			0.251***	(0.05)
Pre-study job			-0.011	(0.05)			-0.009	(0.05)			-0.006	(0.05)
Student internship			-0.208***	(0.03)			-0.188***	(0.04)			-0.195***	(0.04)

Student job			0.010	(0.05)			0.007	(0.05)			0.009	(0.05)
Work-based high. edu.			-0.647***	(0.07)			-0.660***	(0.07)			-0.661***	(0.07)
Exchange			0.164***	(0.04)			0.164***	(0.04)			0.166***	(0.04)
Public empl.			-0.002	(0.04)			-0.003	(0.04)			-0.004	(0.04)
Medium			-0.053	(0.04)			-0.053	(0.04)			-0.054	(0.04)
Large			0.061	(0.04)			0.060	(0.04)			0.060	(0.04)
Manufacturing			0.047	(0.51)			0.086	(0.53)			0.071	(0.52)
Electricity ...			0.183	(0.53)			0.221	(0.55)			0.199	(0.54)
Water Supply ...			0.336	(0.60)			0.382	(0.61)			0.363	(0.61)
Construction			0.099	(0.53)			0.129	(0.55)			0.119	(0.54)
Wholesale ...			0.131	(0.51)			0.178	(0.53)			0.159	(0.53)
Transportation ...			0.336	(0.52)			0.395	(0.54)			0.377	(0.53)
Accommodation ...			0.054	(0.53)			0.119	(0.54)			0.090	(0.54)
Information ...			0.150	(0.51)			0.194	(0.53)			0.181	(0.52)
Financial ...			0.017	(0.51)			0.063	(0.53)			0.049	(0.53)
Real Estate			0.102	(0.54)			0.146	(0.56)			0.129	(0.55)
Scientific ...			0.140	(0.51)			0.187	(0.53)			0.171	(0.52)
Administrative ...			0.169	(0.52)			0.223	(0.54)			0.205	(0.53)
Public ...			0.575	(0.51)			0.628	(0.53)			0.612	(0.53)
Education			-0.256	(0.52)			-0.203	(0.53)			-0.222	(0.53)
Health ...			-0.035	(0.51)			0.022	(0.53)			-0.004	(0.53)
Arts ...			0.213	(0.52)			0.270	(0.54)			0.245	(0.53)
Other service ...			0.534	(0.52)			0.588	(0.53)			0.559	(0.53)
Extraterritorial ...			0.520	(0.58)			0.575	(0.59)			0.505	(0.59)
Lausanne			0.251**	(0.10)			0.253**	(0.10)			0.248**	(0.10)
Sion			0.199	(0.16)			0.192	(0.16)			0.190	(0.16)
Fribourg			0.346**	(0.14)			0.347**	(0.14)			0.352***	(0.14)
Neuchatel			0.214	(0.15)			0.206	(0.15)			0.202	(0.15)
Biel			0.154	(0.15)			0.147	(0.15)			0.147	(0.15)
Bern			0.440***	(0.12)			0.433***	(0.12)			0.431***	(0.12)
Basel			0.458***	(0.14)			0.460***	(0.14)			0.454***	(0.14)
Aarau-Olten			0.193	(0.14)			0.197	(0.14)			0.195	(0.14)
Zurich			0.287**	(0.12)			0.287**	(0.12)			0.285**	(0.12)
Winterthur-SH			0.145	(0.15)			0.136	(0.15)			0.128	(0.15)
St. Gallen			0.072	(0.15)			0.071	(0.15)			0.067	(0.15)
Chur			0.068	(0.18)			0.071	(0.18)			0.063	(0.18)
Luzern			0.128	(0.14)			0.129	(0.14)			0.121	(0.14)
Bellinzona			0.141	(0.20)			0.138	(0.20)			0.140	(0.20)
Lugano			-0.049	(0.18)			-0.044	(0.18)			-0.046	(0.18)
Abroad			0.729***	(0.16)			0.730***	(0.16)			0.733***	(0.16)
Ori: BE									-0.040	(0.05)	-0.073	(0.08)
Ori: LU									-0.157***	(0.06)	-0.006	(0.10)
Ori: UR									-0.306*	(0.18)	-0.076	(0.33)
Ori: SZ									-0.226**	(0.09)	-0.015	(0.13)
Ori: OW									-0.113	(0.15)	0.080	(0.26)
Ori: NW									-0.150	(0.17)	-0.040	(0.28)
Ori: GL									-0.083	(0.21)	0.162	(0.30)
Ori: ZG									-0.218**	(0.11)	-0.175	(0.17)
Ori: FR									-0.305***	(0.07)	-0.239*	(0.13)
Ori: SO									-0.011	(0.07)	-0.129	(0.11)
Ori: BS									-0.332***	(0.13)	-0.092	(0.14)
Ori: BL									-0.260***	(0.08)	-0.082	(0.12)
Ori: SH									-0.096	(0.13)	-0.564**	(0.24)
Ori: AR									0.037	(0.13)	0.103	(0.19)
Ori: AI									-0.418	(0.30)	-0.082	(0.46)
Ori: SG									-0.026	(0.06)	-0.017	(0.09)
Ori: GR									-0.081	(0.07)	-0.129	(0.13)
Ori: AG									0.016	(0.05)	-0.119	(0.09)
Ori: TG									-0.075	(0.08)	-0.100	(0.11)
Ori: TI									-0.312***	(0.09)	-0.036	(0.17)
Ori: VD									-0.390***	(0.07)	-0.160	(0.12)
Ori: VS									-0.426***	(0.07)	-0.070	(0.13)
Ori: NE									-0.361***	(0.09)	-0.092	(0.15)
Ori: GE									-0.600***	(0.10)	-0.325**	(0.15)
Ori: JU									-0.320***	(0.10)	-0.120	(0.20)
Constant	-0.794***	(0.02)	1.784***	(0.65)	-0.765***	(0.05)	1.841***	(0.67)	0.030	(0.13)	1.868***	(0.66)
Observations	13571		13571		13571		13571		13571		13571	
Pseudo R^2	0.033		0.178									

Notes: The table shows the regression coefficients (Coef.) and standard errors (SE) from the probit regressions (first two columns) and IV regressions (last four columns) on internship. The data is from the one-year post-graduation surveys. Columns Probit1 and IV1 include no controls, whereas IV3 includes region of origin fixed effects. Columns Probit2 and IV2 include all controls, whereas IV4 additionally includes region of origin fixed effects. The estimations from the first stage include the same controls as the estimations from the second stage. Standard errors are robust and no sampling weights are used. ***,** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B.8: Regression table for wage five years post-graduation

	Tobit1		Tobit2		IV1		IV2		IV3		IV4	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
A. First stage												
Reg. enrol. rate VET					2.539***	(0.24)	1.176	(0.76)	-2.234	(2.29)	-3.315	(2.90)
B. Second stage												
VET	0.085***	(0.01)	0.027	(0.02)	0.228***	(0.04)	0.118**	(0.05)	0.143***	(0.05)	0.117**	(0.05)
Age			0.016***	(0.01)			0.014**	(0.01)			0.014**	(0.01)
Female			-0.100***	(0.01)			-0.090***	(0.02)			-0.090***	(0.02)
Marital status			0.014	(0.01)			0.012	(0.01)			0.012	(0.01)
Child			-0.168***	(0.02)			-0.167***	(0.02)			-0.170***	(0.02)
Dad: Upp.-sec.			-0.039	(0.02)			-0.042*	(0.02)			-0.040	(0.02)
Dad: Post-sec.			-0.026	(0.02)			-0.029	(0.02)			-0.025	(0.02)
Mom: Upp.-sec.			0.016	(0.02)			0.015	(0.02)			0.015	(0.02)
Mom: Post-sec.			0.002	(0.03)			0.004	(0.03)			0.005	(0.03)
Res: BE			-0.094***	(0.04)			-0.096***	(0.04)			-0.092**	(0.04)
Res: LU			-0.014	(0.04)			-0.008	(0.04)			-0.029	(0.04)
Res: UR			0.135	(0.12)			0.138	(0.12)			0.345**	(0.15)
Res: SZ			0.026	(0.05)			0.028	(0.05)			-0.017	(0.07)
Res: OW			0.061	(0.11)			0.054	(0.11)			-0.102	(0.12)
Res: NW			0.049	(0.10)			0.055	(0.10)			0.096	(0.10)
Res: GL			-0.101**	(0.05)			-0.100**	(0.05)			0.008	(0.09)
Res: ZG			-0.014	(0.04)			-0.007	(0.04)			0.025	(0.04)
Res: FR			-0.084**	(0.04)			-0.084**	(0.04)			-0.040	(0.05)
Res: SO			-0.064*	(0.04)			-0.074*	(0.04)			-0.085*	(0.05)
Res: BS			-0.096**	(0.05)			-0.084*	(0.05)			-0.088*	(0.05)
Res: BL			0.003	(0.05)			0.011	(0.05)			0.005	(0.06)
Res: SH			0.080	(0.06)			0.074	(0.06)			0.131	(0.10)
Res: AR			0.115*	(0.07)			0.113*	(0.07)			0.141	(0.09)
Res: AI			-0.512	(0.45)			-0.516	(0.46)			-0.649	(0.46)
Res: SG			-0.003	(0.03)			-0.009	(0.03)			0.001	(0.04)
Res: GR			0.041	(0.08)			0.052	(0.08)			0.069	(0.08)
Res: AG			-0.001	(0.03)			-0.002	(0.03)			0.021	(0.03)
Res: TG			0.034	(0.04)			0.020	(0.04)			0.002	(0.05)
Res: TI			-0.032	(0.06)			-0.029	(0.06)			-0.076	(0.07)
Res: VD			-0.066	(0.04)			-0.062	(0.04)			-0.037	(0.05)
Res: VS			-0.055	(0.06)			-0.053	(0.06)			-0.021	(0.07)
Res: NE			-0.085	(0.06)			-0.080	(0.06)			-0.029	(0.06)
Res: GE			-0.138**	(0.06)			-0.129**	(0.06)			-0.088	(0.07)
Res: JU			-0.148**	(0.07)			-0.158**	(0.07)			-0.160	(0.12)
UAS			-0.060	(0.29)			-0.124	(0.30)			-0.116	(0.28)
Master			0.116***	(0.03)			0.121***	(0.03)			0.117***	(0.03)
UNI 2			0.038	(0.05)			0.037	(0.05)			0.036	(0.05)
UNI 3			0.036	(0.05)			0.030	(0.05)			0.028	(0.05)
UNI 4			0.057	(0.06)			0.051	(0.06)			0.064	(0.06)
UNI 5			0.053	(0.05)			0.051	(0.05)			0.056	(0.05)
UNI 6			-0.056	(0.15)			-0.065	(0.15)			-0.070	(0.15)
UNI 7			-0.001	(0.06)			-0.009	(0.06)			0.004	(0.06)
UNI 8			0.159***	(0.06)			0.166***	(0.06)			0.164***	(0.06)
UNI 9			-0.014	(0.05)			-0.015	(0.05)			-0.019	(0.05)
UNI 10			0.002	(0.07)			0.010	(0.07)			-0.002	(0.07)
UNI 11			0.016	(0.05)			0.029	(0.05)			0.036	(0.05)
UNI 12			0.045	(0.04)			0.059	(0.04)			0.054	(0.05)
UAS 1			0.074	(0.28)			0.094	(0.29)			0.076	(0.28)
UAS 2			0.105	(0.28)			0.136	(0.29)			0.131	(0.28)
UAS 3			0.086	(0.28)			0.101	(0.29)			0.090	(0.28)
UAS 4			0.054	(0.28)			0.070	(0.29)			0.047	(0.28)
UAS 5			0.114	(0.29)			0.130	(0.29)			0.110	(0.28)
UAS 6			0.061	(0.28)			0.078	(0.29)			0.065	(0.28)
UAS 7			0.091	(0.28)			0.110	(0.29)			0.092	(0.28)
UAS 8			0.000	(.)								
Arts			-0.119	(0.07)			-0.109	(0.07)			-0.111	(0.07)
Edu. Sciences			0.109**	(0.04)			0.103**	(0.04)			0.098**	(0.04)
Economics			0.276***	(0.04)			0.261***	(0.04)			0.259***	(0.04)
Nat. Sciences			0.153***	(0.05)			0.139***	(0.05)			0.139***	(0.05)
Medi. Sciences			0.214***	(0.07)			0.203***	(0.08)			0.201***	(0.07)
Health			0.057	(0.05)			0.056	(0.05)			0.056	(0.05)
Engineering			0.192***	(0.05)			0.166***	(0.05)			0.166***	(0.05)
Agri. Sciences			0.256***	(0.05)			0.227***	(0.05)			0.228***	(0.05)
Others			0.011	(0.09)			-0.004	(0.09)			-0.006	(0.09)
Grade			0.026	(0.02)			0.025	(0.02)			0.024	(0.02)
Cohort=2017			-0.022	(0.01)			-0.014	(0.01)			-0.015	(0.01)
Exchange			-0.001	(0.02)			-0.002	(0.02)			0.000	(0.02)
Pre-study job			0.026	(0.02)			0.028	(0.02)			0.029*	(0.02)
Student internship			0.012	(0.01)			0.021	(0.01)			0.022	(0.01)
Student job			0.032*	(0.02)			0.030*	(0.02)			0.029*	(0.02)
Work-based high. edu.			0.057**	(0.02)			0.048*	(0.03)			0.052**	(0.03)

Cont. studies		-0.195***	(0.03)		-0.196***	(0.03)				-0.200***	(0.03)	
Add. studies		0.010	(0.02)		0.008	(0.02)				0.009	(0.02)	
Cont. education		0.046***	(0.02)		0.046***	(0.02)				0.047***	(0.02)	
Medium		0.064***	(0.02)		0.063***	(0.02)				0.062***	(0.02)	
Large		0.122***	(0.02)		0.122***	(0.02)				0.121***	(0.02)	
Public empl.		-0.009	(0.02)		-0.007	(0.02)				-0.004	(0.02)	
Electricity ...		-0.004	(0.06)		-0.008	(0.06)				-0.021	(0.06)	
Water Supply ...		-0.466	(0.30)		-0.428	(0.29)				-0.429	(0.30)	
Construction		0.134***	(0.05)		0.129***	(0.05)				0.148***	(0.05)	
Wholesale ...		0.050*	(0.03)		0.041	(0.03)				0.042	(0.03)	
Transportation ...		-0.079	(0.05)		-0.074	(0.05)				-0.066	(0.05)	
Accommodation ...		-0.185**	(0.09)		-0.180**	(0.08)				-0.171**	(0.09)	
Information ...		0.033	(0.02)		0.033	(0.02)				0.038	(0.02)	
Financial ...		0.146***	(0.02)		0.145***	(0.02)				0.148***	(0.02)	
Real Estate		0.030	(0.16)		0.033	(0.15)				0.038	(0.15)	
Scientific ...		0.040**	(0.02)		0.041**	(0.02)				0.044**	(0.02)	
Administrative ...		-0.121*	(0.07)		-0.114	(0.07)				-0.109	(0.07)	
Public ...		0.037	(0.03)		0.037	(0.03)				0.040	(0.03)	
Education		-0.190***	(0.04)		-0.185***	(0.04)				-0.185***	(0.04)	
Health ...		-0.091***	(0.03)		-0.086***	(0.03)				-0.085***	(0.03)	
Arts ...		-0.139**	(0.06)		-0.133**	(0.06)				-0.129**	(0.06)	
Other service ...		-0.141***	(0.05)		-0.143***	(0.05)				-0.140***	(0.05)	
Extraterritorial ...		-0.187	(0.20)		-0.184	(0.21)				-0.175	(0.21)	
Lausanne		-0.084**	(0.04)		-0.081**	(0.04)				-0.083**	(0.04)	
Sion		-0.109*	(0.06)		-0.108*	(0.06)				-0.107*	(0.06)	
Fribourg		-0.062	(0.05)		-0.065	(0.05)				-0.065	(0.05)	
Neuchatel		-0.099*	(0.06)		-0.109*	(0.06)				-0.111*	(0.06)	
Biel		-0.105*	(0.06)		-0.102*	(0.06)				-0.101	(0.06)	
Bern		-0.045	(0.05)		-0.041	(0.05)				-0.041	(0.05)	
Basel		-0.033	(0.06)		-0.031	(0.06)				-0.026	(0.06)	
Aarau-Olten		-0.110*	(0.06)		-0.103*	(0.06)				-0.101*	(0.06)	
Zurich		-0.027	(0.05)		-0.023	(0.05)				-0.021	(0.05)	
Winterthur-SH		-0.109*	(0.06)		-0.104*	(0.06)				-0.107*	(0.06)	
St. Gallen		-0.080	(0.06)		-0.072	(0.06)				-0.073	(0.06)	
Chur		-0.139	(0.09)		-0.150*	(0.09)				-0.148*	(0.09)	
Luzern		-0.123*	(0.06)		-0.121*	(0.06)				-0.121*	(0.07)	
Bellinzona		-0.169**	(0.08)		-0.167**	(0.08)				-0.163**	(0.08)	
Lugano		-0.204**	(0.08)		-0.207**	(0.08)				-0.200**	(0.08)	
Abroad		-0.142	(0.10)		-0.136	(0.10)				-0.132	(0.10)	
Ori: BE								-0.095***	(0.03)	-0.001	(0.03)	
Ori: LU								-0.017	(0.04)	0.021	(0.04)	
Ori: UR								-0.110	(0.09)	-0.232**	(0.11)	
Ori: SZ								0.085*	(0.04)	0.074	(0.06)	
Ori: OW								0.078	(0.07)	0.183***	(0.07)	
Ori: NW								0.002	(0.04)	-0.056	(0.07)	
Ori: GL								-0.069	(0.07)	-0.141	(0.09)	
Ori: ZG								-0.027	(0.08)	-0.076	(0.06)	
Ori: FR								-0.060*	(0.03)	-0.062	(0.04)	
Ori: SO								-0.025	(0.04)	0.023	(0.05)	
Ori: BS								-0.040	(0.10)	-0.001	(0.07)	
Ori: BL								-0.026	(0.05)	-0.008	(0.05)	
Ori: SH								0.025	(0.07)	-0.064	(0.08)	
Ori: AR								-0.037	(0.08)	-0.030	(0.07)	
Ori: AI								-0.321	(0.32)	0.130**	(0.05)	
Ori: SG								-0.031	(0.03)	-0.017	(0.03)	
Ori: GR								-0.045	(0.06)	-0.032	(0.05)	
Ori: AG								-0.025	(0.03)	-0.043	(0.04)	
Ori: TG								-0.014	(0.05)	0.035	(0.05)	
Ori: TI								-0.084**	(0.04)	0.042	(0.04)	
Ori: VD								-0.032	(0.03)	-0.034	(0.04)	
Ori: VS								-0.072**	(0.03)	-0.043	(0.05)	
Ori: NE								-0.117***	(0.04)	-0.077	(0.05)	
Ori: GE								-0.050	(0.04)	-0.060	(0.05)	
Ori: JU								-0.199***	(0.05)	-0.009	(0.10)	
Constant	11.288***	(0.01)	10.533***	(0.22)	11.231***	(0.02)	10.582***	(0.22)	11.306***	(0.03)	10.592***	(0.22)
Observations	2817		2817		2817		2817		2817		2817	
Pseudo R^2	0.013		0.548									

Notes: The table shows the regression coefficients (Coef.) and standard errors (SE) from the tobit regressions (first two columns) and IV regressions (last four columns) on wage (ln). The data is from the five-year post-graduation surveys. Columns Tobit1 and IV1 include no controls, whereas IV3 includes region of origin fixed effects. Columns Tobit2 and IV2 include all controls, whereas IV4 additionally includes region of origin fixed effects. The estimations from the first stage include the same controls as the estimations from the second stage. Standard errors are robust and no sampling weights are used. ***,** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B.9: Regression table for unemployment during the five years post-graduation

	Probit1		Probit2		IV1		IV2		IV3		IV4	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
A. First stage												
Reg. enrol. rate VET					2.663***	(0.22)	1.169	(0.80)	-2.836	(2.00)	-3.249	(2.93)
B. Second stage												
VET	-0.242***	(0.06)	0.015	(0.09)	-1.549***	(0.05)	0.024	(0.38)	-0.966*	(0.58)	-0.049	(0.41)
Age			0.086***	(0.03)			0.086***	(0.03)			0.096***	(0.03)
Female			0.092	(0.07)			0.093	(0.08)			0.086	(0.08)
Marital status			-0.056	(0.09)			-0.056	(0.09)			-0.071	(0.09)
Child			-0.075	(0.11)			-0.074	(0.11)			-0.058	(0.12)
Dad: Upp.-sec.			-0.096	(0.13)			-0.097	(0.13)			-0.085	(0.13)
Dad: Post-sec.			-0.236*	(0.13)			-0.237*	(0.13)			-0.236*	(0.13)
Mom: Upp.-sec.			-0.196*	(0.11)			-0.196*	(0.11)			-0.198*	(0.11)
Mom: Post-sec.			-0.117	(0.12)			-0.117	(0.12)			-0.138	(0.12)
Res: BE			0.361**	(0.18)			0.361**	(0.18)			0.398**	(0.20)
Res: LU			0.128	(0.21)			0.129	(0.21)			0.042	(0.26)
Res: UR			0.000	(.)			0.000	(.)			0.000	(.)
Res: SZ			-0.225	(0.30)			-0.225	(0.30)			0.264	(0.30)
Res: OW			0.000	(.)			0.000	(.)			0.000	(.)
Res: NW			0.000	(.)			0.000	(.)			0.000	(.)
Res: GL			0.000	(.)			0.000	(.)			0.000	(.)
Res: ZG			0.044	(0.22)			0.045	(0.22)			-0.035	(0.26)
Res: FR			0.306	(0.25)			0.306	(0.25)			0.466	(0.30)
Res: SO			0.100	(0.23)			0.099	(0.23)			0.114	(0.28)
Res: BS			0.456*	(0.26)			0.457*	(0.26)			0.454*	(0.27)
Res: BL			0.173	(0.29)			0.173	(0.29)			0.207	(0.32)
Res: SH			-0.000	(0.37)			-0.001	(0.37)			-0.363	(0.48)
Res: AR			0.000	(.)			0.000	(.)			0.000	(.)
Res: AI			0.000	(.)			0.000	(.)			0.000	(.)
Res: SG			0.147	(0.19)			0.146	(0.19)			-0.011	(0.22)
Res: GR			0.051	(0.34)			0.052	(0.34)			0.051	(0.41)
Res: AG			-0.058	(0.15)			-0.058	(0.15)			0.149	(0.18)
Res: TG			-0.423	(0.31)			-0.425	(0.31)			-0.449	(0.33)
Res: TI			0.367	(0.30)			0.367	(0.30)			0.365	(0.36)
Res: VD			0.224	(0.23)			0.224	(0.23)			0.065	(0.27)
Res: VS			-0.305	(0.30)			-0.305	(0.30)			-0.045	(0.34)
Res: NE			0.006	(0.27)			0.006	(0.27)			-0.351	(0.32)
Res: GE			0.114	(0.29)			0.115	(0.30)			-0.206	(0.36)
Res: JU			0.284	(0.34)			0.283	(0.34)			-0.050	(0.48)
UAS			-0.159	(0.25)			-3.768	(.)			-3.558***	(0.51)
Master			0.102	(0.12)			0.103	(0.12)			0.091	(0.12)
UNI 2			-0.166	(0.25)			-0.166	(0.25)			-0.174	(0.26)
UNI 3			-0.105	(0.27)			-0.105	(0.27)			-0.097	(0.28)
UNI 4			0.066	(0.28)			0.065	(0.28)			-0.022	(0.30)
UNI 5			0.178	(0.26)			0.178	(0.26)			0.090	(0.27)
UNI 6			0.407	(0.47)			0.406	(0.47)			0.516	(0.48)
UNI 7			0.362	(0.29)			0.361	(0.29)			0.211	(0.31)
UNI 8			-0.582*	(0.34)			-0.581*	(0.34)			-0.596	(0.36)
UNI 9			-0.263	(0.25)			-0.263	(0.25)			-0.256	(0.26)
UNI 10			0.065	(0.37)			0.066	(0.37)			0.009	(0.39)
UNI 11			0.272	(0.27)			0.274	(0.27)			0.188	(0.29)
UNI 12			-0.291	(0.25)			-0.290	(0.26)			-0.333	(0.27)
UAS 1			-0.121	(0.18)			3.484	(.)			3.317***	(0.37)
UAS 2			0.172	(0.16)			3.778	(.)			3.531***	(0.38)
UAS 3			-0.079	(0.16)			3.525	(.)			3.379***	(0.35)
UAS 4			0.008	(0.17)			3.612	(.)			3.430***	(0.35)
UAS 5			0.232	(0.29)			3.836	(.)			3.640***	(0.43)
UAS 6			-0.308*	(0.17)			3.297	(.)			3.077***	(0.35)
UAS 7			0.000	(.)			3.604	(.)			3.420***	(0.32)
UAS 8			0.000	(.)								
Arts			0.248	(0.24)			0.249	(0.24)			0.263	(0.25)
Edu. Sciences			-0.319*	(0.17)			-0.319*	(0.17)			-0.257	(0.18)
Economics			-0.306*	(0.17)			-0.307*	(0.18)			-0.274	(0.18)
Nat. Sciences			-0.046	(0.19)			-0.048	(0.20)			0.000	(0.20)
Medi. Sciences			-1.969***	(0.45)			-1.970***	(0.45)			-1.938***	(0.46)
Health			-0.947***	(0.24)			-0.947***	(0.24)			-0.920***	(0.24)
Engineering			-0.894***	(0.23)			-0.897***	(0.25)			-0.921***	(0.25)
Agri. Sciences			-0.512***	(0.19)			-0.515**	(0.22)			-0.480**	(0.23)
Others			-0.280	(0.31)			-0.281	(0.31)			-0.243	(0.31)
Grade			-0.487***	(0.10)			-0.487***	(0.10)			-0.477***	(0.10)
Cohort=2017			0.087	(0.07)			0.088	(0.08)			0.069	(0.08)
Exchange			0.193**	(0.08)			0.193**	(0.08)			0.202**	(0.08)
Pre-study job			-0.245***	(0.09)			-0.245***	(0.09)			-0.255***	(0.09)
Student internship			-0.130*	(0.07)			-0.129	(0.08)			-0.128	(0.08)
Student job			-0.124	(0.10)			-0.124	(0.10)			-0.133	(0.10)
Work-based high. edu.			-0.335***	(0.13)			-0.336**	(0.14)			-0.325**	(0.14)

Cont. studies		-0.075	(0.10)		-0.076	(0.10)			-0.065	(0.10)	
Add. studies		-0.177*	(0.10)		-0.177*	(0.10)			-0.161	(0.10)	
Cont. education		-0.176*	(0.11)		-0.176*	(0.11)			-0.176*	(0.11)	
Medium		0.018	(0.09)		0.018	(0.09)			0.028	(0.09)	
Large		-0.175**	(0.08)		-0.175**	(0.08)			-0.178**	(0.08)	
Public empl.		-0.132	(0.10)		-0.132	(0.10)			-0.134	(0.10)	
Electricity ...		0.088	(0.29)		0.088	(0.29)			0.133	(0.30)	
Water Supply ...		0.000	(.)		0.000	(.)			0.000	(.)	
Construction		-0.111	(0.30)		-0.111	(0.30)			-0.055	(0.30)	
Wholesale ...		0.044	(0.14)		0.043	(0.14)			0.056	(0.15)	
Transportation ...		-0.066	(0.21)		-0.066	(0.21)			-0.113	(0.21)	
Accommodation ...		-0.051	(0.39)		-0.050	(0.39)			-0.023	(0.39)	
Information ...		-0.417***	(0.13)		-0.417***	(0.13)			-0.395***	(0.14)	
Financial ...		-0.184	(0.15)		-0.184	(0.15)			-0.174	(0.15)	
Real Estate		-0.456	(0.40)		-0.456	(0.40)			-0.544	(0.41)	
Scientific ...		-0.281**	(0.12)		-0.281**	(0.12)			-0.270**	(0.12)	
Administrative ...		0.066	(0.21)		0.066	(0.21)			0.019	(0.21)	
Public ...		-0.031	(0.18)		-0.031	(0.18)			-0.048	(0.18)	
Education		0.161	(0.19)		0.162	(0.19)			0.138	(0.19)	
Health ...		0.127	(0.16)		0.127	(0.16)			0.106	(0.16)	
Arts ...		0.045	(0.23)		0.046	(0.24)			0.045	(0.24)	
Other service ...		-0.448**	(0.21)		-0.448**	(0.21)			-0.473**	(0.21)	
Extraterritorial ...		-0.573	(0.70)		-0.572	(0.70)			-0.453	(0.74)	
Lausanne		-0.176	(0.19)		-0.176	(0.19)			-0.136	(0.19)	
Sion		-0.202	(0.34)		-0.202	(0.34)			-0.129	(0.35)	
Fribourg		-0.474*	(0.27)		-0.474*	(0.27)			-0.365	(0.28)	
Neuchatel		-0.064	(0.27)		-0.065	(0.28)			-0.051	(0.28)	
Biel		-0.367	(0.28)		-0.367	(0.28)			-0.310	(0.29)	
Bern		-0.557**	(0.25)		-0.557**	(0.25)			-0.463*	(0.25)	
Basel		-0.627**	(0.32)		-0.626**	(0.32)			-0.545*	(0.32)	
Aarau-Olten		-0.525*	(0.29)		-0.524*	(0.29)			-0.442	(0.30)	
Zurich		-0.258	(0.25)		-0.257	(0.26)			-0.176	(0.26)	
Winterthur-SH		-0.601*	(0.32)		-0.601*	(0.32)			-0.508	(0.33)	
St. Gallen		-0.600*	(0.33)		-0.599*	(0.33)			-0.558*	(0.33)	
Chur		-0.463	(0.41)		-0.465	(0.41)			-0.385	(0.42)	
Luzern		-0.572*	(0.33)		-0.572*	(0.33)			-0.455	(0.34)	
Bellinzona		-0.428	(0.42)		-0.427	(0.42)			-0.329	(0.42)	
Lugano		-0.213	(0.39)		-0.213	(0.39)			-0.160	(0.39)	
Abroad		-0.355	(0.50)		-0.355	(0.50)			-0.249	(0.51)	
Ori: BE							0.047	(0.13)	-0.046	(0.17)	
Ori: LU							-0.088	(0.17)	0.134	(0.23)	
Ori: UR							0.000	(.)	0.000	(.)	
Ori: SZ							-0.717**	(0.30)	-0.852**	(0.33)	
Ori: OW							0.000	(.)	0.000	(.)	
Ori: NW							-0.137	(0.43)	0.311	(0.53)	
Ori: GL							0.000	(.)	0.000	(.)	
Ori: ZG							-0.036	(0.28)	0.208	(0.34)	
Ori: FR							0.156	(0.16)	-0.236	(0.26)	
Ori: SO							0.139	(0.17)	0.078	(0.24)	
Ori: BS							-0.036	(0.39)	0.069	(0.32)	
Ori: BL							-0.185	(0.19)	-0.048	(0.25)	
Ori: SH							0.061	(0.27)	0.410	(0.38)	
Ori: AR							-0.095	(0.40)	0.068	(0.45)	
Ori: AI							0.000	(.)	0.000	(.)	
Ori: SG							0.081	(0.14)	0.272	(0.17)	
Ori: GR							-0.150	(0.21)	0.061	(0.30)	
Ori: AG							-0.166	(0.15)	-0.304	(0.19)	
Ori: TG							-0.136	(0.20)	0.031	(0.21)	
Ori: TI							0.307	(0.25)	0.058	(0.26)	
Ori: VD							0.395	(0.27)	0.301	(0.21)	
Ori: VS							-0.102	(0.19)	-0.252	(0.25)	
Ori: NE							0.508*	(0.29)	0.585**	(0.27)	
Ori: GE							0.413	(0.32)	0.533*	(0.30)	
Ori: JU							0.729***	(0.24)	0.452	(0.40)	
Constant	-0.825***	(0.03)	0.531	(1.03)	-0.034	(0.04)	0.535	(1.05)	-0.552	(0.43)	0.109	(1.07)
Observations	2817		2760		2817		2808		2817		2805	
Pseudo R^2	0.007		0.155									

Notes: The table shows the regression coefficients (Coef.) and standard errors (SE) from the probit regressions (first two columns) and IV regressions (last four columns) on unemployment. The data is from the five-year post-graduation surveys. Columns Probit1 and IV1 include no controls, whereas IV3 includes region of origin fixed effects. Columns Probit2 and IV2 include all controls, whereas IV4 additionally includes region of origin fixed effects. The estimations from the first stage include the same controls as the estimations from the second stage. Standard errors are robust and no sampling weights are used. ***,** and * denote significance at the 1%, 5% and 10% level, respectively.

Table B.10: Regression table for employment position five years post-graduation

	Oprobit1		Oprobit2		IV1		IV2		IV3		IV4	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
A. First stage												
Reg. enrol. rate VET					2.501***	(0.24)	1.263	(0.79)	-3.625*	(1.89)	-3.153	(2.93)
B. Second stage												
VET	0.141***	(0.04)	0.027	(0.07)	0.783***	(0.16)	0.314	(0.25)	-0.904***	(0.17)	0.182	(0.27)
Age			0.041*	(0.02)			0.035	(0.02)			0.036	(0.02)
Female			-0.122**	(0.06)			-0.093	(0.06)			-0.107*	(0.06)
Marital status			0.101	(0.07)			0.094	(0.07)			0.091	(0.07)
Child			-0.035	(0.08)			-0.034	(0.08)			-0.028	(0.08)
Dad: Upp.-sec.			-0.189*	(0.10)			-0.198**	(0.10)			-0.208**	(0.10)
Dad: Post-sec.			-0.126	(0.10)			-0.132	(0.10)			-0.132	(0.10)
Mom: Upp.-sec.			0.219**	(0.09)			0.214**	(0.09)			0.213**	(0.09)
Mom: Post-sec.			0.221**	(0.10)			0.225**	(0.10)			0.221**	(0.10)
Res: BE			-0.085	(0.14)			-0.090	(0.14)			-0.085	(0.15)
Res: LU			-0.067	(0.16)			-0.046	(0.16)			-0.006	(0.18)
Res: UR			0.384	(0.43)			0.397	(0.43)			1.075*	(0.61)
Res: SZ			0.108	(0.18)			0.114	(0.18)			0.140	(0.21)
Res: OW			0.008	(0.28)			-0.013	(0.29)			0.420	(0.35)
Res: NW			0.018	(0.34)			0.037	(0.34)			0.466	(0.44)
Res: GL			-0.640**	(0.31)			-0.636**	(0.30)			-0.327	(0.40)
Res: ZG			0.058	(0.16)			0.079	(0.16)			0.310	(0.19)
Res: FR			-0.155	(0.19)			-0.156	(0.19)			-0.022	(0.23)
Res: SO			-0.215	(0.17)			-0.243	(0.17)			-0.408*	(0.21)
Res: BS			-0.098	(0.19)			-0.059	(0.20)			-0.083	(0.20)
Res: BL			0.108	(0.18)			0.130	(0.18)			0.073	(0.21)
Res: SH			-0.065	(0.21)			-0.086	(0.21)			0.079	(0.28)
Res: AR			0.426	(0.34)			0.414	(0.33)			0.703*	(0.39)
Res: AI			0.013	(0.27)			0.003	(0.27)			-1.352	(0.87)
Res: SG			0.061	(0.12)			0.041	(0.12)			0.178	(0.14)
Res: GR			0.028	(0.25)			0.063	(0.26)			0.035	(0.28)
Res: AG			-0.035	(0.11)			-0.039	(0.11)			0.011	(0.13)
Res: TG			-0.236	(0.17)			-0.278	(0.17)			-0.252	(0.20)
Res: TI			-0.327	(0.27)			-0.319	(0.26)			-0.325	(0.31)
Res: VD			0.017	(0.18)			0.026	(0.18)			0.112	(0.21)
Res: VS			0.086	(0.20)			0.093	(0.20)			0.206	(0.25)
Res: NE			0.164	(0.22)			0.176	(0.23)			0.400	(0.29)
Res: GE			-0.242	(0.23)			-0.215	(0.23)			0.057	(0.31)
Res: JU			0.184	(0.27)			0.151	(0.27)			0.039	(0.38)
UAS			0.239	(0.24)			0.036	(0.29)			0.081	(0.31)
Master			0.235**	(0.10)			0.250**	(0.10)			0.250**	(0.10)
UNI 2			-0.181	(0.18)			-0.185	(0.18)			-0.180	(0.18)
UNI 3			-0.479**	(0.19)			-0.497***	(0.19)			-0.466**	(0.20)
UNI 4			0.199	(0.20)			0.180	(0.20)			0.279	(0.21)
UNI 5			-0.166	(0.19)			-0.171	(0.19)			-0.126	(0.20)
UNI 6			-0.377	(0.48)			-0.402	(0.48)			-0.363	(0.48)
UNI 7			-0.499**	(0.23)			-0.519**	(0.23)			-0.448*	(0.24)
UNI 8			0.267	(0.21)			0.285	(0.21)			0.295	(0.22)
UNI 9			-0.254	(0.17)			-0.254	(0.17)			-0.241	(0.18)
UNI 10			-0.190	(0.26)			-0.166	(0.26)			-0.136	(0.27)
UNI 11			-0.080	(0.19)			-0.039	(0.19)			-0.009	(0.21)
UNI 12			-0.206	(0.16)			-0.161	(0.16)			-0.179	(0.17)
UAS 1			-0.347*	(0.20)			-0.282	(0.20)			-0.282	(0.22)
UAS 2			-0.338*	(0.20)			-0.238	(0.21)			-0.193	(0.23)
UAS 3			-0.272	(0.19)			-0.222	(0.19)			-0.207	(0.20)
UAS 4			-0.413**	(0.19)			-0.361*	(0.19)			-0.312	(0.20)
UAS 5			-0.285	(0.27)			-0.234	(0.27)			-0.203	(0.28)
UAS 6			-0.490***	(0.19)			-0.432**	(0.18)			-0.401**	(0.20)
UAS 7			-0.261	(0.18)			-0.200	(0.18)			-0.186	(0.19)
UAS 8			0.000	(.)								
Arts			0.177	(0.23)			0.209	(0.23)			0.159	(0.24)
Edu. Sciences			0.234	(0.16)			0.213	(0.16)			0.175	(0.17)
Economics			0.642***	(0.16)			0.595***	(0.16)			0.572***	(0.17)
Nat. Sciences			0.145	(0.18)			0.102	(0.18)			0.082	(0.18)
Medi. Sciences			0.428*	(0.25)			0.394	(0.25)			0.391	(0.25)
Health			0.308	(0.20)			0.306	(0.20)			0.288	(0.20)
Engineering			0.546***	(0.18)			0.466**	(0.19)			0.487**	(0.19)
Agri. Sciences			0.297*	(0.17)			0.208	(0.18)			0.220	(0.19)
Others			0.150	(0.23)			0.103	(0.23)			0.080	(0.23)
Grade			0.180**	(0.07)			0.178**	(0.07)			0.184**	(0.07)
Cohort=2017			-0.165***	(0.05)			-0.140**	(0.05)			-0.149***	(0.06)
Exchange			-0.114*	(0.06)			-0.118*	(0.06)			-0.118*	(0.06)
Pre-study job			0.165**	(0.07)			0.171**	(0.07)			0.178**	(0.07)
Student internship			0.016	(0.06)			0.043	(0.06)			0.043	(0.06)
Student job			0.164**	(0.07)			0.156**	(0.07)			0.156**	(0.07)
Work-based high. edu.			0.223**	(0.09)			0.194**	(0.09)			0.223**	(0.09)

Cont. studies		-0.179**	(0.08)		-0.183**	(0.08)			-0.180**	(0.08)		
Add. studies		0.090	(0.08)		0.084	(0.08)			0.088	(0.08)		
Cont. education		0.188***	(0.07)		0.186***	(0.07)			0.198***	(0.07)		
Medium		-0.292***	(0.07)		-0.293***	(0.07)			-0.286***	(0.07)		
Large		-0.472***	(0.06)		-0.471***	(0.06)			-0.467***	(0.06)		
Public empl.		-0.107	(0.07)		-0.101	(0.07)			-0.100	(0.07)		
Electricity ...		0.037	(0.22)		0.022	(0.22)			-0.062	(0.20)		
Water Supply ...		-0.784	(0.52)		-0.667	(0.53)			-0.692	(0.53)		
Construction		-0.007	(0.22)		-0.023	(0.22)			0.039	(0.23)		
Wholesale ...		0.019	(0.11)		-0.009	(0.11)			0.009	(0.12)		
Transportation ...		-0.008	(0.13)		0.006	(0.14)			0.010	(0.14)		
Accommodation ...		-0.295	(0.35)		-0.282	(0.34)			-0.328	(0.34)		
Information ...		-0.299***	(0.10)		-0.300***	(0.10)			-0.294***	(0.10)		
Financial ...		-0.258**	(0.10)		-0.261**	(0.10)			-0.264**	(0.10)		
Real Estate		0.165	(0.31)		0.172	(0.31)			0.198	(0.31)		
Scientific ...		-0.218***	(0.08)		-0.217***	(0.08)			-0.214***	(0.08)		
Administrative ...		-0.062	(0.20)		-0.040	(0.20)			-0.020	(0.21)		
Public ...		-0.163	(0.15)		-0.162	(0.15)			-0.166	(0.15)		
Education		-0.716***	(0.16)		-0.696***	(0.16)			-0.740***	(0.16)		
Health ...		-0.359***	(0.13)		-0.338***	(0.13)			-0.363***	(0.13)		
Arts ...		-0.005	(0.20)		0.015	(0.19)			0.004	(0.19)		
Other service ...		0.003	(0.15)		-0.004	(0.15)			-0.003	(0.15)		
Extraterritorial ...		-0.695**	(0.30)		-0.686**	(0.29)			-0.657**	(0.30)		
Lausanne		0.047	(0.15)		0.056	(0.15)			0.024	(0.15)		
Sion		0.064	(0.26)		0.066	(0.25)			0.060	(0.26)		
Fribourg		0.239	(0.22)		0.225	(0.22)			0.202	(0.22)		
Neuchatel		0.055	(0.23)		0.020	(0.24)			0.040	(0.24)		
Biel		0.175	(0.22)		0.181	(0.22)			0.186	(0.22)		
Bern		0.143	(0.20)		0.152	(0.19)			0.135	(0.20)		
Basel		0.212	(0.24)		0.217	(0.24)			0.220	(0.24)		
Aarau-Olten		0.338	(0.22)		0.356	(0.22)			0.332	(0.22)		
Zurich		0.220	(0.20)		0.232	(0.20)			0.219	(0.20)		
Winterthur-SH		0.377*	(0.23)		0.389*	(0.22)			0.372	(0.23)		
St. Gallen		0.310	(0.23)		0.333	(0.23)			0.311	(0.23)		
Chur		0.390	(0.32)		0.353	(0.32)			0.389	(0.32)		
Luzern		0.374	(0.24)		0.378	(0.24)			0.352	(0.24)		
Bellinzona		0.839**	(0.36)		0.839**	(0.35)			0.832**	(0.35)		
Lugano		0.396	(0.35)		0.386	(0.35)			0.389	(0.36)		
Abroad		0.375	(0.31)		0.392	(0.31)			0.390	(0.32)		
Ori: BE							-0.214**	(0.09)	-0.036	(0.13)		
Ori: LU							-0.012	(0.11)	-0.034	(0.15)		
Ori: UR							-0.270	(0.30)	-0.818*	(0.47)		
Ori: SZ							-0.148	(0.16)	-0.049	(0.21)		
Ori: OW							-0.443**	(0.21)	-0.596*	(0.30)		
Ori: NW							-0.161	(0.21)	-0.562	(0.37)		
Ori: GL							-0.288	(0.21)	-0.421	(0.36)		
Ori: ZG							-0.484**	(0.19)	-0.680***	(0.25)		
Ori: FR							-0.233*	(0.12)	-0.199	(0.20)		
Ori: SO							0.154	(0.12)	0.257	(0.18)		
Ori: BS							-0.474**	(0.22)	-0.122	(0.27)		
Ori: BL							-0.053	(0.13)	0.016	(0.17)		
Ori: SH							0.018	(0.15)	-0.207	(0.24)		
Ori: AR							0.004	(0.24)	-0.398	(0.27)		
Ori: AI							0.376	(0.49)	1.312	(0.83)		
Ori: SG							0.042	(0.09)	-0.197	(0.12)		
Ori: GR							-0.096	(0.15)	-0.015	(0.19)		
Ori: AG							0.068	(0.09)	-0.127	(0.14)		
Ori: TG							0.137	(0.12)	0.001	(0.15)		
Ori: TI							-0.360***	(0.11)	-0.070	(0.20)		
Ori: VD							-0.360***	(0.10)	-0.142	(0.18)		
Ori: VS							-0.245**	(0.12)	-0.185	(0.21)		
Ori: NE							-0.422***	(0.14)	-0.385*	(0.23)		
Ori: GE							-0.554***	(0.12)	-0.439*	(0.25)		
Ori: JU							0.045	(0.16)	0.041	(0.31)		
Observations	2817	2817		2817	2817		2817		2817			
Pseudo R^2	0.002	0.072										

Notes: The table shows the regression coefficients (Coef.) and standard errors (SE) from the ordered probit regressions (first two columns) and IV regressions (last four columns) on employment position. The data is from the five-year post-graduation surveys. Columns Oprobit1 and IV1 include no controls, whereas IV3 includes region of origin fixed effects. Columns Oprobit2 and IV2 include all controls, whereas IV4 additionally includes region of origin fixed effects. The estimations from the first stage include the same controls as the estimations from the second stage. Standard errors are robust and no sampling weights are used. ***,** and * denote significance at the 1%, 5% and 10% level, respectively.

B.3 Estimations from robustness checks

Table B.11: Summary statistics of entire dataset and our sample

	Dataset			Sample		
	Mean	SE	Obs	Mean	SE	Obs
Dependent variables						
Wage	39280.70	40518.72	95060	72745.48	23942.50	13899
Search time	13.37	10.42	95060	4.45	5.20	13899
Internship	0.15	0.36	56889	0.17	0.37	13899
Explanatory variables						
VET	0.23	0.42	93913	0.38	0.49	13899
Regional enrolment rate in VET	0.70	0.12	65179	0.72	0.11	13899
Channel						
Related VET	0.14	0.35	95050	0.27	0.45	13899
CV: Personal characteristics						
Age	27.29	4.56	95060	26.19	1.60	13899
Female	0.53	0.50	95060	0.50	0.50	13899
Marital status	0.10	0.30	89051	0.06	0.24	13899
Child	0.06	0.23	89034	0.02	0.15	13899
Education of father						
Dad: Comp.	0.08	0.27	86244	0.08	0.27	13899
Dad: Upp.-sec.	0.36	0.48	86244	0.42	0.49	13899
Dad: Post-sec.	0.57	0.50	86244	0.51	0.50	13899
Education of mother						
Mom: Comp.	0.10	0.30	86704	0.09	0.29	13899
Mom: Upp.-sec.	0.53	0.50	86704	0.61	0.49	13899
Mom: Post-sec.	0.37	0.48	86704	0.30	0.46	13899
CV: Education						
UAS	0.34	0.47	95060	0.62	0.49	13899
Institute						
UNI 1	0.06	0.24	95060	0.03	0.16	13899
UNI 2	0.08	0.27	95060	0.04	0.20	13899
UNI 3	0.06	0.23	95060	0.04	0.18	13899
UNI 4	0.07	0.26	95060	0.03	0.16	13899
UNI 5	0.07	0.25	95060	0.03	0.18	13899
UNI 6	0.01	0.12	95060	0.00	0.06	13899
UNI 7	0.02	0.15	95060	0.02	0.12	13899
UNI 8	0.03	0.18	95060	0.02	0.15	13899
UNI 9	0.11	0.32	95060	0.05	0.22	13899
UNI 10	0.02	0.13	95060	0.01	0.09	13899
UNI 11	0.04	0.20	95060	0.03	0.18	13899
UNI 12	0.08	0.28	95060	0.08	0.26	13899
UAS 1	0.04	0.19	95060	0.07	0.26	13899
UAS 2	0.09	0.29	95060	0.16	0.37	13899
UAS 3	0.04	0.21	95060	0.08	0.27	13899
UAS 4	0.03	0.18	95060	0.06	0.25	13899
UAS 5	0.02	0.13	95060	0.02	0.14	13899
UAS 6	0.03	0.17	95060	0.07	0.26	13899
UAS 7	0.08	0.27	95060	0.15	0.35	13899
UAS 8	0.00	0.06	95060	0.00	0.06	13899
Master	0.35	0.48	95060	0.35	0.48	13899
Subject						
Humanities	0.08	0.26	95060	0.03	0.17	13899
Arts	0.05	0.23	95060	0.03	0.18	13899

Edu. Sciences	0.18	0.39	95060	0.15	0.35	13899
Law	0.08	0.27	95060	0.00	0.00	13899
Economics	0.19	0.39	95060	0.29	0.46	13899
Nat. Sciences	0.11	0.31	95060	0.06	0.24	13899
Medi. Sciences	0.07	0.25	95060	0.02	0.14	13899
Health	0.04	0.20	95060	0.09	0.29	13899
Engineering	0.06	0.23	95060	0.09	0.29	13899
Agri. Sciences	0.12	0.32	95060	0.22	0.41	13899
Others	0.02	0.15	95060	0.01	0.11	13899
Grade	5.08	0.41	86612	5.09	0.39	13899
No. of semester	6.53	2.39	94767	6.18	1.94	13899
Cohort						
2011	0.20	0.40	95060	0.10	0.31	13899
2013	0.26	0.44	95060	0.23	0.42	13899
2015	0.27	0.44	95060	0.30	0.46	13899
2017	0.27	0.44	95060	0.37	0.48	13899
CV: Experience						
Pre-study job	0.83	0.38	95060	0.88	0.33	13899
Student internship	0.43	0.50	95011	0.46	0.50	13899
Student job	0.86	0.35	95060	0.87	0.33	13899
Work-based high. edu.	0.10	0.30	95060	0.13	0.33	13899
Exchange	0.16	0.37	94993	0.16	0.37	13899

Notes: The table shows the unweighted summary statistics including mean, standard deviation (SD), and number of observations (Obs) for the entire dataset and our sample separately. The dataset is from the one-year post-graduation surveys. The main difference between the dataset and our sample lies on our sample focusing on higher education graduates entering the labour market with little work experience required in their higher education curricula. See the methodology section for more information on our sample formation.

Table B.12: Regression table on sample selection

	HWage	
	Coef.	SE
Wage		
VET	0.068***	(0.01)
Age	0.018**	(0.01)
Female	-0.052***	(0.01)
Marital status	0.023	(0.01)
Child	-0.076***	(0.02)
Dad: Upp.-sec.	0.000	(0.01)
Dad: Post-sec.	0.002	(0.01)
Mom: Upp.-sec.	-0.005	(0.01)
Mom: Post-sec.	-0.011	(0.01)
Res: BE	-0.055**	(0.02)
Res: LU	-0.019	(0.02)
Res: UR	-0.028	(0.06)
Res: SZ	-0.011	(0.03)
Res: OW	-0.127*	(0.05)
Res: NW	-0.142**	(0.05)
Res: GL	-0.034	(0.06)
Res: ZG	0.018	(0.03)
Res: FR	-0.045	(0.02)
Res: SO	0.012	(0.02)
Res: BS	-0.068**	(0.02)
Res: BL	-0.000	(0.03)
Res: SH	-0.051	(0.03)
Res: AR	-0.036	(0.05)
Res: AI	0.036	(0.08)
Res: SG	0.009	(0.02)
Res: GR	-0.048	(0.03)
Res: AG	-0.006	(0.02)
Res: TG	-0.001	(0.02)
Res: TI	-0.100***	(0.03)
Res: VD	-0.080***	(0.02)
Res: VS	-0.016	(0.03)
Res: NE	-0.108***	(0.03)
Res: GE	-0.136***	(0.03)
Res: JU	-0.068	(0.04)
UAS	0.223***	(0.06)
Master	0.162***	(0.01)
UNI 2	0.007	(0.03)
UNI 3	0.099***	(0.03)
UNI 4	0.044	(0.03)
UNI 5	-0.079**	(0.03)
UNI 6	0.027	(0.05)
UNI 7	-0.069*	(0.03)
UNI 8	0.192***	(0.03)
UNI 9	0.030	(0.02)
UNI 10	-0.054	(0.04)
UNI 11	0.033	(0.03)
UNI 12	0.074**	(0.02)
UAS 1	-0.074	(0.05)
UAS 2	-0.077	(0.06)
UAS 3	-0.073	(0.06)
UAS 4	-0.070	(0.06)
UAS 5	-0.119	(0.06)

UAS 6	-0.098	(0.06)
UAS 7	-0.086	(0.05)
UAS 8	0.000	(.)
Arts	-0.335***	(0.03)
Edu. Sciences	0.143***	(0.02)
Economics	0.225***	(0.02)
Nat. Sciences	0.141***	(0.02)
Medi. Sciences	0.239***	(0.03)
Health	0.233***	(0.03)
Engineering	0.200***	(0.03)
Agri. Sciences	0.238***	(0.02)
Others	0.026	(0.03)
Grade	0.054***	(0.01)
No. of semester	0.001	(0.00)
Cohort=2013	-0.074***	(0.02)
Cohort=2015	-0.085***	(0.02)
Cohort=2017	-0.099***	(0.02)
Exchange	-0.002	(0.01)
Pre-study job	0.002	(0.01)
Student internship	0.036***	(0.01)
Student job	-0.006	(0.01)
Work-based high. edu.	0.067***	(0.01)
Medium	0.081***	(0.01)
Large	0.122***	(0.01)
Public empl.	-0.015	(0.01)
Manufacturing	0.299*	(0.13)
Electricity ...	0.388**	(0.14)
Water Supply ...	0.397**	(0.15)
Construction	0.309*	(0.14)
Wholesale ...	0.280*	(0.13)
Transportation ...	0.222	(0.13)
Accommodation ...	-0.030	(0.14)
Information ...	0.301*	(0.13)
Financial ...	0.375**	(0.13)
Real Estate	0.253	(0.14)
Scientific ...	0.306*	(0.13)
Administrative ...	0.222	(0.13)
Public ...	0.218	(0.13)
Education	0.141	(0.13)
Health ...	0.193	(0.13)
Arts ...	0.070	(0.13)
Other service ...	0.072	(0.13)
Extraterritorial ...	0.081	(0.15)
Lausanne	-0.092***	(0.02)
Sion	-0.096**	(0.03)
Fribourg	-0.091**	(0.03)
Neuchatel	-0.077*	(0.03)
Biel	-0.039	(0.03)
Bern	-0.051	(0.03)
Basel	-0.099**	(0.03)
Aarau-Olten	-0.072*	(0.03)
Zurich	-0.040	(0.03)
Winterthur-SH	-0.024	(0.03)
St. Gallen	-0.048	(0.03)
Chur	-0.031	(0.04)
Luzern	-0.039	(0.03)
Bellinzona	-0.039	(0.04)

Lugano	-0.184***	(0.04)
Abroad	-0.251***	(0.04)
Constant	9.892***	(0.18)
sample		
Continued study	-18.510	(.)
Searched employment	7.586***	(0.37)
VET	0.134***	(0.03)
Age	-0.358***	(0.01)
Female	0.000	(0.02)
Marital status	-0.156***	(0.03)
Child	-0.045	(0.05)
Dad: Upp.-sec.	-0.002	(0.04)
Dad: Post-sec.	-0.052	(0.04)
Mom: Upp.-sec.	0.062	(0.04)
Mom: Post-sec.	-0.097*	(0.04)
Res: BE	0.121*	(0.05)
Res: LU	0.033	(0.06)
Res: UR	0.085	(0.19)
Res: SZ	0.099	(0.08)
Res: OW	-0.143	(0.16)
Res: NW	-0.007	(0.16)
Res: GL	-0.095	(0.17)
Res: ZG	0.018	(0.08)
Res: FR	0.179*	(0.08)
Res: SO	0.119	(0.07)
Res: BS	0.080	(0.07)
Res: BL	0.196*	(0.08)
Res: SH	0.326**	(0.12)
Res: AR	0.075	(0.16)
Res: AI	-0.225	(0.23)
Res: SG	0.128*	(0.06)
Res: GR	0.115	(0.09)
Res: AG	0.136**	(0.04)
Res: TG	0.098	(0.07)
Res: TI	0.478***	(0.09)
Res: VD	0.033	(0.07)
Res: VS	0.229**	(0.08)
Res: NE	0.050	(0.10)
Res: GE	0.045	(0.09)
Res: JU	-0.009	(0.13)
UAS	0.334*	(0.15)
Master	-0.213***	(0.03)
UNI 2	-0.024	(0.07)
UNI 3	0.116	(0.08)
UNI 4	-0.015	(0.08)
UNI 5	-0.017	(0.08)
UNI 6	-0.101	(0.14)
UNI 7	0.209*	(0.10)
UNI 8	-0.113	(0.08)
UNI 9	0.003	(0.07)
UNI 10	-0.533***	(0.11)
UNI 11	-0.093	(0.08)
UNI 12	0.127	(0.07)
UAS 1	-0.167	(0.14)
UAS 2	-0.133	(0.15)
UAS 3	-0.209	(0.14)
UAS 4	0.026	(0.14)

UAS 5	-0.505**	(0.16)
UAS 6	-0.171	(0.14)
UAS 7	-0.179	(0.14)
UAS 8	0.000	(.)
Arts	0.034	(0.07)
Edu. Sciences	0.345***	(0.05)
Law	-16.438	(.)
Economics	0.210***	(0.05)
Nat. Sciences	0.306***	(0.06)
Medi. Sciences	-0.083	(0.07)
Health	0.362***	(0.07)
Engineering	0.520***	(0.06)
Agri. Sciences	0.400***	(0.06)
Others	0.162	(0.08)
Grade	-0.038	(0.03)
No. of semester	-0.016***	(0.00)
Cohort=2013	0.693***	(0.03)
Cohort=2015	0.863***	(0.03)
Cohort=2017	1.264***	(0.03)
Exchange	-0.034	(0.03)
Pre-study job	0.119***	(0.03)
Student internship	-0.079***	(0.02)
Student job	0.058	(0.03)
Work-based high. edu.	-0.129***	(0.03)
Medium	0.025	(0.03)
Large	-0.039	(0.02)
Public empl.	0.019	(0.03)
Mining ...	-4.805	(.)
Manufacturing	1.026***	(0.29)
Electricity ...	0.895**	(0.31)
Water Supply ...	0.743*	(0.38)
Construction	0.795**	(0.31)
Wholesale ...	1.054***	(0.29)
Transportation ...	0.963**	(0.30)
Accommodation ...	0.747*	(0.31)
Information ...	0.958**	(0.29)
Financial ...	0.854**	(0.29)
Real Estate	0.871**	(0.32)
Scientific ...	0.816**	(0.29)
Administrative ...	1.063***	(0.30)
Public ...	0.897**	(0.30)
Education	0.726*	(0.29)
Health ...	0.555	(0.29)
Arts ...	0.954**	(0.30)
Other service ...	0.860**	(0.30)
Extraterritorial ...	0.463	(0.34)
Lausanne	0.111	(0.06)
Sion	-0.001	(0.10)
Fribourg	0.165	(0.09)
Neuchatel	0.214*	(0.10)
Biel	0.055	(0.09)
Bern	0.240**	(0.08)
Basel	0.194*	(0.09)
Aarau-Olten	0.237**	(0.09)
Zurich	0.244**	(0.08)
Winterthur-SH	0.182*	(0.09)

St. Gallen	0.227*	(0.10)
Chur	0.239*	(0.12)
Luzern	0.181*	(0.09)
Bellinzona	0.151	(0.14)
Lugano	-0.001	(0.13)
Abroad	0.040	(0.11)
Constant	0.238	(.)
/mills		
lambda	-0.034	(0.04)
Observations	35012	

Notes: The table shows the regression coefficients (Coef.) and standard errors (SE) from the two-stage Heckman correction model on wage. The data is from the one-year post-graduation surveys. The standard control variables are included and two instruments (continued study and searched employment) as exclusion restrictions. No sampling weights are used.

Table B.13: Regression table with nearest neighbour matching

	Wage Coef./SE
ATE	
r1vs0.VET	0.101***
	(0.02)
Observations	6436

Notes: The table shows the regression coefficients (Coef.) and standard errors (SE) from the nearest neighbour matching model for wage. The data is from the one-year post-graduation surveys. We use the observable variables age, gender, type of education, level of education, subject, and final grades for matching. No sampling weights are used.

Appendix C

Additional material of chapter 3

Table C.1: Effect of the free movement policy on firms' training behaviour by industry I

	Construction			Manufacturing			Services (trade)		
	(1) trfirm Coef./SE	(2) noappr Coef./SE	(3) recopp Coef./SE	(4) trfirm Coef./SE	(5) noappr Coef./SE	(6) recopp Coef./SE	(7) trfirm Coef./SE	(8) noappr Coef./SE	(9) recopp Coef./SE
$I(d_i \leq 15)$	-0.078	-0.126	-0.575	0.000	0.015	-0.114	-0.038	-0.058	0.024
	(0.061)	(0.109)	(0.408)	(0.054)	(0.080)	(0.320)	(0.030)	(0.043)	(0.141)
$I(d_i \leq 15) * I(t = 2004)$	0.120	0.172	0.439	-0.085	-0.179	-0.209	-0.007	0.004	-0.007
	(0.092)	(0.151)	(0.520)	(0.081)	(0.112)	(0.472)	(0.050)	(0.071)	(0.275)
$I(d_i \leq 15) * I(t = 2009)$	0.041	0.033	0.572	-0.113	-0.206*	-1.231***	0.030	0.073	-0.094
	(0.082)	(0.139)	(0.588)	(0.072)	(0.110)	(0.434)	(0.051)	(0.074)	(0.192)
$I(15 < d_i < 30)$	0.019	0.013	-0.017	-0.040	-0.047	-0.118	-0.062**	-0.091**	-0.058
	(0.053)	(0.090)	(0.388)	(0.043)	(0.059)	(0.244)	(0.027)	(0.040)	(0.135)
$I(15 < d_i \leq 30) * I(t = 2004)$	-0.073	-0.099	-0.302	-0.004	-0.007	0.139	0.117**	0.162**	0.411
	(0.076)	(0.123)	(0.489)	(0.076)	(0.117)	(0.495)	(0.048)	(0.069)	(0.259)
$I(15 < d_i \leq 30) * I(t = 2009)$	-0.006	0.006	0.187	0.011	0.054	-0.070	0.100**	0.152**	0.156
	(0.073)	(0.122)	(0.523)	(0.070)	(0.105)	(0.518)	(0.045)	(0.065)	(0.220)
Observations	1748	1748	1553	2415	2415	2116	4185	4185	3812
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	No	No	No	No	No
Firm size FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents the estimation results of the free movement policy on the training behaviour of firms in the cost-benefit data for the construction, manufacturing, and services (trade) industries. The construction industry consists of the industry branch mining and quarrying, energy and water supply, construction. The manufacturing industry consists of the industry branches food and beverages manufacture, textiles and apparel manufacture, wood and paper products manufacture, chemicals and plastic manufacture, metal products manufacture, machinery and equipment manufacture, electrical equipment manufacture, and other manufacture. The services (trade) industry consists of the industry branches trade and repair, food and beverage service activities, and transport and telecommunications. The DiD estimations are based on OLS regressions of aggregate cross-sections for all firms in 2000, 2004 and 2009. The dependent variable training firm (trfirm) is 0 for firms not training apprentices and 1 otherwise. The dependent variable number of apprentices (noappr) is 0 for firms not training apprentices and the IHS of the number of apprentices otherwise. The dependent variable recrutive opportunity benefits (recopp) is the IHS of the amount of Swiss francs a training firm saves from hiring a former apprentice instead of recruiting on the external labour market. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.2: Effect of the free movement policy on firms' training behaviour by industry II

	Services (knowledge)			**Public**		
	(1) trfirm Coef./SE	(2) noappr Coef./SE	(3) recopp Coef./SE	(4) trfirm Coef./SE	(5) noappr Coef./SE	(6) recopp Coef./SE
$I(d_{\text{i}} \leq 15)$	-0.141***	-0.203***	-0.641***	-0.037	-0.117*	-0.265
	(0.032)	(0.049)	(0.187)	(0.055)	(0.062)	(0.174)
$I(d_{\text{i}} \leq 15) * I(t = 2004)$	0.002	0.050	0.496	0.028	0.044	0.523
	(0.051)	(0.071)	(0.320)	(0.086)	(0.116)	(0.442)
$I(d_{\text{i}} \leq 15) * I(t = 2009)$	0.138	0.217	0.072	-0.154	-0.155	-0.557
	(0.085)	(0.154)	(0.320)	(0.101)	(0.119)	(0.399)
$I(15 < d_{\text{i}} < 30)$	-0.082***	-0.111**	-0.363**	-0.084*	-0.118**	-0.277**
	(0.031)	(0.046)	(0.183)	(0.045)	(0.059)	(0.121)
$I(15 < d_{\text{i}} \leq 30) * I(t = 2004)$	0.003	0.052	0.310	0.024	0.030	0.284
	(0.052)	(0.073)	(0.310)	(0.077)	(0.119)	(0.384)
$I(15 < d_{\text{i}} \leq 30) * I(t = 2009)$	0.043	0.064	0.204	0.075	0.129	0.001
	(0.049)	(0.072)	(0.289)	(0.071)	(0.097)	(0.328)
Observations	3624	3624	3331	1951	1951	1576
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	No	No
Firm size FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents the estimation results of the free movement policy on the training behaviour of firms in the cost-benefit data for the services (knowledge) and the public industries. The services (knowledge) industry consists of the industry branches financial services and insurance, real estate activities, and IT. The public industry consists of the industry branches education, human health activities, and public administration. The DiD estimations are based on OLS regressions of aggregate cross-sections for all firms in 2000, 2004 and 2009. The dependent variable training firm (trfirm) is 0 for firms not training apprentices and 1 otherwise. The dependent variable number of apprentices (noappr) is 0 for firms not training apprentices and the IHS of the number of apprentices otherwise. The dependent variable recrutive opportunity benefits (recopp) is the IHS of the amount of Swiss francs a training firm saves from hiring a former apprentice instead of recruiting on the external labour market. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.3: Effect of the free movement policy on firms' training motives (margins for skillw)

	(1) 1 Coef./SE	(2) 2 Coef./SE	(3) 3 Coef./SE	(4) 4 Coef./SE	(5) 5 Coef./SE
$I(d_i \leq 15)$	-0.003	-0.003	-0.002	0.001	0.007
	(0.009)	(0.009)	(0.007)	(0.002)	(0.022)
$I(d_i \leq 15) * I(t = 2004)$	-0.006	-0.006	-0.005	0.002	0.015
	(0.014)	(0.013)	(0.010)	(0.003)	(0.034)
$I(d_i \leq 15) * I(t = 2009)$	0.027**	0.025**	0.019**	-0.007**	-0.065**
	(0.013)	(0.011)	(0.009)	(0.003)	(0.030)
$I(15 < d_i < 30)$	-0.003	-0.003	-0.002	0.001	0.008
	(0.008)	(0.007)	(0.006)	(0.002)	(0.020)
$I(15 < d_i \leq 30) * I(t = 2004)$	0.025**	0.022**	0.018**	-0.006*	-0.059**
	(0.012)	(0.011)	(0.009)	(0.003)	(0.030)
$I(15 < d_i \leq 30) * I(t = 2009)$	0.015	0.014	0.011	-0.004	-0.036
	(0.011)	(0.010)	(0.008)	(0.003)	(0.027)
Observations	14644	14644	14644	14644	14644

Notes: The table presents the margins of the free movement policy on firms' training motive to attract skilled workers (skillw) in the cost-benefit data. The margins are based on ordered probit regressions (from 1 not important to 5 very important) of aggregate cross-sections for all firms in 2000, 2004 and 2009. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.4: Effect of the free movement policy on firms' training motives (margins for hirecost)

	(1) 1 Coef./SE	(2) 2 Coef./SE	(3) 3 Coef./SE	(4) 4 Coef./SE	(5) 5 Coef./SE
$I(d_i \leq 15)$	-0.033**	-0.017**	0.014**	0.021**	0.015**
	(0.017)	(0.009)	(0.007)	(0.011)	(0.008)
$I(d_i \leq 15) * I(t = 2004)$	0.004	0.002	-0.002	-0.003	-0.002
	(0.025)	(0.013)	(0.011)	(0.016)	(0.012)
$I(d_i \leq 15) * I(t = 2009)$	0.040*	0.021*	-0.017*	-0.025*	-0.018*
	(0.022)	(0.011)	(0.009)	(0.014)	(0.010)
$I(15 < d_i < 30)$	-0.014	-0.007	0.006	0.009	0.006
	(0.015)	(0.008)	(0.006)	(0.009)	(0.007)
$I(15 < d_i \leq 30) * I(t = 2004)$	-0.011	-0.005	0.004	0.007	0.005
	(0.023)	(0.012)	(0.010)	(0.014)	(0.010)
$I(15 < d_i \leq 30) * I(t = 2009)$	0.014	0.007	-0.006	-0.009	-0.007
	(0.018)	(0.010)	(0.008)	(0.012)	(0.008)
Observations	14644	14644	14644	14644	14644

Notes: The table presents the margins of the free movement policy on firms' training motive to save hiring costs (hirecost) in the cost-benefit data. The margins are based on ordered probit regressions (from 1 not important to 5 very important) of aggregate cross-sections for all firms in 2000, 2004 and 2009. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.5: Effect of the free movement policy on firms' training motives (margins for poor)

	(1) 1 Coef./SE	(2) 2 Coef./SE	(3) 3 Coef./SE	(4) 4 Coef./SE	(5) 5 Coef./SE
$I(d_i \leq 15)$	-0.040***	-0.027***	0.005**	0.031***	0.030***
	(0.015)	(0.010)	(0.002)	(0.012)	(0.012)
$I(d_i \leq 15) * I(t = 2004)$	0.041*	0.028*	-0.005*	-0.033*	-0.032*
	(0.022)	(0.015)	(0.003)	(0.017)	(0.017)
$I(d_i \leq 15) * I(t = 2009)$	0.037**	0.025**	-0.005**	-0.029**	-0.028**
	(0.018)	(0.012)	(0.002)	(0.014)	(0.014)
$I(15 < d_i < 30)$	-0.011	-0.007	0.001	0.009	0.008
	(0.013)	(0.009)	(0.002)	(0.010)	(0.010)
$I(15 < d_i \leq 30) * I(t = 2004)$	0.007	0.005	-0.001	-0.006	-0.006
	(0.019)	(0.013)	(0.002)	(0.015)	(0.015)
$I(15 < d_i \leq 30) * I(t = 2009)$	0.008	0.005	-0.001	-0.006	-0.006
	(0.016)	(0.011)	(0.002)	(0.012)	(0.012)
Observations	14644	14644	14644	14644	14644

Notes: The table presents the margins of the free movement policy on firms' training motive to avoid poor hiring decision (poor) in the cost-benefit data. The margins are based on ordered probit regressions (from 1 not important to 5 very important) of aggregate cross-sections for all firms in 2000, 2004 and 2009. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.6: Effect of the free movement policy on firms' training motives (margins for uskillw)

	(1) 1 Coef./SE	(2) 2 Coef./SE	(3) 3 Coef./SE	(4) 4 Coef./SE	(5) 5 Coef./SE
$I(d_i \leq 15)$	-0.014	-0.005	0.004	0.009	0.006
	(0.019)	(0.007)	(0.006)	(0.013)	(0.008)
$I(d_i \leq 15) * I(t = 2004)$	-0.015	-0.006	0.004	0.010	0.006
	(0.028)	(0.011)	(0.008)	(0.019)	(0.011)
$I(d_i \leq 15) * I(t = 2009)$	0.025	0.010	-0.007	-0.017	-0.010
	(0.028)	(0.011)	(0.008)	(0.019)	(0.011)
$I(15 < d_i < 30)$	-0.031*	-0.012*	0.009*	0.021*	0.013*
	(0.017)	(0.007)	(0.005)	(0.012)	(0.007)
$I(15 < d_i \leq 30) * I(t = 2004)$	0.017	0.007	-0.005	-0.012	-0.007
	(0.025)	(0.010)	(0.008)	(0.017)	(0.010)
$I(15 < d_i \leq 30) * I(t = 2009)$	0.038	0.015	-0.012	-0.026	-0.016
	(0.025)	(0.010)	(0.007)	(0.017)	(0.010)
Observations	14644	14644	14644	14644	14644

Notes: The table presents the margins of the free movement policy on firms' training motive to replace unskilled worker (uskillw) in the cost-benefit data. The margins are based on ordered probit regressions (from 1 not important to 5 very important) of aggregate cross-sections for all firms in 2000, 2004 and 2009. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.7: Effect of the free movement policy on firms' training motives (margins for adjucost)

	(1) 1 Coef./SE	(2) 2 Coef./SE	(3) 3 Coef./SE	(4) 4 Coef./SE	(5) 5 Coef./SE
$I(d_i \leq 15)$	-0.014	-0.008	0.002	0.011	0.009
	(0.016)	(0.010)	(0.003)	(0.013)	(0.011)
$I(d_i \leq 15) * I(t = 2004)$	-0.003	-0.002	0.001	0.002	0.002
	(0.024)	(0.014)	(0.004)	(0.019)	(0.015)
$I(d_i \leq 15) * I(t = 2009)$	0.005	0.003	-0.001	-0.004	-0.003
	(0.022)	(0.013)	(0.004)	(0.017)	(0.014)
$I(15 < d_i < 30)$	-0.005	-0.003	0.001	0.004	0.003
	(0.014)	(0.008)	(0.002)	(0.011)	(0.009)
$I(15 < d_i \leq 30) * I(t = 2004)$	-0.005	-0.003	0.001	0.004	0.003
	(0.021)	(0.013)	(0.003)	(0.016)	(0.013)
$I(15 < d_i \leq 30) * I(t = 2009)$	-0.003	-0.002	0.000	0.002	0.002
	(0.017)	(0.011)	(0.003)	(0.014)	(0.011)
Observations	14644	14644	14644	14644	14644

Notes: The table presents the margins of the free movement policy on firms' training motive to save adjustment cost (adjucost) in the cost-benefit data. The margins are based on ordered probit regressions (from 1 not important to 5 very important) of aggregate cross-sections for all firms in 2000, 2004 and 2009. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.8: Effect of the free movement policy on firms' training motives (margins for choice)

	(1) 1 Coef./SE	(2) 2 Coef./SE	(3) 3 Coef./SE	(4) 4 Coef./SE	(5) 5 Coef./SE
$I(d_i \leq 15)$	-0.021	-0.014	-0.005	0.017	0.022
	(0.014)	(0.009)	(0.003)	(0.011)	(0.015)
$I(d_i \leq 15) * I(t = 2004)$	0.016	0.010	0.003	-0.013	-0.017
	(0.021)	(0.014)	(0.005)	(0.017)	(0.022)
$I(d_i \leq 15) * I(t = 2009)$	-0.005	-0.003	-0.001	0.004	0.005
	(0.018)	(0.012)	(0.004)	(0.014)	(0.019)
$I(15 < d_i < 30)$	-0.013	-0.009	-0.003	0.011	0.014
	(0.012)	(0.008)	(0.003)	(0.010)	(0.013)
$I(15 < d_i \leq 30) * I(t = 2004)$	0.018	0.012	0.004	-0.015	-0.020
	(0.018)	(0.012)	(0.004)	(0.014)	(0.019)
$I(15 < d_i \leq 30) * I(t = 2009)$	0.013	0.008	0.003	-0.010	-0.014
	(0.016)	(0.011)	(0.004)	(0.013)	(0.018)
Observations	14644	14644	14644	14644	14644

Notes: The table presents the margins of the free movement policy on firms' training motive to hire the best (choice) in the cost-benefit data. The margins are based on ordered probit regressions (from 1 not important to 5 very important) of aggregate cross-sections for all firms in 2000, 2004 and 2009. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.9: Effect of the free movement policy on firms' training motives (margins for turn)

	(1) 1 Coef./SE	(2) 2 Coef./SE	(3) 3 Coef./SE	(4) 4 Coef./SE	(5) 5 Coef./SE
$I(d_i \leq 15)$	-0.032**	-0.025**	-0.008**	0.032**	0.034**
	(0.013)	(0.010)	(0.004)	(0.013)	(0.013)
$I(d_i \leq 15) * I(t = 2004)$	0.020	0.016	0.005	-0.020	-0.021
	(0.019)	(0.015)	(0.005)	(0.019)	(0.020)
$I(d_i \leq 15) * I(t = 2009)$	0.019	0.015	0.005	-0.019	-0.020
	(0.016)	(0.013)	(0.004)	(0.016)	(0.017)
$I(15 < d_i < 30)$	-0.022**	-0.017**	-0.006**	0.022**	0.023**
	(0.011)	(0.008)	(0.003)	(0.011)	(0.011)
$I(15 < d_i \leq 30) * I(t = 2004)$	0.022	0.018	0.006	-0.022	-0.024
	(0.016)	(0.013)	(0.004)	(0.016)	(0.017)
$I(15 < d_i \leq 30) * I(t = 2009)$	0.032**	0.025**	0.008**	-0.032**	-0.034**
	(0.014)	(0.011)	(0.004)	(0.014)	(0.015)
Observations	14644	14644	14644	14644	14644

Notes: The table presents the margins of the free movement policy on firms' training motive to avoid turnover (turn) in the cost-benefit data. The margins are based on ordered probit regressions (from 1 not important to 5 very important) of aggregate cross-sections for all firms in 2000, 2004 and 2009. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.10: Effect of the free movement policy on firms' training motives (margins for train)

	(1) 1 Coef./SE	(2) 2 Coef./SE	(3) 3 Coef./SE	(4) 4 Coef./SE	(5) 5 Coef./SE
$I(d_i \leq 15)$	-0.021**	-0.020**	-0.020**	0.010**	0.052**
	(0.009)	(0.008)	(0.008)	(0.004)	(0.021)
$I(d_i \leq 15) * I(t = 2004)$	0.025**	0.024**	0.024**	-0.012**	-0.061**
	(0.013)	(0.012)	(0.012)	(0.006)	(0.031)
$I(d_i \leq 15) * I(t = 2009)$	0.025**	0.024**	0.024**	-0.012**	-0.061**
	(0.011)	(0.011)	(0.011)	(0.005)	(0.028)
$I(15 < d_i < 30)$	-0.011	-0.010	-0.010	0.005	0.026
	(0.007)	(0.007)	(0.007)	(0.003)	(0.018)
$I(15 < d_i \leq 30) * I(t = 2004)$	0.025**	0.024**	0.023**	-0.012**	-0.060**
	(0.011)	(0.011)	(0.011)	(0.005)	(0.027)
$I(15 < d_i \leq 30) * I(t = 2009)$	0.026**	0.025**	0.025**	-0.012***	-0.064**
	(0.010)	(0.010)	(0.010)	(0.005)	(0.026)
Observations	14644	14644	14644	14644	14644

Notes: The table presents the margins of the free movement policy on firms' training motive to train junior workers (train) in the cost-benefit data. The margins are based on ordered probit regressions (from 1 not important to 5 very important) of aggregate cross-sections for all firms in 2000, 2004 and 2009. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.11: Effect of the free movement policy on firms' training motives (margins for secur)

	(1) 1 Coef./SE	(2) 2 Coef./SE	(3) 3 Coef./SE	(4) 4 Coef./SE	(5) 5 Coef./SE
$I(d_i \leq 15)$	0.013	0.010	0.010	-0.001	-0.031
	(0.010)	(0.007)	(0.007)	(0.001)	(0.023)
$I(d_i \leq 15) * I(t = 2004)$	-0.014	-0.011	-0.011	0.002	0.035
	(0.014)	(0.011)	(0.011)	(0.002)	(0.034)
$I(d_i \leq 15) * I(t = 2009)$	-0.008	-0.006	-0.006	0.001	0.020
	(0.014)	(0.011)	(0.011)	(0.002)	(0.034)
$I(15 < d_i < 30)$	0.003	0.002	0.002	-0.000	-0.007
	(0.009)	(0.006)	(0.007)	(0.001)	(0.021)
$I(15 < d_i \leq 30) * I(t = 2004)$	0.011	0.008	0.009	-0.001	-0.027
	(0.013)	(0.009)	(0.010)	(0.001)	(0.030)
$I(15 < d_i \leq 30) * I(t = 2009)$	0.013	0.010	0.010	-0.001	-0.032
	(0.012)	(0.009)	(0.009)	(0.001)	(0.029)
Observations	14644	14644	14644	14644	14644

Notes: The table presents the margins of the free movement policy on firms' training motive to secure talent pipeline (secur) in the cost-benefit data. The margins are based on ordered probit regressions (from 1 not important to 5 very important) of aggregate cross-sections for all firms in 2000, 2004 and 2009. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.12: Effect of the free movement policy on firms' training behaviour (just NBR)

	All firms			Training firms		
	(1) trfirm Coef./SE	(2) noappr Coef./SE	(3) trintens Coef./SE	(4) noappr Coef./SE	(5) trintens Coef./SE	(6) recopp Coef./SE
$I(d_{\text{i}} \leq 15)$	-0.052***	-0.084***	-1.533**	-0.064	-1.674	-0.244
	(0.019)	(0.029)	(0.731)	(0.056)	(2.846)	(0.681)
$I(d_{\text{i}} \leq 15) * I(t = 2004)$	-0.011	-0.003	-0.291	0.021	2.726	1.310
	(0.031)	(0.045)	(1.129)	(0.080)	(3.619)	(1.055)
$I(d_{\text{i}} \leq 15) * I(t = 2009)$	0.017	0.045	0.598	0.153	-1.426	-1.694
	(0.040)	(0.065)	(1.016)	(0.096)	(3.246)	(1.199)
$I(15 < d_{\text{i}} < 30)$	-0.038**	-0.055**	-1.471**	-0.045	-3.237	0.651
	(0.018)	(0.026)	(0.626)	(0.053)	(2.044)	(0.651)
$I(15 < d_{\text{i}} \leq 30) * I(t = 2004)$	0.012	0.028	1.414	0.083	5.638*	0.050
	(0.030)	(0.044)	(1.086)	(0.071)	(2.973)	(0.940)
$I(15 < d_{\text{i}} \leq 30) * I(t = 2009)$	0.015	0.025	1.419	0.125*	2.984	-0.570
	(0.031)	(0.049)	(0.885)	(0.073)	(2.577)	(1.056)
Observations	12196	12196	12196	3327	3327	2038
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm size FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents the estimation results of the free movement policy on the training behaviour of firms in the cost-benefit data whereby the control group only consists of firms outside the border region. The first three DiD estimations are based on OLS regressions of aggregate cross-sections for all firms in 2000, 2004 and 2009. The latter three DiD estimations are based on OLS regressions of aggregate cross-sections for training firms in 2000, 2004 and 2009. The dependent variable training firm (trfirm) is 0 for firms not training apprentices and 1 otherwise. The dependent variable number of apprentices (noappr) is 0 for firms not training apprentices and IHS of the number of apprentices otherwise. The dependent variable training intensity (trintens) is 0 for firms not training apprentices and else the fraction of apprentices among all workers. The dependent variable recrutive opportunity benefits (recopp) is the IHS of the amount of Swiss francs a training firm saves from hiring a former apprentice instead of recruiting on the external labor market. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.13: Effect of the free movement policy on firms' training behaviour (just BR 30+)

	All firms			**Training firms**		
	(1) trfirm	(2) noappr	(3) trintens	(4) noappr	(5) trintens	(6) recopp
	Coef./SE	Coef./SE	Coef./SE	Coef./SE	Coef./SE	Coef./SE
$I(d_i \leq 15)$	-0.074***	-0.106***	-1.205	0.006	1.900	-0.959
	(0.023)	(0.034)	(0.788)	(0.063)	(3.014)	(0.770)
$I(d_i \leq 15) * I(t = 2004)$	0.030	0.047	-0.680	-0.037	-3.861	2.366**
	(0.035)	(0.050)	(1.351)	(0.093)	(4.425)	(1.195)
$I(d_i \leq 15) * I(t = 2009)$	0.075*	0.116*	1.535	0.081	-3.952	-2.108*
	(0.045)	(0.069)	(1.212)	(0.098)	(3.656)	(1.227)
$I(15 < d_i < 30)$	-0.060***	-0.079**	-1.158*	0.021	0.505	0.016
	(0.022)	(0.032)	(0.695)	(0.059)	(2.197)	(0.721)
$I(15 < d_i \leq 30) * I(t = 2004)$	0.052	0.078	0.992	0.043	-0.928	1.083
	(0.034)	(0.049)	(1.332)	(0.085)	(3.946)	(1.072)
$I(15 < d_i \leq 30) * I(t = 2009)$	0.074*	0.098*	2.372**	0.064	0.204	-1.381
	(0.038)	(0.057)	(1.116)	(0.080)	(2.972)	(1.141)
Observations	10524	10524	10524	2728	2728	1644
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm size FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents the estimation results of the free movement policy on the training behaviour of firms in the cost-benefit data whereby the control group only consists of firms within the border region and more than 30 minutes of the border. The first three DiD estimations are based on OLS regressions of aggregate cross-sections for all firms in 2000, 2004 and 2009. The latter three DiD estimations are based on OLS regressions of aggregate cross-sections for training firms in 2000, 2004 and 2009. The dependent variable training firm (trfirm) is 0 for firms not training apprentices and 1 otherwise. The dependent variable number of apprentices (noappr) is 0 for firms not training apprentices and IHS of the number of apprentices otherwise. The dependent variable training intensity (trintens) is 0 for firms not training apprentices and else the fraction of apprentices among all workers. The dependent variable recrutive opportunity benefits (recopp) is the IHS of the amount of Swiss francs a training firm saves from hiring a former apprentice instead of recruiting on the external labour market. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.14: Effect of the free movement policy on firms' training behaviour (cluster canton)

	All firms			Training firms		
	(1) trfirm	(2) noappr	(3) trintens	(4) noappr	(5) trintens	(6) recopp
	Coef./SE	Coef./SE	Coef./SE	Coef./SE	Coef./SE	Coef./SE
$I(d_i \leq 15)$	-0.060*	-0.092**	-1.403	-0.043	-0.325	-0.496
	(0.031)	(0.044)	(0.990)	(0.047)	(3.456)	(0.626)
$I(d_i \leq 15) * I(t = 2004)$	0.005	0.016	-0.452	0.000	0.196	1.659*
	(0.035)	(0.054)	(1.138)	(0.049)	(4.727)	(0.943)
$I(d_i \leq 15) * I(t = 2009)$	0.040	0.072	0.972	0.137**	-2.231	-1.857*
	(0.038)	(0.061)	(0.789)	(0.059)	(3.682)	(0.926)
$I(15 < d_i < 30)$	-0.046	-0.064	-1.343	-0.021	-1.731	0.428
	(0.030)	(0.042)	(0.807)	(0.038)	(1.553)	(0.623)
$I(15 < d_i \leq 30) * I(t = 2004)$	0.028	0.048	1.232	0.070	3.086	0.384
	(0.039)	(0.056)	(1.270)	(0.058)	(2.745)	(0.817)
$I(15 < d_i \leq 30) * I(t = 2009)$	0.038*	0.054	1.796**	0.106**	1.824	-0.797
	(0.019)	(0.033)	(0.654)	(0.048)	(2.031)	(1.211)
Observations	14623	14623	14623	3997	3997	2431
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm size FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents the estimation results of the free movement policy on the training behaviour of firms in the cost-benefit data. The first three DiD estimations are based on OLS regressions of aggregate cross-sections for all firms in 2000, 2004 and 2009. The latter three DiD estimations are based on OLS regressions of aggregate cross-sections for training firms in 2000, 2004 and 2009. The dependent variable training firm (trfirm) is 0 for firms not training apprentices and 1 otherwise. The dependent variable number of apprentices (noappr) is 0 for firms not training apprentices and IHS of the number of apprentices otherwise. The dependent variable training intensity (trintens) is 0 for firms not training apprentices and else the fraction of apprentices among all workers. The dependent variable recrutive opportunity benefits (recopp) is the IHS of the amount of Swiss francs a training firm saves from hiring a former apprentice instead of recruiting on the external labour market. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and standard errors are clustered at cantonal-level.

Table C.15: Effect of the free movement policy on firms' training motives (RC: LPM)

	(1) skillw Coef./SE	(2) hirecost Coef./SE	(3) poor Coef./SE	(4) uskillw Coef./SE	(5) adjucost Coef./SE	(6) choice Coef./SE	(7) turn Coef./SE	(8) train Coef./SE	(9) secur Coef./SE
$I(d_i \leq 15)$	0.002	0.027	0.076***	-0.003	0.050*	0.040	0.098***	0.061**	-0.025
	(0.027)	(0.026)	(0.029)	(0.026)	(0.029)	(0.030)	(0.031)	(0.027)	(0.028)
$I(d_i \leq 15) * I(t = 2004)$	0.016	-0.043	-0.127***	0.005	-0.062	0.002	-0.067	-0.059	0.051
	(0.044)	(0.038)	(0.043)	(0.040)	(0.044)	(0.047)	(0.047)	(0.043)	(0.043)
$I(d_i \leq 15) * I(t = 2009)$	-0.102**	-0.028	-0.082**	-0.019	-0.016	-0.002	-0.076*	-0.068*	-0.017
	(0.041)	(0.031)	(0.035)	(0.037)	(0.044)	(0.042)	(0.045)	(0.039)	(0.040)
$I(15 < d_i < 30)$	0.002	0.019	0.016	0.051**	0.021	0.016	0.041	0.016	0.011
	(0.024)	(0.023)	(0.025)	(0.025)	(0.025)	(0.027)	(0.027)	(0.025)	(0.025)
$I(15 < d_i \leq 30) * I(t = 2004)$	-0.066*	0.003	0.003	-0.017	-0.008	-0.037	-0.063	-0.066*	-0.044
	(0.038)	(0.034)	(0.039)	(0.037)	(0.038)	(0.041)	(0.041)	(0.039)	(0.038)
$I(15 < d_i \leq 30) * I(t = 2009)$	-0.063*	-0.016	-0.005	-0.071**	0.004	-0.039	-0.078**	-0.084**	-0.073**
	(0.034)	(0.028)	(0.031)	(0.035)	(0.034)	(0.035)	(0.039)	(0.034)	(0.035)
Observations	14644	14644	14644	14644	14644	14644	14644	14644	14644
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm size FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents the estimation results of the free movement policy on the training motives of firms in the cost-benefit data. All DiD estimations are based on linear probability model regressions of aggregate cross-sections for all firms in 2000, 2004 and 2009. The dependent variables attract skilled workers (skillw), save hiring cost (hirecost), avoid the risk of poor hiring decision (poor), replace unskilled workers (uskillw), save adjustment costs (adjucost), hire the best young person (choice), avoid turnover (turn), train junior workers into skilled workers (train), and secure talent pipeline (secur) come from qualitative survey questions on the importance of these training motives (5-point Likert scale, where 1 is not important and 5 is very important). We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.16: Effect of the free movement policy on firms' training behaviour by training approach

	Investment approach			**Production approach**		
	(1) noappr	(2) trintens	(3) recopp	(4) noappr	(5) trintens	(6) recopp
	Coef./SE	Coef./SE	Coef./SE	Coef./SE	Coef./SE	Coef./SE
$I(d_{\text{i}} \leq 15)$	-0.059	1.960	-0.336	-0.021	-1.490	-0.659
	(0.081)	(3.443)	(1.024)	(0.068)	(4.023)	(0.795)
$I(d_{\text{i}} \leq 15) * I(t = 2004)$	-0.013	-5.553	0.963	0.008	4.031	2.587**
	(0.120)	(4.782)	(1.523)	(0.096)	(4.960)	(1.238)
$I(d_{\text{i}} \leq 15) * I(t = 2009)$	0.256*	-1.111	-3.361**	0.034	-3.945	0.484
	(0.134)	(4.199)	(1.503)	(0.094)	(4.371)	(1.240)
$I(15 < d_{\text{i}} < 30)$	-0.101	-1.363	-0.300	0.028	-1.829	0.861
	(0.064)	(2.203)	(1.042)	(0.063)	(2.572)	(0.674)
$I(15 < d_{\text{i}} \leq 30) * I(t = 2004)$	0.139	-1.370	1.013	0.019	5.438	0.323
	(0.093)	(3.657)	(1.385)	(0.084)	(3.854)	(1.037)
$I(15 < d_{\text{i}} \leq 30) * I(t = 2009)$	0.231**	4.308	0.348	0.027	0.646	-1.143
	(0.101)	(3.373)	(1.615)	(0.085)	(3.186)	(1.197)
Observations	1638	1638	1001	2380	2380	1447
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm size FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents the estimation results of the free movement policy on the training behavior of firms following an investment approach or a production approach separately in the cost-benefit data. All DiD estimations are based on OLS regressions of aggregate cross-sections for training firms in 2000, 2004 and 2009. The dependent variable number of apprentices (noappr) is 0 for firms not training apprentices and IHS of the number of apprentices otherwise. The dependent variable training intensity (trintens) is 0 for firms not training apprentices and else the fraction of apprentices among all workers. The dependent variable recrutive opportunity benefits (recopp) is the IHS of the amount of Swiss francs a training firm saves from hiring a former apprentice instead of recruiting on the external labor market. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.17: Effect of the free movement policy on firms' training behaviour (no educational reform)

	All firms			Training firms		
	(1) trfirm	(2) noappr	(3) trintens	(4) noappr	(5) trintens	(6) recopp
	Coef./SE	Coef./SE	Coef./SE	Coef./SE	Coef./SE	Coef./SE
$I(d_{\text{i}} \leq 15)$	-0.093*	-0.151**	-0.272	-0.094	5.310	-1.207
	(0.051)	(0.075)	(2.332)	(0.105)	(7.701)	(1.262)
$I(d_{\text{i}} \leq 15) * I(t = 2004)$	-0.022	-0.047	-1.680	-0.040	-0.561	2.112
	(0.074)	(0.106)	(3.199)	(0.138)	(9.150)	(1.845)
$I(d_{\text{i}} \leq 15) * I(t = 2009)$	0.021	0.044	0.173	0.088	0.250	0.291
	(0.072)	(0.110)	(3.017)	(0.153)	(8.115)	(1.811)
$I(15 < d_{\text{i}} < 30)$	-0.090**	-0.139**	-2.882**	-0.044	-3.195	0.523
	(0.046)	(0.065)	(1.465)	(0.085)	(3.311)	(1.154)
$I(15 < d_{\text{i}} \leq 30) * I(t = 2004)$	0.020	0.029	1.583	0.037	5.191	1.383
	(0.066)	(0.096)	(2.362)	(0.119)	(5.056)	(1.487)
$I(15 < d_{\text{i}} \leq 30) * I(t = 2009)$	0.033	0.065	1.940	0.058	3.601	0.113
	(0.062)	(0.091)	(2.029)	(0.119)	(4.371)	(1.497)
Observations	2580	2580	2580	1148	1148	674
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm size FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents the estimation results of the free movement policy on the training behavior of firms in the cost-benefit data for occupations not affected by the educational reform in 2003. The first three DiD estimations are based on OLS regressions of aggregate cross-sections for all firms in 2000, 2004 and 2009. The latter three DiD estimations are based on OLS regressions of aggregate cross-sections for training firms in 2000, 2004 and 2009. The dependent variable training firm (trfirm) is 0 for firms not training apprentices and 1 otherwise. The dependent variable number of apprentices (noappr) is 0 for firms not training apprentices and IHS of the number of apprentices otherwise. The dependent variable training intensity (trintens) is 0 for firms not training apprentices and else the fraction of apprentices among all workers. The dependent variable recrutive opportunity benefits (recopp) is the IHS of the amount of Swiss francs a training firm saves from hiring a former apprentice instead of recruiting on the external labor market. We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Table C.18: Effect of the free movement policy on firms' training motives (no educational reform)

	(1) skillw Coef./SE	(2) hirecost Coef./SE	(3) poor Coef./SE	(4) uskillw Coef./SE	(5) adjucost Coef./SE	(6) choice Coef./SE	(7) turn Coef./SE	(8) train Coef./SE	(9) secur Coef./SE
main									
$I(d_i \leq 15)$	-0.134	0.047	0.046	0.044	0.081	0.248	0.272*	0.189	-0.095
	(0.167)	(0.169)	(0.185)	(0.164)	(0.183)	(0.163)	(0.157)	(0.175)	(0.173)
$I(d_i \leq 15) * I(t = 2004)$	-0.318	-0.180	-0.370	-0.403	-0.200	-0.711***	-0.768***	-0.767***	-0.210
	(0.273)	(0.251)	(0.255)	(0.249)	(0.247)	(0.245)	(0.254)	(0.246)	(0.269)
$I(d_i \leq 15) * I(t = 2009)$	0.160	-0.107	-0.172	-0.006	-0.219	-0.220	-0.277	-0.202	0.176
	(0.191)	(0.195)	(0.207)	(0.188)	(0.206)	(0.187)	(0.185)	(0.201)	(0.198)
$I(15 < d_i < 30)$	0.111	-0.023	-0.052	0.134	-0.130	0.055	0.137	0.313**	0.112
	(0.142)	(0.145)	(0.161)	(0.173)	(0.159)	(0.153)	(0.151)	(0.150)	(0.169)
$I(15 < d_i \leq 30) * I(t = 2004)$	-0.672***	0.041	-0.015	-0.143	0.200	-0.157	-0.334	-0.623***	-0.339
	(0.212)	(0.213)	(0.219)	(0.225)	(0.208)	(0.220)	(0.212)	(0.214)	(0.228)
$I(15 < d_i \leq 30) * I(t = 2009)$	-0.151	-0.084	0.039	-0.136	0.060	-0.068	-0.104	-0.373**	-0.150
	(0.168)	(0.168)	(0.180)	(0.191)	(0.180)	(0.172)	(0.175)	(0.174)	(0.188)
Observations	2580	2580	2580	2580	2580	2580	2580	2580	2580
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm size FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents the estimation results of the free movement policy on the training motives of firms in the cost-benefit data for occupations not affected by the educational reform in 2003. All DiD estimations are based on ordered probit regressions of aggregate cross-sections for all firms in 2000, 2004 and 2009. The dependent variables attract skilled workers (skillw), save hiring cost (hirecost), avoid the risk of poor hiring decision (poor), replace unskilled workers (uskillw), save adjustment costs (adjucost), hire the best young person (choice), avoid turnover (turn), train junior workers into skilled workers (train), and secure talent pipeline (secur) come from qualitative survey questions on the importance of these training motives (5-point Likert scale, where 1 is not important and 5 is very important). We differentiate highly treated firms (firms within 15 minutes of the border; $I(d\_i \leq 15)$), slightly treated firms (firms within 15–30 minutes of the border; $I(15 < d\_i \leq 30)$), and firms in the two control groups (firms more than 30 minutes of the border a) within the border region and (b) in the central region). All estimations include sample weights and robust standard errors.

Appendix D

Additional material of chapter 4

D.1 Descriptive statistics

Table D.1: Country statistics

Country	General education	School-based VET	Dual VET	Unemployment rate (UR)	Relaxed UR	NEET rate	Incidence of long-term UR	Temporary contract rate	Involuntary part-time work rate	Atypical working hours rate	Skills mismatch rate	In-work at-risk-of-poverty rate	Average hourly earnings
Argentina	74.44	25.56	0.00	16.72	-	-	26.30	-	-	-	-	-	-
Australia	40.68	59.32	0.00	7.78	-	11.75	-	-	14.88	-	-	-	20.51
Austria	21.97	43.44	34.59	8.65	15.69	12.39	14.37	8.52	2.75	19.70	19.80	7.61	17.26
Belgium	29.53	67.53	2.94	18.80	23.67	16.91	32.15	22.31	7.11	15.28	15.84	4.10	22.67
Brazil	91.16	8.84	0.00	13.49	-	23.52	-	-	-	-	-	-	-
Canada	91.62	8.38	0.00	10.25	-	14.36	2.20	-	8.63	-	-	-	17.90
Chile	65.27	34.73	0.00	17.48	-	24.44	6.52	-	13.22	-	-	-	-
Czechia	22.53	42.36	35.11	14.42	18.03	13.80	33.45	13.59	1.41	31.76	15.38	3.34	9.49
Denmark	50.58	0.62	48.80	9.25	18.86	10.37	10.29	11.24	5.12	17.56	7.59	19.89	20.74
Finland	36.47	51.78	11.75	15.42	29.33	14.28	10.48	31.45	7.71	30.05	8.78	8.84	17.17
France	49.80	38.30	11.90	19.62	-	19.04	27.24	31.75	9.43	17.28	18.04	9.44	20.01
Germany	41.10	12.61	46.29	10.94	13.43	14.36	-	16.38	4.04	19.72	19.19	10.09	19.78
Hungary	68.07	18.72	13.21	20.63	32.13	20.46	35.63	18.07	3.00	25.21	12.24	6.42	8.30
Iceland	65.44	18.99	15.57	12.17	20.31	9.75	13.96	25.93	5.04	38.29	16.19	13.73	17.57
Indonesia	61.67	38.33	0.00	15.57	-	-	55.78	-	-	-	-	-	-
Ireland	65.47	31.68	2.85	22.84	27.58	22.54	42.22	7.73	11.83	29.68	14.71	6.35	17.92
Israel	64.79	31.31	3.90	11.73	-	31.10	-	-	6.67	-	-	-	-
Italy	38.41	61.59	0.00	24.04	57.05	26.07	48.61	19.52	13.38	17.30	3.80	11.03	14.35
Japan	75.34	24.66	0.00	8.06	-	12.00	-	-	7.99	-	-	-	15.28
Korea, Rep. of	71.70	28.30	0.00	9.41	-	-	-	-	-	-	-	-	9.79
Luxembourg	38.47	47.06	14.47	13.57	32.98	8.83	-	19.67	2.64	23.11	16.55	10.25	24.01
Mexico	89.77	10.23	0.00	8.19	-	26.05	1.34	-	-	-	-	-	4.39
Netherlands	32.35	47.34	20.31	8.58	18.46	7.34	15.99	11.78	4.76	21.61	11.92	4.88	22.180
New Zealand	65.16	34.84	0.00	12.49	-	16.27	-	-	10.93	-	-	-	-
Norway	43.11	41.91	14.98	6.90	17.35	9.56	-	7.46	2.21	28.38	18.11	21.95	20.59
Poland	54.17	39.55	6.28	22.68	30.47	17.88	27.32	41.09	3.44	27.08	5.31	10.80	7.70
Portugal	68.39	31.61	0.00	20.61	29.92	16.52	31.76	31.98	6.04	24.42	5.72	9.15	8.75
Russia	54.28	45.72	0.00	14.06	-	-	23.28	-	0.35	-	-	-	-
Slovakia	27.09	42.21	30.70	25.65	32.20	19.76	57.82	12.71	3.86	34.99	13.54	4.29	9.24
Slovenia	35.28	63.93	0.79	19.01	26.99	11.80	37.54	53.04	1.67	36.75	14.79	6.00	14.00
Spain	59.07	37.87	3.06	30.01	43.69	23.19	24.13	31.58	12.22	18.07	8.11	10.64	14.43
Sweden	45.73	54.27	0.00	17.08	34.04	13.82	8.91	30.28	10.93	31.39	13.85	18.07	15.67
Switzerland	35.04	6.10	58.86	8.02	14.86	10.68	18.41	11.92	-	15.06	7.36	9.43	12.71
Turkey	60.29	31.76	7.95	18.23	29.40	46.16	-	6.62	0.53	25.72	10.53	15.36	-
United Kingdom	48.63	51.37	0.00	12.99	22.15	18.20	23.44	3.81	7.37	25.86	17.92	9.21	17.74
United States	100.00	0.00	0.00	8.65	-	16.05	8.39	-	2.35	-	-	-	18.60

Notes: This table displays the average values over the years 2004–2014 by country for the explanatory variables (general education, school-based VET, dual VET) and the dependent variables (youth unemployment rate, youth relaxed unemployment rate, NEET rate, youth incidence of long-term unemployment, youth temporary contract rate, youth involuntary part-time work rate, youth atypical working hours rate, youth skills mismatch rate, youth in-work at-risk-of-poverty rate, youth average hourly earnings). For the values of the explanatory variables we use the same data sample as for the youth unemployment rate, however, the values vary slightly for the samples based on the other dependent variables.

Table D.2: Description of regression variables

Variable	Description
Dependent variables: Labour market integration	
Unemployment rate[III]	Ratio of unemployed workers to the labour force (ILO standard)[c]
Relaxed unemployment rate[II]	Ratio of unemployed and discouraged workers to the labour force[a]
NEET rate[V]	Ratio of young people neither in employment nor education and training; labour force participation rate for adults[b]
Incidence of long-term unemployment[III]	Ratio of workers unemployed longer than one year to total unemployed workers[b]
Dependent variables: Job quality	
Temporary contract rate[II]	Ratio of workers on a contract of less than 18 months to total workers[c]
Involuntary part-time work rate[V]	Ratio of involuntary part-time workers to total workers[a]
Atypical working hours rate[II]	Ratio of workers working on Sundays, at night or shifts to total workers[c]
Skills mismatch rate[II]	Index of dissimilarities between ratio of employment and ratio of unemployment at a given education level[c]
In-work at-risk-of-poverty rate[II]	Ratio of workers earning less than 60 per cent of the national median equalized disposable income to total workers[b]
Average hourly earnings[V]	Average hourly wages of employees (US$, constant prices, constant PPP)[d]
Explanatory variables	
General education[V] (baseline)	Enrolment rate in upper-secondary general education programmes; less than 25 per cent vocational content in curriculum
School-based VET[V]	Enrolment rate in upper-secondary school-based vocational education and training programmes; more than 25 per cent vocational content in curriculum; students learn at least 75 per cent of the curriculum in a school environment
Dual VET[V]	Enrolment rate in upper-secondary combined school- and work-based vocational education and training programmes; more than 25 per cent vocational content in curriculum; students learn between 25 and 90 per cent of the curriculum at the workplace
Control variables	
Youth LF participation rate[III]	Ratio of youth in the labour force (LF) to the cohort
GDP per capita[I]	Value of output produced in a country within a year per person
GDP growth[I]	Growth of a country's gross domestic product within a year
Employment protection legislation index[V]	Regulations on the procedures and costs involved in dismissing and hiring employees
PISA score[V]	Measurement of 15 years old students' skills and knowledge
Trade union density[V]	Proportion of employees who take part in a trade union
Unemployment insurance[V]	Income transfers to unemployed people
Economic sectors[VI]	Three economic sectors agriculture (baseline), industry and services; measured as sector value added in percentage of GDP
KOF Globalisation Index[IV]	Index measuring the economic, social and political dimensions of globalisation

Notes: The table defines our regression variables including their data source and age range. Adult control variables are equivalent to the youth labour market indicators, i.e. the dependent variables. The exception is the NEET rate, which is defined only for young people. The control variables in italics are included only in the robustness checks.
Source: [I] Economic Outlook of the International Monetary Fund; [II] Eurostat; [III] ILOSTAT; [IV] KOF Swiss Economic Institute; [V] OECD Data or OECD.stat; [VI] World Development Indicators of the World Bank.
Age range: [a] Youth: 15 to 24 / Adult: 25 to 54; [b] Youth: 20 to 24 / Adult: 25 to 54; [c] Youth: 20 to 24 / Adult: 25 to 64; [d] Youth: 15 to 29 / Adult: 30 to 64

D.2 Estimations from robustness checks

Table D.3: Robustness checks on the effects of the VET programmes on youth labour market integration

		Labour market		Low income		High income		Financial crisis	
		M2	M5	M2	M5	M2	M5	M2	M5
Dependent variable: Labour market integration									
Unemployment rate	School-based VET	0.002	0.106***	0.009	0.268**	-0.036***	-0.106*	-0.01	-0.090*
Observations = 169 , 86 , 115 , 148		(0.012)	(0.038)	(0.019)	(0.135)	(0.012)	(0.063)	(0.01)	(0.052)
Countries = 29 , 16 , 17 , 25	School-based VET^2		-0.001**		-0.005*		0.001		0.001
			(0)		(0.003)		(0.001)		(0.000)
	Dual VET	-0.367***	-0.306	-0.234	-0.385	-0.079**	-0.172	-0.210***	-0.231
		(0.092)	(0.201)	(0.194)	(0.368)	(0.04)	(0.175)	(0.077)	(0.173)
	Dual VET^2		-0.002		0.002		0.001		0
			(0.005)		(0.007)		(0.002)		(0.002)
	Difference in VET	0.000***	0.000***	0.218	0.114	0.299	0.581	0.012**	0.025**
Relaxed unemployment rate	School-based VET	0.002	0.149**	0.103***	0.177	-0.029	-0.490***	0.018	-0.356**
Observations = 96 , 47 , 72 , 71		(0.019)	(0.059)	(0.031)	(0.272)	(0.019)	(0.135)	(0.014)	(0.155)
Countries = 17 , 8 , 13 , 13	School-based VET^2		-0.002**		-0.002		0.005***		0.004**
			(0.001)		(0.006)		(0.001)		(0.002)
	Dual VET	-0.467***	-0.031	-0.542	-0.771	-0.211**	-0.156	-0.420***	-0.067
		(0.143)	(0.308)	(0.474)	(1.009)	(0.091)	(0.185)	(0.136)	(0.201)
	Dual VET^2		-0.011		0.005		-0.002		-0.006*
			(0.007)		(0.019)		(0.002)		(0.004)
	Difference in VET	0.001***	0.001***	0.176	0.376	0.081*	0.002***	0.001***	0.001***
NEET rate	School-based VET	0.024	0.011	0.065	-0.306	0	0.043	0.015	-0.162
Observations = 157 , 70 , 119 , 136		(0.028)	(0.062)	(0.04)	(0.255)	(0.024)	(0.099)	(0.03)	(0.149)
Countries = 26 , 12 , 18 , 22	School-based VET^2		0		0.007		0		0.002
			(0.001)		(0.005)		(0.001)		(0.002)
	Dual VET	-0.016	-0.217	0.473	0.764	-0.054	-0.107	0.200**	0.433
		(0.212)	(0.442)	(0.365)	(0.81)	(0.16)	(0.311)	(0.079)	(0.316)
	Dual VET^2		0.006		-0.004		0.001		-0.004
			(0.008)		(0.014)		(0.005)		(0.004)
	Difference in VET	0.848	0.648	0.257	0.223	0.731	0.854	0.034**	0.063*
Incidence of long-term unemployment	School-based VET	0.002	0.294**	0.085	0.122	-0.102***	0.066	-0.138***	-0.148
Observations = 126 , 66 , 84 , 97		(0.066)	(0.12)	(0.092)	(0.141)	(0.029)	(0.237)	(0.039)	(0.332)
Countries = 21 , 12 , 12 , 16	School-based VET^2		-0.004***		-0.003		-0.002		0
			(0.001)		(0.003)		(0.002)		(0.003)
	Dual VET	-0.608	-1.944***	-0.65	-3.117***	0.067	-0.671	0.384	0.039
		(0.421)	(0.502)	(0.496)	(0.982)	(0.118)	(0.485)	(0.234)	(0.413)
	Dual VET^2		0.035***		0.049***		0.01		0.007
			(0.011)		(0.016)		(0.007)		(0.007)
	Difference in VET	0.143	0.000***	0.104	0.005***	0.178	0.057*	0.044**	0.089*
Controls									
Time fixed effects & controls		YES	YES	YES	YES	YES	YES	YES	YES
Adult control for dependent variable		YES	YES	YES	YES	YES	YES	YES	YES
Additional controls		NO	NO	NO	NO	NO	NO	NO	NO

Notes: The table displays the effect of school-based VET and dual VET on each indicator for labour market integration, whereby we vary the sample as follows: 'Labour Market' countries excludes those with well-established dual VET and low youth unemployment rates (Austria, Denmark, Germany and Switzerland), samples for 'Low income' and 'High income' are based on a sample split and 'Financial crisis' excludes countries strongly hit by the financial crisis in 2008 (Denmark, Hungary, Ireland, Italy, Poland, Portugal, Slovakia and Spain); we report first-difference GMM coefficients and standard errors in parentheses (clustered at country level); ***,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent level, respectively; Difference in VET reports the p-values for the null hypothesis that the coefficients of school-based and dual VET are equal; Observations describes the sample size for each subsample; Countries stands for the number of countries in each subsample; School-based VET contains 25 per cent or more vocational content, which students learn to 75 per cent or more at school; Dual VET contains 25 per cent or more vocational content, which students learn from 25 up to 90 per cent at a company; Controls are the youth labour force participation rate, GDP per capita, GDP growth, employment protection legislation index, PISA scores and time fixed effects; Additional controls (trade union density, unemployment insurance, sectors, KOF Globalisation Index, GDP x school-based VET, GDP x dual VET) are not included.

Table D.4: Robustness checks on the effects of the VET programmes on the job quality of young people I

		Labour market		Low income		High income		Financial crisis	
		M2	M5	M2	M5	M2	M5	M2	M5
Dependent variable: Job quality									
Temporary contract rate	School-based VET	0.073***	0.110**	0.059**	0.299***	0.035*	-0.16	0.040**	-0.095
Observations = 114 , 52 , 94 , 93		(0.022)	(0.055)	(0.029)	(0.062)	(0.019)	(0.144)	(0.019)	(0.131)
Countries = 18 , 8 , 14 , 14	School-based VET^2		0		-0.005***		0.002		0.001
			(0.001)		(0.002)		(0.001)		(0.001)
	Dual VET	-0.454***	-0.386	-0.887***	-0.983*	0.059	-0.277	-0.065	-0.748*
		(0.149)	(0.339)	(0.315)	(0.576)	(0.114)	(0.273)	(0.183)	(0.402)
	Dual VET^2		-0.002		0.004		0.004		0.009*
			(0.006)		(0.008)		(0.004)		(0.005)
	Difference in VET	0.001***	0.000***	0.002***	0.019**	0.836	0.871	0.571	0.190
Involuntary part-time work rate	School-based VET	0.002	0.032	-0.006	0.032	-0.033***	-0.051	-0.015	-0.112*
Observations = 149 , 61 , 112 , 120		(0.012)	(0.029)	(0.014)	(0.048)	(0.012)	(0.062)	(0.014)	(0.065)
Countries = 25 , 11 , 17 , 20	School-based VET^2		0		-0.001		0		0.001*
			(0)		(0.001)		(0.001)		(0.001)
	Dual VET	-0.108	-0.305*	0	-0.481*	0.120***	-0.023	0.051	0.199
		(0.088)	(0.156)	(0.167)	(0.289)	(0.045)	(0.112)	(0.053)	(0.133)
	Dual VET^2		0.005*		0.009***		0.002		-0.003
			(0.002)		(0.003)		(0.002)		(0.002)
	Difference in VET	0.201	0.109	0.970	0.012**	0.000***	0.001***	0.184	0.066*
Atypical working hours rate	School-based VET	-0.040***	0.006	0.023	-0.174***	-0.035*	0.068	-0.047***	0.039
Observations = 114 , 52 , 94 , 93		(0.014)	(0.038)	(0.02)	(0.048)	(0.019)	(0.079)	(0.017)	(0.085)
Countries = 18 , 8 , 14 , 14	School-based VET^2		-0.001		0.004***		-0.001		-0.001
			(0)		(0.001)		(0.001)		(0.001)
	Dual VET	-0.371***	-0.193	-0.295	-0.072	-0.005	-0.142	-0.1	-0.305
		(0.134)	(0.204)	(0.234)	(0.286)	(0.063)	(0.188)	(0.097)	(0.289)
	Dual VET^2		-0.004		-0.005		0.002		0.003
			(0.005)		(0.004)		(0.002)		(0.004)
	Difference in VET	0.011**	0.023**	0.165	0.080*	0.656	0.066*	0.577	0.557
Skills mismatch rate	School-based VET	0.033	-0.002	0.03	-0.355*	0.059	-0.555*	0.044	-0.42
Observations = 114 , 52 , 94 , 93		(0.033)	(0.075)	(0.029)	(0.187)	(0.037)	(0.288)	(0.043)	(0.293)
Countries = 18 , 8 , 14 , 14	School-based VET^2		0		0.008*		0.006**		0.005
			(0.001)		(0.004)		(0.003)		(0.003)
	Dual VET	-0.945***	-1.393**	-1.145***	-0.614	-0.353**	-0.855**	-0.356	-0.962
		(0.279)	(0.674)	(0.377)	(1.062)	(0.155)	(0.41)	(0.243)	(0.64)
	Dual VET^2		0.012		-0.011		0.006		0.008
			(0.015)		(0.02)		(0.005)		(0.009)
	Difference in VET	0.000***	0.006***	0.002***	0.000***	0.019**	0.043**	0.138	0.289
Controls									
Time fixed effects & controls		YES	YES	YES	YES	YES	YES	YES	YES
Adult control for dependent variable		YES	YES	YES	YES	YES	YES	YES	YES
Additional controls		NO	NO	NO	NO	NO	NO	NO	NO

Notes: The table displays the effect of school-based VET and dual VET on job quality indicators, whereby we vary the sample as follows: 'Labour Market' countries excludes those with well-established dual VET and low youth unemployment rates (Austria, Denmark, Germany and Switzerland), samples for 'Low income' and 'High income' are based on a sample split and 'Financial crisis' excludes countries strongly hit by the financial crisis in 2008 (Denmark, Hungary, Ireland, Italy, Poland, Portugal, Slovakia and Spain); we report first-difference GMM coefficients and standard errors in parentheses (clustered at country level); ***,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent level, respectively; Difference in VET reports the p-values for the null hypothesis that the coefficients of school-based and dual VET are equal; Observations describes the sample size for each subsample; Countries stands for the number of countries in each subsample; School-based VET contains 25 per cent or more vocational content, which students learn to 75 per cent or more at school; Dual VET contains 25 per cent or more vocational content, which students learn from 25 up to 90 per cent at a company; Controls are the youth labour force participation rate, GDP per capita, GDP growth, employment protection legislation index, PISA scores and time fixed effects; Additional controls (trade union density, unemployment insurance, sectors, KOF Globalisation Index, GDP x school-based VET, GDP x dual VET) are not included.

Table D.5: Robustness checks on the effects of the VET programmes on the job quality of young people II

		Labour market		Low income		High income		Financial crisis	
		M2	M5	M2	M5	M2	M5	M2	M5
Dependent variable: Job quality									
In-work at-risk-of-poverty rate	School-based VET	0.018	-0.122	0.185***	0.101	-0.014	-0.259	-0.022	-0.364
Observations = 111 , 50 , 89 , 87		(0.029)	(0.120)	(0.049)	(0.143)	(0.042)	(0.271)	(0.027)	(0.276)
Countries = 18 , 8 , 14 , 14	School-based VET^2		0.002		0.001		0.003		0.003
			(0.001)		(0.002)		(0.003)		(0.003)
	Dual VET	-0.398**	-1.276***	0.335	-0.555	-0.180	-0.648	0.033	-0.115
		(0.202)	(0.258)	(0.318)	(0.429)	(0.121)	(0.418)	(0.180)	(0.228)
	Dual VET^2		0.024***		0.018***		0.006		0.001
			(0.007)		(0.006)		(0.005)		(0.005)
	Difference in VET	0.046**	0.000***	0.651	0.058	0.242	0.565	0.765	0.619
Average hourly earnings (ln)	School-based VET	0	0	0	-0.002	0	0.001	0.001**	0
Observations = 114 , 46 , 87 , 97		(0)	(0.001)	(0.001)	(0.009)	(0.000)	(0.002)	(0.000)	(0.002)
Countries = 22 , 9 , 17 , 18	School-based VET^2		0.000		0.000		0.000		0.000
			(0.000)		(0.000)		(0.000)		(0.000)
	Dual VET	0.003	-0.007	-0.003	0.007	-0.003	-0.008***	0.002	-0.002
		(0.003)	(0.006)	(0.005)	(0.014)	(0.002)	(0.002)	(0.003)	(0.006)
	Dual VET^2		0.000		0.000		0.000		0.000
			(0.000)		(0.000)		(0.000)		(0.000)
	Difference in VET	0.235	0.170	0.693	0.862	0.135	0.005***	0.735	0.882
Controls									
Time fixed effects & controls		YES	YES	YES	YES	YES	YES	YES	YES
Adult control for dependent variable		YES	YES	YES	YES	YES	YES	YES	YES
Additional controls		NO	NO	NO	NO	NO	NO	NO	NO

Notes: The table displays the effect of school-based VET and dual VET on job quality indicators, whereby we vary the sample as follows: 'Labour Market' countries excludes those with well-established dual VET and low youth unemployment rates (Austria, Denmark, Germany and Switzerland), samples for 'Low income' and 'High income' are based on a sample split and 'Financial crisis' excludes countries strongly hit by the financial crisis in 2008 (Denmark, Hungary, Ireland, Italy, Poland, Portugal, Slovakia and Spain); we report first-difference GMM coefficients and standard errors in parentheses (clustered at country level); ***,** and * denote significance at the 1 per cent, 5 per cent and 10 per cent level, respectively; Difference in VET reports the p-values for the null hypothesis that the coefficients of school-based and dual VET are equal; Observations describes the sample size for each subsample; Countries stands for the number of countries in each subsample; School-based VET contains 25 per cent or more vocational content, which students learn to 75 per cent or more at school; Dual VET contains 25 per cent or more vocational content, which students learn from 25 up to 90 per cent at a company; Controls are the youth labour force participation rate, GDP per capita, GDP growth, employment protection legislation index, PISA scores and time fixed effects; Additional controls (trade union density, unemployment insurance, sectors, KOF Globalisation Index, GDP x school-based VET, GDP x dual VET) are not included.

Curriculum Vitae

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Academic Working Papers

Caves, K., and Oswald-Egg, M. E. (2020). Storming and forming: A case study of education policy implementation. *KOF Working Papers, 477*. (*R&R from Journal of Vocational Education & Training*)

Bolli, T., Caves, K., and Oswald-Egg, M. E. (2019). Valuable experience: How university internships affect graduates' income. *KOF Working Papers, 459*. (*2. R&R from Research in Higher Education*)

Bolli, T., Oswald-Egg, M. E. and Rageth, L. (2017, updated in 2019). Meet the need – The role of vocational education and training for the youth labour market. *KOF Working Papers, 429*. (*R&R from Kyklos*)

Egg, M. E. and Renold, U. (2015). The Swiss vocational education and training system: What can Spain learn from Switzerland?. *KOF Working Papers, 383*.

Academic Reports

Renold, U., Caves, K., Oswald-Egg, M. E., Markovic, J., Veselinovic, Z. and Todorovic, M. (2020). Implementation of the Serbian law on dual education: Third report on drivers and barriers. *CES Studies, vol. 8*

Renold, U., Caves, K., Oswald-Egg, M. E., Maldonado-Mariscal, K., Markovic, J., Veselinovic, Z. and Todorovic, M. (2020). Implementation of the Serbian law on dual education: Second report on barriers and drivers in the implementation phase. *CES Studies, vol. 4*.

Bolli, T., Oswald-Egg, M. E., Rageth, L. and Renold, U. (2020). Zweiter Bericht zum AKAD-Bildungsangebot zur Berufsmaturität II: Ergebnisse einer Ehemaligenbefragung. *CES Studies, vol. 3*

Pusterla, F. and Oswald-Egg, M. E. (2019). Heterogeneity in education and training; Sixth release of the KOF Youth Labour Market Index. *KOF Studies, 143*.

Renold, U., Bolli, T., Hulfeld, F. and Oswald-Egg, M. E. (2019). Erster Bericht zum AKAD-Bildungsangebot zur Berufsmaturität II: Wirksamkeit von Präsenzunterricht und Frühwarnsystem. *KOF Studies, 136*.

Renold, U., Caves, K., Maldonado-Mariscal, K., Oswald-Egg, M. E., Markovic, J., Veselinovic, Z., Stankovic, D., Ceneric, I. and Todorovic, M. (2019). Implementation of the Serbian law on dual education: First report on drivers and barriers in the pre-implementation phase. *KOF Studies, 129*.

Caves, K., Oswald-Egg, M. E., and Renold, U. (2019). Governance im Berufsbildungssystem Schweiz: Systemische Steuerung des schweizerischen Berufsbildungssystems/ Rapport sur la gouvernance dans la formation professionnelle: pilotage systémique du modèle suisse. *KOF Studies, 127*.

Pusterla, F., Oswald-Egg, M. E., Bolli, T., and Renold, U. (2018). Disentangling skills mismatch; Fifth release of the KOF Youth Labour Market Index,*KOF Studies, 123*.

Renold, U., Bolli, T., Oswald-Egg, M. E., and Pusterla, F. (2018). KOF Youth Labour Market Index for Scotland. *KOF Studies, 117*.

Renold, U. and Oswald-Egg, M. E. (2017). Analysis of challenges to strengthening the Serbian dual VET system. *KOF Studies, 103*.

Renold, U., Bolli, T., Caves, K., Buergi, J., Egg, M. E., Kemper, J. and Rageth, L. (2017). Comparing international vocational education and training programs: The KOF Education-Employment Linkage Index. *KOF Studies, 98*.

Renold, U., Caves, K., Kemper, J. and Egg, M. E. (2017). Pacific alliance countries: Policy framework report on vocational education and training. *KOF Studies, 96*.

Renold, U., Bolli, T., Caves, K., Bürgi, J., Egg, M. E., Kemper, J., and Rageth, L. (2016). Feasibility study for a curriculum comparison in vocational education and training: Intermediary report II: Education-Employment Linkage Index. *KOF Studies, 80*.

Bolli, T., Egg, M. E., Rageth, L. and Renold, U. (2016). Evaluation des Rahmenlehrplans für den Bildungsgang "dipl. Betriebswirtschafter/in HF", Bericht zur zweiten Befragungswelle 2015. *KOF Studies, 75*.

Egg, M. E. and Renold, U. (2015). Entwicklung der Reglementierung von 10 MEM-Berufen im Kontext von Bildungsreformen und dem Wandel in der Arbeitswelt: Eine Kurzstudie im Auftrag von LIBS. *KOF Studies, 63*.

Renold, U., Bolli, T., Egg, M. E. and Pusterla, F. (2014). On the multiple dimensions of youth labour markets. *KOF Studies, 51*.

Book Chapters

Renold, U., Bolli, T., Oswald-Egg, M. E. and Pusterla, F. (2020). Monitoring the youth labour market situation around the globe. In: *Economics and governance of vocational and professional education and training*, edited by Backes-Gellner, U., Renold, U. and Wolter, S. hep Verlag, Bern (Switzerland).

Egg, M. E. and Renold, U. (2016). Das Bildungssystem Schweiz mit Schwerpunkt Berufsbildung. In: *Schweizer Berufsbildungsinitiative in Indien: Hintergründe, Konzept und Ergebnisse des Pilotversuchs 2008-2013*, edited by Renold, U. and Probst, F. Bern: Hep der Bildungsverlag.

Egg, M. E. and Renold, U. (2016). The Swiss education system, with a special focus on vocational education and training. In: *The Swiss vocational education and training initiative India: background, concept and results of the pilot project 2008-2013*, edited by Renold, U. and Probst, F. Bern: Hep der Bildungsverlag.

Non-academic Articles

Bolli, T., Caves, K. and Oswald-Egg, M. E. (2019). Zahlen sich Praktika wirklich aus?. *KOF Bulletin, No. 135, December*.

Renold, U., Bolli, T., Hulfeld, F. and Oswald-Egg, M. E. (2019). Chancen und Herausforderungen des Selbststudiums. *SGAB Newsletter, vol. 3*.

Renold, U., Caves, K.M. and Oswald-Egg, M. E. (2019). Wie gut arbeiten die Akteure der Berufsbildung zusammen?. *SGAB Newsletter, vol. 2019 (2)*.

Bolli, T., Oswald-Egg, M. E. and Rageth, L. (2017). Die duale Berufsbildung bereitet die Jugendlichen besser auf den Arbeitsmarkt vor: KOF Forschungsprojekt *SGAB Newsletter, vol. 2017 (3)*.

Bolli, T., Oswald-Egg, M. E. and Rageth, L. (2017). Die Rolle der Berufsbildung zur Verbesserung der Lage auf dem Jugendarbeitsmarkt. *KOF Analysen, vol. 2017 (1)*, pp. 89-102.

Egg, M. E. (2017). Arbeitsstelle ohne Berufserfahrung?. *KOF Bulletin, No. 103, January*.

Egg, M. E. (2016). Macht Berufserfahrung den Unterschied aus? Die Bedeutung von Berufserfahrung für einen reibungslosen Übergang in die Berufswelt. *KOF Analysen, vol. 2016 (4)*, pp. 31-43.

Oswald-Egg, M. E. and Renold, U. (2014). Die Situation der Jugendlichen auf den Arbeitsmärkten: Jugendarbeitsmarktindex *Panorama, vol. 2014 (6)*, pp. 14-15.

Academic Research in Progress

New information, new interests? The effect of an occupation finder for dual vocational education and training on students' occupational choice

The role of intermediaries in education governance and public-private partnership (with Caves, K.)

Train drain? The availability of skilled foreign workers and firms' willingness to train (with Siegenthaler, M.)

Unintended consequences - A game-theoretic analysis of companies' participation in training in Serbia (with Caves, K.)

The gender gap in competitive behavior (with Chumbley, J., Huber, D. and Fehr, E.)

Policy Evaluation in Progress

Implementation of the Serbian law on dual education. (with Caves, K. and Renold, U.)

Analyse des AKAD-Bildungsangebots zur Berufsmaturität II. (with Bolli, T., Rageth, L. and Renold, U.)

Conferences, Seminars and Workshops

2019 *UZH-Uni Bern-KOF Workshop*, Zurich, Switzerland; *KOF Brown Bag Seminar*, Zurich, Switzerland; *2nd BIBB Conference on the Economics of Vocational Education and Training: Market - Institution - System*, Siegburg/Bonn, Germany.

2018 *SSES Annual Congress 2018*, St. Gallen, Switzerland; *XXVII Meeting of the Economics of Education Association*, Barcelona, Spain; *TMS Meeting HSG*, St. Gallen, Switzerland; *CVER Conference*, London, United Kingdom; *Workshop on Dynamics of Skills Supply and Demand*, Maastricht, Netherlands.

2017 *PhD Discussion Workshop: Personnel Economics and Economics of Education*, Grindelwald, Switzerland; *IAAEU Workshop on Labour Economics 2017*, Trier, Germany; *SASE 2nd Early Career Workshop*, Lyon, France; *SASE 29th Annual Conference*, Lyon, France.

2016 *PhD Discussion Workshop: Personnel Economics and Economics of Education*, Laax, Switzerland; *KOF Brown Bag Seminar*, Zurich, Switzerland; *Workshop "Sistemes de Formació Professional a Europa"*, Tarragona, Spain; *LH-KOF-Retreat Castle Marbach*, Öhningen, Germany; *Leading House "Economics of Education, Firm Behaviour and Training Policies" 2006-2016. Alumni Workshop and Networking Event*, Lucerne, Switzerland.

2015 *Swiss State Secretariat for Economic Affairs*, Bern, Switzerland; *8th International Conference of Panel Data Users in Switzerland*, Lausanne, Switzerland; *XXIV Meeting of the Economics of Education Association*, Madrid, Spain; *4th Multidisciplinary International Congress of Educational Research*, Valencia, Spain; *ESA PHD Workshop*, Prague, Czech Republic; *BIBB International Conference on "The Economics of Vocational Education and Training: Markets - Institutions – Systems"*, Bonn, Germany.

Grants

2017 Competitive scholarship to attend the Society for the Advancement of Socio-Economics (SASE) 2nd Early Career Workshop and the SASE 29th Annual Conference

2015 Competitive scholarship to attend the European Sociological Association PhD Student Workshop

Teaching Experience

2018 Youth Labour Market Outcomes, Institutions and Governance of Vocational Education and Training Systems, *Master-level*, ETH Zurich, Fall Term.

2016 Learn to teach, *Teaching Course*, ETH Zurich, Spring Term.

Referee Activities

Journal of Vocational Education & Training

Languages

German (native), Spanish (native), English (fluent), French (intermediate)

Computational Skills

Stata, Matlab, LaTeX

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