Dual Education and Career Consequences

Dissertation
for the Faculty of Economics, Business Administration and Information Technology of the University of Zurich

to achieve the title of
Doctor of Philosophy
in Management & Economics

presented by
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from Sargans SG

approved in September 2011 at the request of

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The Faculty of Economics, Business Administration and Information Technology of the University of Zurich hereby authorises the printing of this Doctoral Thesis, without thereby giving any opinion on the views contained therein.

Zurich, September 21st, 2011

Chairman of the Doctoral Committee: Prof. Dr. Dieter Pfaff

Acknowledgments

First and foremost, I would like to sincerely thank my advisor, Prof. Dr. Uschi Backes- Gellner, for her excellent supervision, guidance, knowledge, and consistent encouragement throughout my graduate studies. I am very grateful that she gave me this unique opportunity and encouraged me to start down this educational path. Moreover, she enabled me to participate in international conferences where I was able to present my projects and exchange ideas with other researchers from all over the world. She gave me valuable advice both in and outside my academic research and contributed a great deal to my advancement.

I would also like to express my gratitude to Prof. Dr. Egon Franck for agreeing to be my co-advisor and for contributing helpful comments and insights to this project.

I would like to thank Prof. Dr. Stefan Wolter, director of the Leading House on the Economics of Education, Firm Behavior and Training Policies, for helpful feedback during our meetings. Financial support from the Swiss Federal Office for Professional Education and Technology (OPET) through its Leading House on the Economics of Education, Firm Behaviour and Training Policies is gratefully acknowledged.

My thanks also go to colleagues at the University of Zurich for valuable comments and discussions. I am deeply grateful for their help and support, particularly to Christa Pálffy, Dr. Johannes Mure, and Dr. Simone Tuor, who fostered a friendly, cooperative, and supportive atmosphere and provided me with advice regarding all aspects of life. Thanks also to Fabian Müller, Tim Hagmann, and Katharina Schwarzinger for their excellent research assistance.

Last but not least, I would like to thank my family for their support. Special thanks go to Christian for his love, patience, and understanding. To my sister Franziska for being my best friend and for always being there. To my brother Thomas for showing me how endurance and purposefulness can lead to success. But most especially, I thank my parents, Käthi and Anton, for their endless support and motivation that made it possible for me to pursue this educational path. I will always be grateful for their belief in me, and I would like to dedicate this thesis to them.

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CHAPTER 1

Introduction

Due to continuous technological change, comprehensive initial education and lifelong learning are both crucial. Skill requirements are not only increasing rapidly, they are also changing frequently. As a result, workers who want to sustain their employability must be flexible. They can cultivate such flexibility on the one hand by adapting earlier acquired skills to new requirements or on the other hand by investing in different human capital. Therefore, the flexibility that is increasingly demanded of workers also has implications for the educational system, which must provide graduates with qualifications tailored to actual market needs and skills that are quickly adaptable to changing conditions and skill requirements.

Although this structural change challenges all established educational systems, dual education systems are particularly criticized as being too inert and inflexible (Heckman 1994, Carnoy 2004, Krueger and Kumar 2004). In an educational system with a focus on dual education, both specific vocational and general academic skills are acquired at the same time. The employability and thus the mobility and flexibility of graduates are contingent on the skills that they have obtained. Dual education, however, is in international discussions often perceived as too focused on narrow skill requirements within one particular occupation, thus limiting employability.

The aim of this dissertation is to provide an elaborate analysis of the career consequences of dual education. Our empirical analyses are based on data from Switzerland and Germany, two countries in which dual education is a fundamental element of the educational system. In a dual education system, pupils acquire specific vocational skills while working at a training firm and general academic skills in school during apprenticeship training (at the level of upper secondary education). On the tertiary level, universities of applied sciences focus on practically oriented studies, thus imparting students with both vocational and academic skills. In contrast, academic universities focus on general academic skills. Therefore, dual education

emphasizes the acquisition of different skill bundles, containing vocational and academic skills.

We begin our analysis of career consequences in the next two chapters by investigating if skills acquired during dual education are adaptable to new requirements. In Chapter 2, we investigate the employability of dual education graduates in terms of occupational mobility (that is, the ability to not only change jobs or employers, but to change the occupation). We explore the career consequences of acquiring specific skill bundles during dual education.

In general, workers who change occupations must take into account that they loose (at least partly) returns on their earlier acquired skills. Traditionally, Becker's (1964) standard human capital theory distinguishes between two types of human capital, general and specific. Specific human capital can only be productively used at the current firm and is lost after a job change. However, we use Lazear's (2009) skill-weights approach, which emphasizes the importance of specific skill combinations. This novel approach suggests that while all skills are general, firms apply different weights to different skills. Specificity occurs because the particular combination of necessary skills varies across firms. In case of a job change, other firms may demand a different combination of skills, rendering part of the worker's earlier acquired skills worthless and leading to wage loss. Mobility thus depends on the particular combination of skills. It is this combination that is specific and not the single skills themselves.

Due to a unique dataset with detailed information on skills required for particular occupations, we are able to apply the skill-weights model to dual education and measure the specificity of a training occupation in an innovative way. Our findings show that the theoretical predictions regarding the skill-weights approach are supported by our empirical findings. We find that the probability of an occupational change is smaller when the acquired skill combination is more specific. Thus, the first innovative contribution of this dissertation is its application of Lazear's skill-weights model to measure specificity of dual education in a completely new empirical approach. As a result, we present a novel definition of occupational specificity on the skill-level and subsequently analyze the influence of occupational specificity on later mobility.

Previous research on occupational mobility has focused on occupational codes and occupations per se, but has not provided detailed skill analysis. We show in Chapter 2, that occupational specificity reduces occupational mobility and that not the occupation per se, but the occupation-specific skill combination acquired in the dual system of apprenticeship training

crucially determines occupational mobility and income. Thus we examine the career consequences of these skill combinations in greater detail in Chapter 3 and investigate whether graduates of the dual system of apprenticeship training are mobile later in their careers even though they acquire seemingly narrow and specific skill bundles.

In applying this new, skill-oriented view based on Lazear (2009), we analyze the effects of occupation-specific skill combinations on occupational mobility. Based on Lazear we hypothesize that the effects of occupational mobility vary according to the differences between the earlier acquired skill combination in the training occupation and the required skill combination in the new occupation. We thus analyze career consequences of the acquired skill combinations on the skill level, comparing skill combinations of different occupations, as single skills are crucial. We assume that mobility towards closely related occupations with similar skill combinations should be facilitated whereas mobility towards occupations with very different skill combinations should be constrained.

Therefore, we analyze the effects of skill specificity on occupational mobility by comparing the different skill combinations of various occupations and studying the impact of such occupational changes on income. The results show that employees in specific occupations have a comparatively higher probability of changing to other occupations with similar skill combinations than to occupations with very different skill combinations. Moreover, the former occupational change results in wage gains, while the latter results in wage losses. Hence, the acquired skill combination, rather than the occupation per se, is crucial in determining mobility. We show that dual education graduates are flexible and mobile, even though they acquire seemingly narrow and specific skill combinations. Our second contribution is thus the detailed analysis of the acquired occupational skill-combination on the level of single skills and the resulting mobility and income effects.

Dual education graduates are able to not only change jobs or employers but also change occupations, and thus they can profit from beneficial career opportunities. After this detailed analysis of occupational mobility based on the ability to adjust earlier acquired skills to new requirements, we will focus in the following two chapters on further human capital investments that can help sustain employability. In the context of the general labor market trend toward higher education and training requirements, tertiary education is becoming increasingly important, and provides advantages over lower level education during working life. As we have identified the importance of an analysis on the skill-level, we continue our investiga-

tion of career consequences of dual education on the tertiary level as this combines academic and vocational skills.

Chapter 4 investigates educational mobility among dual education graduates. Unlike academic graduates, dual education graduates are often expected to be limited in their further educational steps. After secondary vocational education, however, dual education graduates can undertake tertiary vocational education at a university of applied sciences. We therefore compare career consequences after vocational tertiary education (i.e. studies at a university of applied sciences) and academic tertiary education (i.e. studies at an academic university) to determine how limited mobility is after dual education.

Because career entry after education and first career steps determine an individual's future labor market success, we analyze how the type of tertiary education – vocational or academic – influences individual career entry and labor market success after graduation. We use the Swiss Graduate Survey, which contains detailed and unique information regarding each graduate's educational and career path. Our results show that vocational graduates face the same unemployment risk, but higher income expectations and a lower income risk than academic graduates. In the longer term, the initial monetary advantage of vocational education disappears, but nonetheless a lower unemployment risk remains. Attending vocational tertiary education becomes a further educational career step for dual education graduates that demonstrates their educational mobility. On this basis, the third contribution of this dissertation is its thorough analysis of career consequences of dual education on the tertiary education level, which combines vocational and academic skills.

Hence, we provide evidence that dual education – i.e. the acquisition of vocational and academic skills – at the tertiary education level eases career entry. We further hypothesize that dual education could be replicated: students working part-time while studying also acquire both vocational and academic skills. The question is if this combination also leads to similar labor market advantages as dual education. Beyond distinguishing between tertiary education types (that is, skills acquired in different educational institutions) as in chapter 4, we can also distinguish student employment status during tertiary education, examining skills acquired during formal education and those acquired in parallel through work experience.

Chapter 5 examines whether student employment during tertiary education also generates positive career consequences. We assume that student employment complements formal education by providing additional work experience and leads to positive labor market returns.

Nonetheless, from a learning perspective, we argue that this complementary effect only emerges if the student employment is related to the field of studies (e.g., an economics student working part-time in a bank). Otherwise, field-unrelated student employment (e.g., an economics student working part-time as a waiter in a fast-food restaurant) potentially detracts from more productive educational investments. This question of whether systematic differences exist between the outcomes of different types of student employment has not yet been thoroughly analyzed.

Our results show positive labor market returns of student employment. However, we find that the relationship between student employment and the field of study is crucial; only working in a related student employment has positive career consequences. Therefore, only related student employment complements formal education and can thus be seen as a form of dual education that allows students to acquire a fruitful combination of both academic and vocational skills. The fourth contribution of this dissertation is thus the analysis of student employment as a form of dual education, considering its relationship to the studies from a learning perspective – an aspect that up to now has been neglected in the literature.

In the final chapter, we draw conclusions by synthesizing the results of our analysis of the career consequences of dual education, and we present preliminary policy implications.

CHAPTER 2

Specificity of Occupational Training and Occupational Mobility:

An Empirical Study Based on Lazear's Skill-Weights Approach

2.1. Introduction

The occupational skills of employees are important to the competitiveness of their firms. Particularly, in the ongoing process of globalization and an increasingly competitive world market, a qualified workforce is fundamental (Bosworth, Jones, and Wilson 2008). Furthermore, better qualifications are strongly associated with higher probabilities of individual labor market success (Borooah and Mangan 2008). However, firms still may not be willing to invest in occupational skills if they are transferable to other firms and if workers frequently leave the company after training; in this case, investments are not expected to pay off.

One such example of transferable occupational skills is apprenticeship training, leading to the acquisition of certificated skills. According to standard human capital theory (Becker 1964), firm-financed general training cannot be explained. Thus, firm-financed apprenticeship training – as it is typically seen in German speaking countries (see Noll et al. 1983, Von Bardeleben et al. 1995, and Beicht et al. 2004) – raises important research questions. There has been a large body of literature explaining why firms may still be willing to invest in general training,

most of it referring to imperfect labor market issues (see Katz and Ziderman 1990; Harhoff and Kane 1997; Acemoglu and Pischke 1998, 1999; Euwals and Winkelmann 2004; Zwick 2007). However, the question to what extent apprenticeship training is general and how differences in transferability might impact worker mobility, and thereby firms' willingness to invest, has never been explicitly raised nor studied.

Our paper, therefore, takes one step back and actually studies how specificity of training may be defined and whether different degrees in specificity might influence how much firms are willing to invest. Since the goal of apprenticeship training is receiving a particular occupational degree, we consider the specificity of the occupation to be an important determinant for the willingness of a firm to cover a substantial share of training costs. Lazear's skill-weights approach (2009) thereby provides a model to define specificity at the skill level. Whereas standard human capital theory strictly differentiates between general and specific human capital, Lazear's skill-weights approach assumes that all skills are general in nature, but the combination of single skills varies from firm to firm. Thus, it is only the particular combination of individual skills that makes them specific. This approach therefore provides an ideal foundation to operationalise the specificity of any type of occupational training (see also Mure 2007). We build occupation-specific skill-weights and derive empirically testable hypotheses regarding the mobility of workers who have been trained in a particular occupation and thereby focus on horizontal occupational mobility rather than on upward (or career) mobility. Accordingly, we derive hypotheses regarding the willingness of firms to invest in training of this particular occupation.

In our empirical analysis, German apprenticeship training serves as an example to test our implications. We use the BIBB/IAB Qualification and Career Surveys and BIBB cost-benefit evaluations. The first data set contains extensive information regarding the required skills at a workplace and allows constructing an occupational specificity index. From the second data set, we use data on the costs of apprenticeship training as an indicator of the investment share of firms in a particular occupation. We find all implications to be borne out in the data. Occupational mobility is lower if the specificity is higher and, at the same time, firms bear a higher share of the training costs if specificity of an occupation is higher.

The remainder of this chapter is structured as follows. In the next section, we use Lazear's skill-weights model to derive empirically testable implications about firm's financial investment in apprenticeship training and individual occupational mobility after graduation. Section

2.3 introduces the data sets and describes our explanatory variable, the degree of specificity. Section 2.4 presents empirical results and section 2.5 concludes.

2.2. Theoretical framework: Basic idea and testable implications of the skill-weights approach

Lazear's main assumption is that all skills are naturally general. All firms can use the general skills, but it is the combination of these skills that vary from firm to firm. Specificity, therefore, occurs because firms demand different combinations and different weights of skills. These varying demands result in firm-specific skills. In the basic skill-weights model, there are only two skills and two periods. The two skills are general and can thus be used at other firms as well. A worker invests in either skill in the first period and receives a payoff in the second period. In the first period, the worker decides to acquire particular amounts of skills A and B at cost $C(A,B)$, which determines his payoff in the second period. His payoff at firm *i* is determined according to the following earnings function (Lazear 2009, 916):

$$y_i = \lambda_i A + (1 - \lambda_i)B \qquad [2.1]$$

λ_i is the relative weight of skill A in firm *i*. Since λ_i may be different from the relative weight of skill A in any other firm *j*, the worker must determine the extent to which he wants to acquire skills A and B, considering whether he stays at the initial firm or moves on to another firm with skill-weights λ_j. If the employee could be certain that he will remain at the initial firm indefinitely, then he would focus on λ_i and invest in the skill bundle that maximises his income at the initial firm. However, if the employee cannot be certain that he can stay with his original firm he must consider looking for a new job in another firm. Other firms may demand a different weighting of skills and the employee's skill bundle may not be optimal in an outside firm, making part of his investment worthless. Therefore, in case of a separation, the worker may be faced with a wage loss. The outside market determines how much his investment will depreciate, which in the model is given by the difference between the weight of the initial firm and the expected market weight, λ_i - $\bar{\lambda}$. Thus, skill combinations

can be rather general or rather specific. If a combination is rather general, then the difference between the weight of the initial firm and the market weight λ_i - $\overline{\lambda}$ is small, as is the expected wage loss. However, if a skill combination is rather specific, the difference λ_i - $\overline{\lambda}$ is large and the wage loss is large as well. Firms anticipate this and expect workers to be unwilling to invest in rather specific skill combinations. Therefore, firms are willing to finance a larger part of the investment if they want employees to acquire the firm's ideal skill combination. Thus, the firm's share of expenses increases with the requirement for a more specific combination of skills.

We use this basic idea and apply it to apprenticeship training, where the combination of skills is given by the training occupation. The intuition is rather clear: employees in occupations with more specific skill combinations are faced with higher losses if they have to change their occupation. The more likely occupational change becomes, the less willing employees become to invest in these specific apprenticeship training occupations. If firms want employees to acquire skills in an occupation that is needed in the firm, but is rarely required in the external labor market, they must bear a larger part of the investment. Thus, a firm's investment share is higher in occupations with a more specific combination of skills. Accordingly, we derive our first empirically testable hypothesis:

> **H1** *The more specific the skill requirements of an occupation (compared to the labor market in general), the bigger the share of the educational investment the firm bears.*

At the same time, a very rare combination of skills in an occupation prevents a worker from changing occupations. Thus our second testable hypothesis is:

> **H2** *The more specific the skill requirements of an occupation (compared to the labor market in general), the smaller the likelihood that workers change occupations after completion of apprenticeship training.*

2.3. Data and data specifications

Our empirical estimation is based on the German BIBB/IAB Qualification and Career Surveys of the years 1979, 1991/92, and 1998/99. These surveys are cross-sectional samples of the working population in Germany and were gathered by the Federal Institute for Vocational Training (BIBB - Bundesinstitut für Berufsbildung), Berlin, in collaboration with the Federal Employment Service's Institute for Employment Research (IAB - Institut für Arbeitsmarkt- und Berufsforschung), Nuremberg. The samples are representative of Germany and contain retrospective information on individual educational and occupational careers. These datasets are especially interesting because of the extensive information about the skill profile of the interviewees. Based on a large set of questions about the workers' skills, we are able to generate skill portfolios and operationalise our main explanatory variable, occupational specificity.

Additionally, we also require information about the costs of apprenticeship training in the particular occupations to estimate firms' investment share. The Federal Institute for Vocational Training (BIBB - Bundesinstitut für Berufsbildung) provides this data in a series of descriptive cross-section cost/benefit evaluations[1] for the years 1980 (see Noll et al. 1983), 1991 (see Von Bardeleben et al. 1995), and 1999 (see Beicht et al. 2004).

We restrict our analysis to individuals between 15 (the minimum age for leaving school and entering the labor market) and 65 years of age (the mandatory age of retirement for paid employees). Furthermore, we exclude all civil servants (because they have no layoff risk) and all self-employed people. Only employees in West Germany are included[2] and the mobility analysis is restricted to male employees[3]. After eliminating observations with missing data, a sample of 15,319 male employees is included in the analysis. Descriptive statistics of all variables used in our analysis are given in Table A2.1 in the Appendix.

[1] Since the number of occupations in these cost evaluations is limited, we have to concentrate the empirical analysis in this paper on these particular occupations.

[2] The cost evaluation 1991 includes only training firms from West Germany, while the newest study also includes East Germany. Not only were the labour market structures (and thus mobility) of the two parts of the country quite different, but also training compensation and therefore training costs differ considerably.

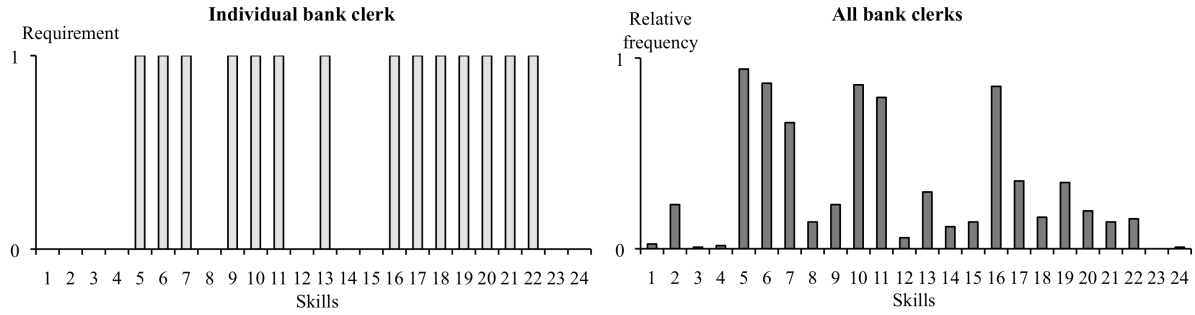
[3] To homogenise our sample we exclude female employees as they show a different behaviour towards mobility than their male counterparts. We cannot control for any interruption in working life, e.g. pregnancy or maternity leave.

2.3.1. Explanatory variable: Degree of specificity

One of the main innovations in this paper is to define an index to measure the degree of specificity according to the skill-weights approach. The BIBB/IAB Qualification Surveys contain a set of questions about workers' skill portfolios. The respondents were asked to report on a large set of skills that are required to perform their current job[4]. Hence, we are able to generate a unique skill portfolio for each individual. The left panel of Figure 2.1, for example, shows the skill portfolio of an individual bank clerk. If the respective skill is required at the workplace, the variable takes the value of 1, 0 otherwise.

To determine the specificity of an occupation, we use this information on individual skill profiles of those who completed apprenticeship training in this particular occupation during the last five years and have not since changed their occupation[5]. The aggregation of these individual skill portfolios by occupation leads us to a weighted occupation-specific skill portfolio (cf. Figure 2.1, right panel).

Figure 2.1: Skill portfolios of bank clerks: Individual and occupational level



Source: BIBB/IAB 1979, own calculations.

The right panel of Figure 2.1 provides the skill portfolio of bank clerks in the year 1979. On the x-axis, there are 24 single skills, while the y-axis shows their relative frequencies over all employees working as bank clerks. As can be seen and as one would expect, not all of the single skills are equally important for bank clerks. For example skill #5 mathematics, #6 orthography, #10 typing, #11 accounting, and #16 finance are required for more than 80% of all bank clerks, whereas knowledge in #1 material science, #3 technical drawing, #4 electrical

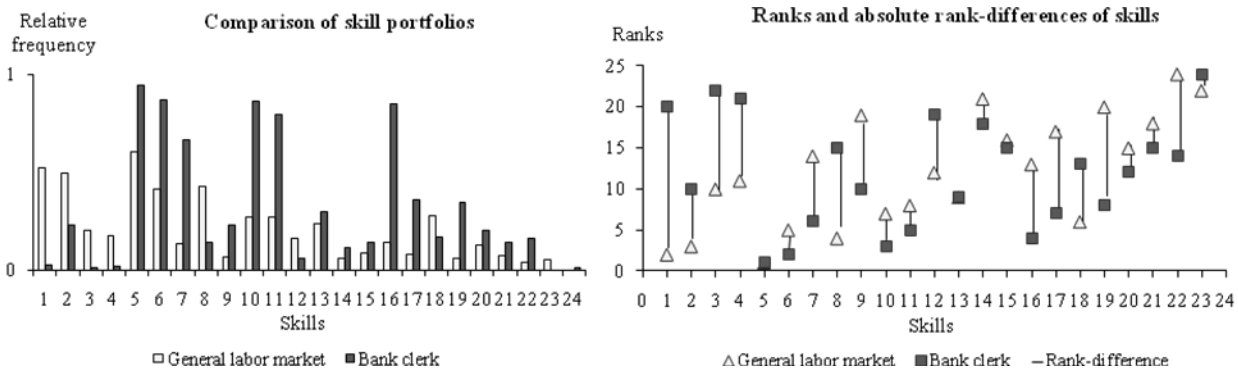
[4] A complete list of skills in the data sets can be found in the Appendix, Table A2.2.

[5] A complete list of all analyzed apprenticeship training occupations in this paper can be found in the Appendix, Table A2.3.

engineering, #23 physical technology, and #24 chemical engineering are required by none or less than 3% of all bank clerks.

Next, we take the analysis one step further and aggregate all individual skill profiles to receive a skill portfolio for the German labor market in general with which we compare an occupation-specific skill portfolio in order to derive a measure for the specificity of a particular skill portfolio. Again, we take the bank clerk as an example. If on the one hand, bank clerks use exactly the same skill portfolio as is used on the German labor market, then their occupational skill portfolio would be a very general one and not at all specific. Accordingly, it would be easy for a bank clerk to change occupations and the risk of losing the initial investment in occupation-specific training would be low. Based on this, banks would not be interested in investing in this type of apprenticeship training. If, on the other hand, bank clerks use a completely unique skill portfolio that is used in no other occupation in the German labor market, their occupational skill portfolio would be very specific. As such, if they had to change occupations, they would suffer heavy losses on their training investments and would thus not be willing to invest, forcing firms to invest more if they require this particular type of skill combination. In reality, neither of the two extremes is expected, as every occupation will be found somewhere in between these two extremes. For example, the skill portfolio for bank clerks, which we can observe in 1979, is, for some skills, very different, and for other skills quite similar to the overall skill portfolio of the labor market (cf. Figure 2.2, left panel).

Figure 2.2: Comparison of occupation-specific skill portfolios with overall skill portfolio of the general labor market



Source: BIBB/IAB 1979, own calculations.

To calculate the degree of specificity, we compare how important the single skills are in the occupation in comparison to its importance on the general labor market. Therefore, we ranked the skills of each occupation and of the general labor market according to their relative frequencies. If, for example, the most important skill in the occupation is the least important skill for the labor market in general, then a large part of the occupation-specific skill portfolio is likely to become useless if an individual changes the occupation. If the most important skill in the occupation is of equal importance in the external labor market, then a large part of the occupation-specific skill portfolio is likely to be used again in the outside labor market. The same, of course, applies to the second, third, or fourth most important skills. Thus, we compare the relative importance of each skill in the occupation-specific portfolio to the relative importance of the respective skill in the general labor market portfolio. For each occupation, we calculate the distances between the ranks of the individual skills in the occupation portfolio and the overall labor market portfolio.[6] An example of how these distances look is given in the right panel of Figure 2.2. For example, skill #5 (mathematics) is the most important skill for bank clerks as well as for the general labor market. But the rank of skill #1 (material science) is very different: it ranks 20 in the bank clerks skill portfolio compared to ranking 2 in the general labor market portfolio. Therefore material science is very important on the general labor market but it is very unimportant for bank clerks.

To generate a single specificity variable measuring the degree of specificity of a particular occupation, we weighted the absolute rank-differences between each occupation and the general market with their corresponding relative frequency and summed them. The larger the number, the more atypical are the skills needed for a particular occupation. Thus, an increase in the number indicates that skill-weights in the occupation are very different from skill-weights in the general labor market. Therefore, this variable indicates us the degree of specificity as it is suggested by the skill-weights approach. The empirical results of our specificity degrees range from 4.1 to 33.6 units, with a mean of 14.6 units. According to our hypotheses, we therefore expect a higher degree of occupational specificity to correspond with a higher share of firm investment and with a lower rate of occupational change on the workers side.

For our empirical analysis, we calculate the degree of specificity for all occupations as mentioned above. Since we have data for three very different time periods (1980, 1991/92, and

[6] We use ranks instead of relative frequencies to normalise our explanatory variable. The specificity degree must not be distorted by the number of acquired skills in an occupation. If this were the case, we would replicate the (low or high) skill level of an education, instead of the specificity of a skill combination.

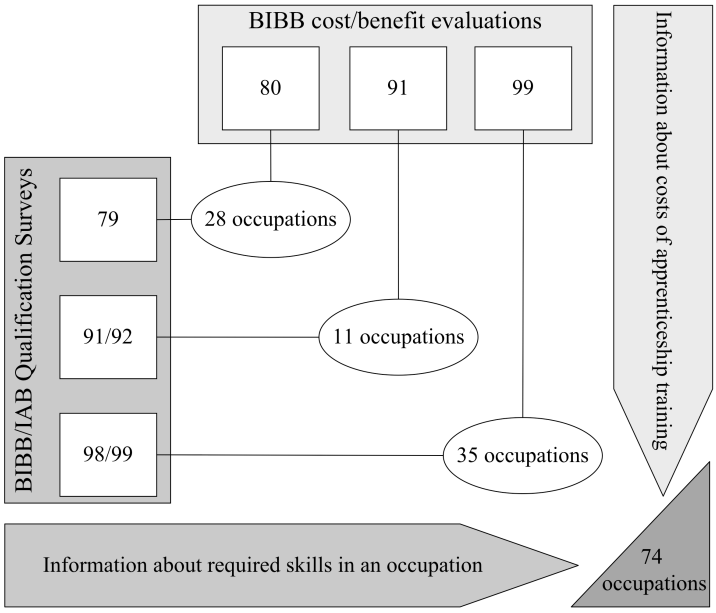
1998/99) in between which there may have been substantial changes in some occupations, we calculate the degree of specificity for each occupation for each of the periods.

2.3.2. Dependent variable: Net costs

To measure firms' investments in apprenticeship training in these occupations we use occupation-specific net costs of apprenticeship training derived from the BIBB cost-benefit evaluations. We use the net costs, which consist of all costs an apprentice incurs during the training period minus all benefits an apprentice generates due to his productivity during the same period. According to the BIBB cost/benefit evaluations, net costs of apprenticeship training vary substantially across occupations. For example, apprenticeship training as a chemical laboratory assistant was the most expensive occupation (18,673 EUR in 1998/99), while apprenticeship training to become a legal assistant involved the lowest net costs (4,287 EUR in 1998/99). The average net costs of a year of apprenticeship training amounted to 7,825 EUR. We have occupation-specific net costs of apprenticeship training for 74 occupations from the BIBB cost-benefit study, which we combine with our explanatory variable, degree of occupational specificity, which we derive from the BIBB/IAB Qualification Surveys.[7] Figure 2.3 shows how the different data sets are matched.

[7] We are able to perfectly match 28 training occupations in the 1980s, 11 training occupations in the early 1990s, and 35 occupations in the late 1999s. Overall, this makes 74 cases with different degrees of occupational specificity.

Figure 2.3: Matching of BIBB cost/benefit evaluations with BIBB/IAB qualification surveys



2.3.3. Dependent variable: Occupational mobility

Occupational Mobility is measured with two different variables. First, we generate a variable representing occupational change during an individual's work life, which stands for mobility in the long run. Here, we compare workers' current occupations with the occupations of their apprenticeship. If workers no longer work in their original occupation, we consider this to be an occupational change and the dependent variable takes the value of 1 (it takes the value of 0 if the occupation remains unchanged)[8]. Overall, about 60% of the employees in our sample changed their occupation, while about 40% did not.

Second, we generate a mobility variable covering only occupational changes occurring right after apprenticeship training has been completed, representing mobility in the short run. To do this, we compare the year of the completion of the apprenticeship training with the year in which an occupational change took place. If the years are the same, the dummy variable takes the value 1 (if the years are different, it takes the value 0). About five percent of the apprenticeship graduates changed their occupation in the first year, while 95% did not.

[8] As we use broad classification codes, an employee is in case of upward career mobility (e.g. promotion) nonetheless still classified in the same occupation and therefore no horizontal occupational change occurred despite this career move.

2.4. Empirical results

First, we assess the impact of occupational specificity on firms' investments in apprenticeship training using a standard ordinary least square regression. We use the net costs of the 74 occupations as the dependent variable, as we only have occupation-specific cost and skill portfolio information. The analysis of the investment share is, therefore, based on the population of these 74 training occupations in our sample. Due to the small number of observations, the conclusions should be interpreted with some caution, but the result is nonetheless very clear. We use control variables in our regression model, which take the values of the means of the observations on the occupation level. We include the age upon completion of apprenticeship training, the size of the training firm, and year dummies. Estimation results with robust standard errors are provided in Table 2.1, model 1.

Table 2.1: Model 1, OLS regression

Net Costs	Coef.	Std. Err.	t	P>|t|	
Occupational specificity	119.58	52.05	2.30	0.025	**
Age leaving apprenticeship	854.97	317.27	2.69	0.009	***
Ref.Cat.: BIBB/IAB - Survey 1998					
BIBB/IAB - Survey 1979	-3'677.81	1'036.51	-3.55	0.001	***
BIBB/IAB - Survey 1991	-3'213.43	962.10	-3.34	0.001	***
Ref.Cat.: Firm size < 10 employees					
Firm size between 10 and 49 employees	-119.03	2'067.88	-0.06	0.954	
Firm size between 50 and 99 employees	-1'322.81	4'680.92	-0.28	0.778	
Firm size between 100 and 999 employees	4'726.07	3'426.32	1.38	0.173	
Firm size > 1000 employees	12'806.88	1'987.28	6.44	0.000	***
Constant	-10'584.59	6'419.06	-1.65	0.104	
Number of observations	74				
F(8, 65)	28.81				
Prob > F	0.0000				
R^2	0.6854				

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%; robust standard errors.

As we expected, the coefficient for the degree of occupational specificity is positive and statistically significant. The more specific the skill portfolio in an occupation, in comparison to the labor market in general, the higher the net costs firms are bearing for apprenticeship training in the respective occupations because workers are unwilling to bear the costs for such types of training. As the skills necessary for an occupation become less specific compared to those required for the whole labor market, firms are willing to bear less of the training costs. Thus, our results provide a different explanation for why firms finance apprenticeship training

than has been provided in the previous literature. Formally, apprenticeship training is an investment in general human capital as assumed by previous studies: firms must follow national training curricula and apprentices attend vocational schools for 1-2 days per week. Apprentices are awarded a certificate after successful completion of final exams, which are recognized nationwide. Therefore, apprenticeship training was always considered to be general training. Standard human capital theory would not be able to explain firms' investments in such training, so a number of new models have been developed to explain why firms nevertheless invest in such training. We argue that, in the first place, apprenticeship training should, in principal, not be considered general training. Rather, the degree of specificity depends on the combination of skills in the respective occupation although all single skills are general. There are some occupations that are highly specific whereas other occupations are far more general. According to Lazear's skill-weights approach, it can be expected that firms invest to a larger degree in the former ones because workers have only a limited interest to invest in this type of occupational skill portfolio.

Second, we study the impact of occupational specificity on occupational mobility of employees. Since both dependent variables (occupational mobility in the short run right after apprenticeship training as well as occupational mobility in the long run) are dummy variables, ordinary least square estimation is not appropriate. To account for the bivariate form of these variables we use probit regressions (Wooldridge 2009; 575-84). We use a standard set of control variables in our regression models. We include age, age-squared, and the age upon completion of apprenticeship training. Other control variables are the size of the training firm (five dummies), the size of the community (four dummies), and the highest educational degree (four dummies). Furthermore, we include a dummy for participation in further vocational training and year dummies. Table 2.2 and 2.3 provide the results of our probit estimations with robust standard errors and show the marginal effect of each variable, which is the derivative of each outcome probability with respect to the explanatory variable evaluated at the sample means of the independent variables.

Table 2.2: Model 2, probit regression

Occupational Change after Apprenticeship	dF/dx	Std. Err.	z	P>|z|	
Occupational specificity	-0.0008	0.0004	-2.26	0.024	**
Age leaving apprenticeship	0.0017	0.0007	2.40	0.016	**
Ref.Cat.: Communizy size < 20'000					
Community size between 20'000 and 99'999	0.0012	0.0040	0.30	0.767	
Community size between 100'000 and 499'999	0.0072	0.0050	1.51	0.132	
Community size > 500'000	-0.0086	0.0048	-1.70	0.090	*
Ref.Cat.: Firm size < 10 employees					
Firm size between 10 and 49 employees	-0.0053	0.0038	-1.38	0.169	
Firm size between 50 and 99 employees	-0.0151	0.0049	-2.70	0.007	***
Firm size between 100 and 999 employees	-0.0141	0.0042	-3.07	0.002	***
Firm size > 1000 employees	-0.0247	0.0041	-4.70	0.000	***
Ref.Cat.: Lower secondary school					
Intermediate secondary school	0.0053	0.0044	1.23	0.219	
Entrance examination for university of applied science	-0.0012	0.0096	-0.13	0.900	
High school diploma	0.0235	0.0113	2.43	0.015	**
Ref.Cat.: BIBB/IAB - Survey 1998					
BIBB/IAB - Survey 1979	0.0783	0.0074	11.94	0.000	***
BIBB/IAB - Survey 1991	0.0033	0.0066	0.51	0.612	
Number of observations	15'319				
LogL	-3'008.4				
Wald chi2 (16)	392.0				
Prob > chi2	0.0000				
Pseudo R^2	0.0627				

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%; robust standard errors; probit coefficients represent marginal effects.

In model 2 (Table 2.2), we analyze the short-term influence of occupational specificity on occupational change. As we expected according to our second hypothesis, the specificity degree is negatively correlated with an employee's probability of changing occupations. The more specific the skill requirements are in an occupation, the smaller is the probability of an occupational change right after completion of apprenticeship training. According to Lazear's model, graduates in very specific occupations are stuck in their occupation because if they change their occupation the value of their particular skill combination will be dramatically reduced. So in the short run, occupational mobility is, indeed, restricted.

Analyzing career consequences, we are interested in studying whether this restriction also holds true in the long run or whether the specificity of the initial skill combination decreases over time. Therefore, in model 3 (table 2.3), we study the impact of occupational specificity on occupational change in the long run.

Table 2.3: Model 3, probit regression

Later Occupational Change	dF/dx	Std. Err.	z	P>|z|
Occupational specificity	-0.0031	0.0010	-3.07	0.002 ***
Age	0.0397	0.0026	15.50	0.000 ***
Age squared	-0.0004	0.0000	-12.04	0.000 ***
Further vocational training	0.1302	0.0086	14.81	0.000 ***
Ref.Cat.: Community size < 20'000				
Community size between 20'000 and 99'999	0.0184	0.0100	1.84	0.065 *
Community size between100'000 and 499'999	0.0080	0.0118	0.68	0.498
Community size > 500'000	-0.0072	0.0129	-0.56	0.575
Ref.Cat.: Lower secondary school				
Intermediate secondary school	0.0316	0.0099	3.18	0.001 ***
Entrance examination for university of applied science	0.1869	0.0194	8.37	0.000 ***
High school diploma	0.1126	0.0187	5.67	0.000 ***
Ref.Cat.: BIBB/IAB - Survey 1998				
BIBB/IAB - Survey 1979	0.0458	0.0140	3.26	0.001 ***
BIBB/IAB - Survey 1991	0.0673	0.0147	4.51	0.000 ***
Number of observations	15'319			
LogL	-9'780.5			
Wald chi2 (16)	1'175.7			
Prob > chi2	0.0			
Pseudo R^2	0.0584			

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%; robust standard errors; probit coefficients represent marginal effects.

We find that the effect of specificity on occupational mobility in the long run is also negative and significant, i.e. the more specific the skill requirements are in an occupation, the smaller is the probability of an occupational change during an employee's entire career. Even in the long run, an employee is bound to the original occupation if its skill combination is specific. Overall, we find clear evidence supporting our theoretical predictions. Occupational specificity can be analyzed according to Lazear's skill-weights approach (2009) and such an analysis shows that not all apprenticeship training is similarly general. Rather, there is a continuum of specificity and depending on whether an occupation is more or less specific, workers are more or less mobile, and firms are more or less willing to invest in apprenticeship training.

2.5. Conclusions

According to standard human capital theory, firm-financed training cannot be explained if skills are general in nature. Nevertheless, firms' investments in general training can be observed and there has been a large volume of literature to explain this puzzle, mostly referring to imperfect labor market issues. Moreover, in German-speaking countries, firms invest heavily in apprenticeship training, which is also assumed to be general. However, the question of whether apprenticeship training is general and how differences in transferability might impact

worker mobility and thereby firms willingness to invest has never been explicitly raised nor studied.

Our paper, therefore, studies for the first time how to define specificity of training and whether different degrees of specificity might influence how much firms are willing to invest. Lazear's skill-weights approach provides a model to define specificity on the skill level, assuming that all skills are general in nature but that the specificity of combinations of single skills varies. Based on this approach, we derive empirically testable hypotheses regarding the mobility of workers after training and the willingness of firms to invest in training. In our empirical analysis, German apprenticeship training serves as an example to test our hypotheses. Since the aim of apprenticeship training is earning a particular occupational degree, we consider the specificity of the skills required for the occupation as crucial. We use unique German Qualification and Career Surveys, which contain extensive information about the required skills at a workplace. With this information, we can build occupation-specific skill-weights and operationalise our main explanatory variable, the degree of specificity. We study the impact of occupational specificity on a firm's investment in apprenticeship training and on the occupational mobility of employees. We find all implications to be borne out in the data: The more specific the skill portfolio in an occupation, in comparison to the general labor market, the higher the net costs firms are bearing for apprenticeship training in the respective occupations because workers are unwilling to bear the cost of such types of training. At the same time, the more specific the skill requirements are in an occupation, the smaller is the probability of an occupational change during an employee's entire career.

Due to this new definition of occupational specificity, we find that apprenticeship training - formerly seen as general training - is very heterogeneous in its specificity. Some apprenticeships are more general, whereas others are highly specific compared to the whole labor market. The general contents of apprenticeship training are specifically bundled and vary strongly in their degree of specificity. The empirical analyses presented here demonstrate both a greater willingness on the part of the firm to invest in training and reduced mobility of the employee as a result of an increasing specificity of skill combinations. Obviously, there exists a trade-off: if apprenticeship training should become less specific in order to prepare employees for technological changes, occupational mobility might increase, but, at the same time, firms would reduce their training investments.

Hence, not the specific occupations per se, but the acquired occupation-specific skill bundles crucially determine occupational mobility and consequently income. We examine the career consequences of these skill combinations in greater detail in the next chapter.

Appendix

Table A2.1: Descriptive statistics

Description	Mean	Std. Dev.	Min	Max
Occupational specificity	14.6	6.43	4.1	33.6
Net costs (EUR)	7,825	3,842	1,230	18,673
Occupational change after apprenticeship	0.05	0.23	0	1
Later occupational change	0.59	0.49	0	1
Age	38.9	11.1	15	65
Age squared	1,636	896	225	4,225
Age leaving school	16.0	2.7	8	50
Age leaving apprenticeship	19.0	2.3	11	53
Age at occupational change	27.2	8.2	12	63
Lower secondary school (Hauptschule)	0.68	0.47	0	1
Intermediate secondary school (Realschule/Mittlere Reife)	0.24	0.43	0	1
Entrance examination for university of applied science (Fachhochschulreife)	0.04	0.18	0	1
High school diploma (Abitur)	0.05	0.21	0	1
Tenure	12.6	10.0	0	53
Experience	16.9	11.4	0	49
Further vocational training	0.35	0.48	0	1
Firm size < 10 employees	0.32	0.47	0	1
Firm size between 10 and 49 employees	0.31	0.46	0	1
Firm size between 50 and 99 employees	0.09	0.29	0	1
Firm size between 100 and 999 employees	0.17	0.38	0	1
Firm size > 1000 employees	0.10	0.30	0	1
Industry	0.27	0.44	0	1
Handcraft	0.53	0.50	0	1
Trade	0.09	0.29	0	1
Other sector	0.11	0.31	0	1
Community size < 20'000	0.44	0.50	0	1
Community size between 20'000 and 99'999	0.27	0.44	0	1
Community size between 100'000 and 499'999	0.16	0.37	0	1
Community size > 500'000	0.13	0.34	0	1
BIBB/IAB - Survey 1979	0.42	0.49	0	1
BIBB/IAB - Survey 1991	0.24	0.43	0	1
BIBB/IAB - Survey 1998	0.35	0.48	0	1

Table A2.2: List of required skills at a workplace (translated from German)

	#	Required Skills
1998/99	1	Mathematics, statistics
	2	Orthography (German)
	3	Presentation techniques, conduct of negotiations
	4	Foreign languages
	5	Sales, marketing, public relations
	6	Design
	7	Programm application
	8	Software developement
	9	Computer literacy
	10	Other technical knowledge
	11	Labour law
	12	Other legal knowledge
	13	Business management, human resource management
	14	Finance, taxes
	15	Controlling
	16	Accident prevention, safety instructions
	17	Medical science
	18	Other skills
1991/92	1	Mathematics, statistics
	2	Foreign languages
	3	Typing
	4	Computer literacy
	5	Data processing
	6	Accounting
	7	Finance, taxes
	8	Purchase
	9	Sales, marketing, public relations
	10	Business management, human resource management
	11	Chemistry
	12	Mechanics
	13	Electrical engineering
	14	Measurement and regulation technology
	15	Physics
	16	Technical drawing
	17	Commercial knowledge of commodities
	18	Accident prevention, safety instructions
	19	Labour law
	20	Other legal knowledge
	21	Pedagogy, psychology
	22	Medical science

1979	1	Material science
	2	Machinery skills
	3	Technical drawing
	4	Electrical engineering
	5	Mathematics, statistics
	6	Orthography (German)
	7	Computer literacy
	8	Commercial knowledge of commodities
	9	Foreign languages
	10	Typing
	11	Accounting
	12	Purchase
	13	Sales, marketing, public relations
	14	Human resource management
	15	Business management
	16	Finance
	17	Taxes, tax law
	18	Accident prevention, safety instructions
	19	Private law
	20	Labour law
	21	Social law
	22	Administrative law
	23	Physical technology
	24	Chemical engineering

Table A2.3: List of apprenticeship training occupations, specificity degrees and net costs (translated from German)

	Apprenticeship Training Occupations	Degree of Specificity	Net Costs (EUR)
1998/99	Bank clerk	7.0	10361
	Architectural drafter	4.7	7675
	Office clerk/Office management assistant	7.6	7940
	Chemical laboratory assistant	4.1	18674
	Skilled chemical worker	4.4	18532
	Typographer	6.8	15290
	Power supply technician	6.2	17219
	Florist	8.7	6760
	Hotel clerk	7.7	4777
	Industrial business management assistant	7.5	7399
	Industrial mechanic	10.4	18226
	Retail salesperson	8.6	7604
	Wholesale and international trade specialist	6.4	5668
	Chef/Cook	11.4	6793
	Travel agent	8.8	10860
	Tool mechanic	7.5	12861
	Optician	6.9	11978
	Baker	8.4	6364
	Electrician	7.2	8580
	Sales clerk	6.4	6209
	Butcher	8.2	9485
	Hairdresser	7.1	5873
	Plumber	7.3	8804
	Motor vehicle mechanic	7.0	9304
	Painter/Varnisher	8.8	7449
	Mason	6.8	9374
	Metal worker	7.4	7914
	Carpenter	9.1	7435
	Dental technician	8.2	9136
	Heating and ventilation engineer	9.1	9000
	Doctor's assistant	6.7	9691
	Certified dental assistant	6.2	10100
	Legal assistant	7.8	4287
	Assistant tax accountant	8.7	7589
	Administrative specialist	7.2	9255

1991/92	Industrial mechanic	21.1	14537
	Wholesale merchant	9.5	7268
	Retail salesperson	9.2	5529
	Bank clerk	15.3	11509
	Industrial business management assistant	10.3	7256
	Motor vehicle mechanic	23.1	3740
	Electrician	24.3	6856
	Carpenter	17.5	5686
	Hairdresser	15.8	5885
	Salesperson in the food industry	10.4	3528
	Office clerk/Office management assistant	11.7	5196
1979	Bank clerk	30.8	8409
	Office clerk/Office management assistant	24.8	7048
	Chemical laboratory assistant	12.9	11180
	Lathe operator	15.4	12771
	Typographer	10.7	8688
	Chef/Cook	13.3	4307
	Mechanic	14.1	9050
	Draftsperson	11.5	7532
	Sales clerk	16.0	4301
	Tool maker	14.9	9249
	Baker	12.7	3456
	Electrician	16.6	3408
	Butcher	16.4	4213
	Hairdresser	15.2	3818
	Motor vehicle mechanic	17.7	4838
	Agricultural machine mechanic	14.6	3004
	Painter	16.9	2623
	Mason	14.4	6222
	Locksmith	14.6	3844
	Carpenter	15.8	3246
	Dental technician	15.3	6282
	Pharmacy assistant	17.3	3000
	Doctor's assistant	19.2	6570
	Assistant tax accountant	31.1	7090
	Telecommunication craftsman	16.2	12885
	Administrative specialist	25.7	7206
	Gardener	14.1	1230
	Agronomist	17.6	2411

CHAPTER 3

Occupational Mobility Within and Between Skill Clusters:

An Empirical Analysis Based on the Skill-Weights Approach

3.1. Introduction

Mobility and flexibility are increasingly demanded as structural change challenges established educational systems and traditional occupational demarcations. Due to continuous technological innovation, skill requirements not only increase rapidly but also change frequently (Autor et al. 2003, Autor and Dorn 2009). Educational systems must therefore provide graduates with both qualifications tailored to actual market needs and skills that are quickly adaptable to changing conditions and skill requirements (Winkelmann 2006, Hotz-Hart 2008, Spitz-Oener 2008).

Although this structural change challenges all established educational systems, in particular, vocational education and training (VET) is often criticized as too inert and inflexible (Heckman 1994, Carnoy 2004, Krueger and Kumar 2004). In contrast to academic education, which is considered broad and general, VET is perceived as too focused on narrow skill requirements within one particular occupation.

In contrast, we argue that to appropriately evaluate different types of education, one must first and foremost analyze how the level of flexibility of vocational education can be measured and how the degree of this flexibility within vocational education is determined. In this paper, we

argue that neither comparisons of academic education with vocational education nor the number of apprenticeship training occupations, the two common criteria to judge on flexibility, are relevant, but that we must rather consider the specificity of the acquired skill combination. We show that the skill combination, and not the occupation per se, crucially determines occupational mobility and the wage consequences of an employee.

Previous research on occupational mobility, however, focuses on occupational codes and occupations per se[9] but does not engage in a detailed skill analysis.[10] This omission is partly due to a lack of detailed skill data and partly to a lack of an analytical model that could guide a detailed empirical analysis of skills. Therefore, empirical research on skill-based mobility is still at an early stage. Nevertheless, in our paper, we are able to overcome both of these problems. On the one hand, we are able to work with a rich dataset that contains very detailed information on acquired and required skills as well as on educational and occupational careers. On the other hand, we build on Lazear's skill-weights approach (2009), which is ideal for studying occupational specificity at the level of single skills as well as the resulting bundles of these skills.

In applying a new, skill-oriented point of view, we are able to analyze occupational specificity and study the effects of acquired occupation-specific skill combinations on occupational mobility and income. Because occupations with similar skill combinations can be clustered into labor market segments (subsequently also referred to as *skill clusters*), we focus on the labor market segment in which an occupation with its skill bundle is embedded, rather than on broad classification codes. This means that more relevant and more important than the occupation per se is the skill combination acquired and required in that occupation. Mobility has to be evaluated with respect to the entire labor market segment that is relevant for a skill combination and not only to the single occupation.

Taken together, our study is innovative in at least three ways. First, we analyze occupational mobility *at the level of single skills* required in occupations as well as the resulting combina-

[9] Occupational experience, which represents occupation-specific human capital, increases earnings (Kambourov and Manovskii 2009) and thus reduces occupational mobility (Shaw 1987, Borghans and Golsteyn 2007, Kambourov and Manovskii 2008, Geel et al. 2009). However, employees also attempt to realize better income possibilities or career chances through occupational changes (Goeggel and Zwick 2009, Fitzenberger and Spitz 2004, Clark and Fahr 2001). Another strand of literature deals with job polarization (Autor et al. 2006, Dustman et al. 2009, Goos and Manning, 2007); in contrast to these studies, we do not evaluate the skills, but analyze mobility patterns based on particular skill combinations.

[10] One exception is a recent paper by Poletaev and Robinson (2008) that analyzes mobility based on the skill portfolios of jobs and finds that wage losses are more closely associated with switching skill portfolios than switching occupation codes per se.

tions of these skills. Second, we use Lazear's skill-weights approach (2009) as a theoretical framework that provides us with a new empirical approach to operationalize occupational specificity as well as to examine occupational mobility and that allows for a micro-founded analysis of specific and general human capital. Third, we determine occupational skill clusters containing occupations with similar skill combinations. We analyze the effects of the specificity of skill combinations on occupational mobility within and between these skill clusters and the impact of such occupational changes on income.

3.2. Theoretical framework: The skill-weights approach (Lazear 2009)

According to Lazear's model, all skills are general, but firms use them with different weights. Specificity, therefore, occurs because the required combination of skills varies from firm to firm. In the basic skill-weights model, there are only two skills and two periods. A worker invests in either skill in the first period at cost $C(A,B)$ and receives a payoff in the second period according to the following earnings function:

$$y_i = \lambda_i A + (1 - \lambda_i) B \qquad [3.1]$$

λ_i is the relative weight of skill A in firm i. Since λ_i may be different from the relative weight of skill A in any other firm j, the worker must determine the extent to which he wants to acquire skills A and B. If the employee is certain that he will remain at the initial firm indefinitely, then he will focus on λ_i and invest in the respective income-maximizing skill bundle. However, if the employee cannot be certain that he will stay at the initial firm, he must consider looking for a new job in another firm. In case of a change, other firms may demand a different weighting of skills, rendering part of the employee's investment worthless and leading to a wage loss. The outside market determines how much his investment will depreciate depending on the difference between the weight of the initial firm and the expected market weight, λ_i - $\bar{\lambda}$. Thus, skill combinations can be rather general compared to the outside market (if the difference λ_i - $\bar{\lambda}$ is small, as is the expected wage loss) or rather specific (if the difference λ_i - $\bar{\lambda}$ is large, as is the expected wage loss). Thus, starting in an occupation with

a specific bundle of skills strongly determines mobility and income for the rest of a worker's career.

3.2.1 Application to apprenticeship training

The advantage of using the skill-weights approach in our analysis is the theoretical foundation that allows us to study occupational specificity at the level of single skills and the resulting skill combinations. Thus, we use Lazear's basic idea and apply it to apprenticeship training in which the combination of acquired skills is given by the occupation of a graduate.[11] We therefore use *occupation-specific* rather than firm-specific skill-weights. Because the expected lifetime net earnings are not only dependent on the skill-weights of the training occupation but also on the skill-weights outside in the total labor market, the individual investment problem involves choosing a training occupation and investing accordingly in its skills. Intuitively, employees in occupations with very specific skill combinations are faced with higher losses if they change their occupation because they will no longer be able to make use of all their skills[12].

Furthermore, we consider different labor market segments. While Lazear's model regards the outside market as a whole as a relevant factor in occupational changes, we argue that in line with labor market segmentation theory (Doeringer and Piore 1971, for an overview see Leontardi 1998) and occupational labor market theory (Marsden 1986, Eyraud et al. 1990), the labor market is composed of a variety of segments, which may not all be equally relevant in the case of an occupational change. We expect the labor market to be segmented into different *skill-combination clusters.* These skill clusters contain occupations with similar skill combinations within clusters but different skill combinations across clusters. Intuitively, even after an occupational change, an investment in a skill combination can still be valuable and productively used if the former and the new occupations are classified into the same skill cluster and require very similar skill combinations. The skill cluster with its average skill-weight $\overline{\lambda}_k$, thus represents the segment of the labor market that is relevant for potential occupational changes without a major loss in human capital investments. Therefore, the difference between the

[11] Lazear (2009: 932) briefly mentions this idea, suggesting that skill-weights are not only specific to firms, but rather that all individuals in an occupation have identical skill-weights. However, he does not provide empirical evidence for this particular application.

[12] The cause of an occupational change is not important for our research question. We thus do not consider whether an occupational change was planed in the first place, but we rather analyze mobility patterns and their wage implications.

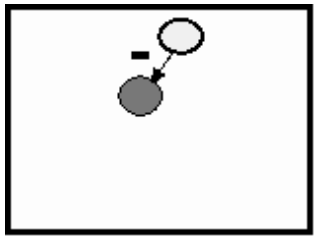
skill-weights of an individual occupation in comparison to the skill-weights of the respective skill segment λ_i - $\overline{\lambda}_k$ defines the cluster specificity of an occupation.

3.2.2 Testable implications

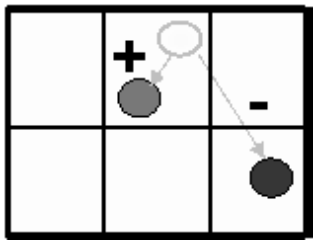
To test these implications, we differentiate two types of occupational specificity, namely, "total specificity," which compares the skill-weights of an occupation with the skill-weights across the total labor market, and "cluster specificity," which compares the skill-weights of an occupation with the skill-weights of the respective skill cluster. Furthermore, we define three types of occupational mobility: first, occupational mobility in total; second, occupational mobility *within* a skill cluster; and third, occupational mobility *between* skill clusters.
According to Lazear, mobility is more likely if the skill-weights in one's actual employment are very similar to the skill-weights on the external labor market. Thus, regarding particular skill combinations, we expect the following patterns to occur:

Probability of occupational mobility **Figure 3.1: Mobility-Hypotheses**

H1 *The more specific the skill combinations of occupations as compared to the total labor market ("total specificity"), the smaller the likelihood that workers will change occupations after completion of apprenticeship training.*



H2 *The more specific the skill combinations of occupations as compared to the total labor market ("total specificity"), the greater the likelihood that workers who change occupations will change within a skill cluster rather than between skill clusters.*



H3 *The more specific the skill combinations of occupations as compared to its respective skill cluster ("cluster specificity"), the smaller the likelihood that*

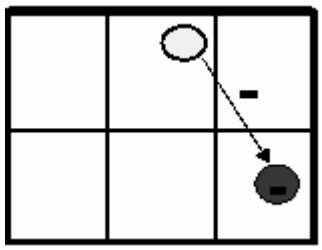
workers will change occupations within this skill cluster.

Furthermore, wage losses and wage gains may occur after occupational changes. According to Lazear, if workers change occupations towards an occupation with a very similar skill combination, they lose little in terms of initial human capital investment and can use formerly acquired skills as productively as before. They may even gain by switching, for example, into an occupation with labor shortages and accordingly higher wages. Thus, for individuals who are mobile within clusters, wages may either remain constant or even increase in case of a better skill match. However, for changes between clusters, the skill combination will be very different from the original occupation. Thus, cluster changers lose severely in terms of their initial human capital investment because their skills may no longer be used as productively as before. Moreover, the resulting loss may not be offset by wage gains due to a higher demand for the new occupation. This leads us to the following hypotheses:

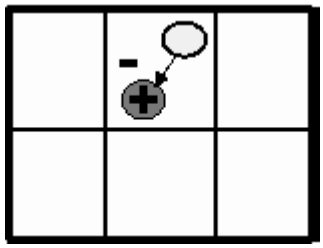
Income effects of occupational mobility

Figure 3.2: Income-Hypotheses

H4 *a) Occupational changes between skill clusters cause wage losses.*
b) The size of the respective wage loss is expected to be the larger the more specific the skill combination of the occupation is as compared to the total labor market.



H5 *a) Occupational changes within skill clusters cause wage gains.*
b) The size of the respective wage gain is expected to be the smaller the more specific the skill combination of the training occupation is within its relevant skill cluster.



3.3. Estimation methods

3.3.1 Probability of occupational mobility

First, we study the impact of occupational specificity on the occupational mobility of employees. We differentiate not only so-called occupational stayers from occupational changers, but also occupational changers within from changers between skill clusters. We use the following probit model framework (Wooldridge 2009: 575-578):

$$\begin{aligned} y*_{oc} &= \beta_1 Z + \beta_2 X + \varepsilon \\ y_{oc} &= 1 \text{ if } y*_{oc} > 0 \\ y_{oc} &= 0 \text{ if } y*_{oc} \leq 0 \end{aligned} \qquad [3.2]$$

The latent index $y*_{oc}$ models the underlying process of a worker's decision to change occupation. In the case of occupational mobility, y_{oc} takes the value one, and zero otherwise. Z contains the main explanatory variable for specificity; therefore, β_1 is the influence of the specificity degree. X contains the control variables, while ε indicates the error term.

3.3.2 Income effects of occupational mobility

Second, we test the wage effects of occupational specificity and mobility on income by estimating a log-linear ordinary least square regression. The basic equation can be written as an extended Mincer (1974) earnings equation:

$$\ln y = \alpha + \beta_1 M + \beta_2 Z + \beta_3 (Z * M) + \beta_4 X + \varepsilon \qquad [3.3]$$

where $ln\ y$ is log hourly earnings. M contains the dummies for the two different types of occupational change (i.e., either within or between skill clusters); therefore, β_1 is the influence of an occupational change on earnings. Z contains the main explanatory variable for specificity; therefore, β_2 is the influence of the specificity degree on earnings. $Z*M$ is an interaction term[13] that we include to analyze the combined effect of specificity and mobility, β_3. X contains the control variables while ε represents an unobservable error.

[13] To reduce potential problems with multicollinearity due to interaction effects between a quantitative variable and a dummy variable in multiple regression analysis, we center the quantitative variable prior to the for-

3.4. Data and variable construction

Our empirical estimation is based on the BIBB/BAuA Employment Survey 2005/06,[14] a representative cross-sectional sample of the working population in Germany. The dataset contains retrospective information on individual educational and occupational careers and – most importantly – the required skills at the workplace in detail, a crucial and unique feature of this dataset.

Table 3.1: Descriptions of variables

Variable	*Mean*	*Std. dev.*	*Min*	*Max*
Occupational total specificity	8.5	2.3	4.5	15.1
Occupational cluster specificity	3.7	2.3	1.2	10.8
Occupational change	0.58	0.49	0	1
Occupational change *within* skill cluster	0.21	0.41	0	1
Occupational change *between* skill clusters	0.37	0.48	0	1
Hourly wage (ln)	2.5	0.47	0.8	3.8
Age	40.2	9.8	18	65
Married	0.52	0.50	0	1
Children	0.45	0.50	0	1
Blue collar	0.35	0.48	0	1
German nationality	0.97	0.16	0	1
East Germany	0.15	0.35	0	1
Tenure	10.8	9.1	0	49
Further training	0.57	0.50	0	1
Lower secondary school	0.29	0.46	0	1
Intermediate secondary school	0.54	0.50	0	1
High school diploma	0.16	0.36	0	1
No school graduation	0.01	0.08	0	1
Firm size under 10 employees	0.20	0.40	0	1
Firm size between 10 and 49 employees	0.28	0.45	0	1
Firm size between 50 and 249 employees	0.23	0.42	0	1
Firm size over 250 employees	0.28	0.45	0	1
Industry	0.32	0.47	0	1
Handcraft	0.15	0.36	0	1
Trade	0.18	0.39	0	1
Service	0.34	0.47	0	1
Other sector	0.01	0.09	0	1

Source: BIBB/BAuA 2005/2006, own calculations.

In our study, we focus on skilled workers with apprenticeship training and restrict our analysis to individuals between 18 and 65 years of age. Furthermore, we exclude all civil servants

mation of the product term (Jaccard et al. 1990, Aiken and West 1991) so that a specificity degree of 0 corresponds to the mean specificity.

[14] BIBB/BAuA Employment Survey 2005/2006 is a survey jointly conducted by the German Federal Institute for Vocational Education and Training (BIBB) and the Federal Institute for Occupational Safety and Health (BAuA).

and all self-employed people. After eliminating observations with missing data, a sample of 4,217 male employees in 71 different occupations is included in the analysis.[15] Table 3.1 reports the means and standard deviations of the variables used in our empirical analysis.

3.4.1 Dependent variables: Occupational mobility and income

We use three different variables to measure occupational mobility, comparing the current occupations of workers at the time of the survey with their apprenticeship training occupations. First, we generate a variable representing an occupational change during an individual's working life, which stands for total occupational mobility. If workers no longer work in their original occupation, we consider this an occupational change, and the dependent variable takes the value of 1; 0 otherwise. Overall, about 58% of employees in our sample changed their occupation, while about 42% did not.

Second, we generate a mobility variable covering only occupational changes occurring *within* a skill cluster (i.e., the labor market segment containing occupations with similar skill combinations), which represents mobility to an occupation with similar skill-weights. If an individual changed occupation and remained in the same skill cluster, the dummy variable takes the value 1; 0 otherwise.

Third, we generate a mobility variable covering only occupational changes occurring *between* skill clusters, representing mobility into an occupation with relatively different skill-weights. If the individual changed the occupation and the skill cluster, the dummy variable takes the value 1; 0 otherwise.

Furthermore, the survey contains self-reported information on current monthly earnings and the average hours of work per week at the time of the survey; we were thus able to calculate individual hourly wages.[16] In our estimates, the logarithm of wages is used as the dependent variable.

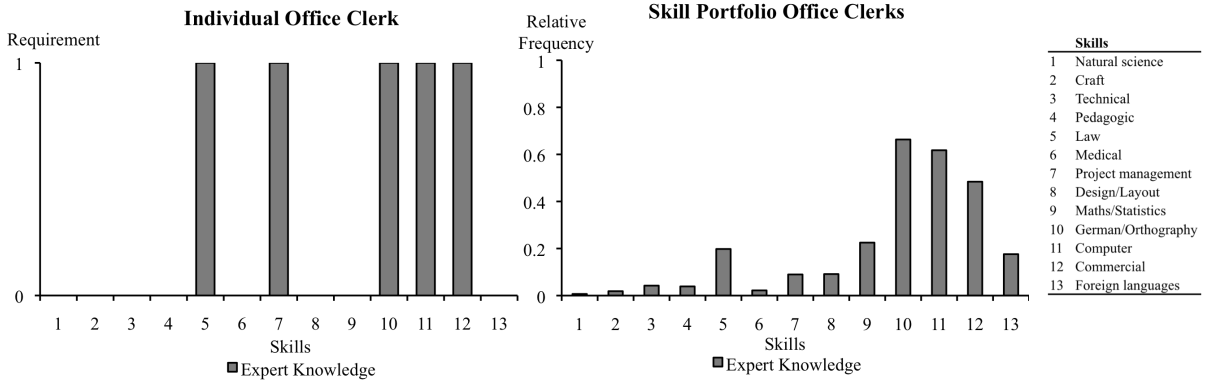
[15] We restrict our analysis to male employees to avoid difficulties related to the interrupted labor market histories of women. We furthermore lose some occupations that have too few observations per occupation to adequately represent the corresponding skill portfolio (occupations are grouped according to the (2-digit) classification of occupational titles by Germany's Federal Employment Bureau in 1992).

[16] We do not include further monetary compensation, only the monthly earnings. Moreover, we dropped observations with earnings above the 99th percentile or below the 1st percentile so that the results are not determined by outliers.

3.4.2 Required skills and occupation-specific skill portfolios

Based on the large set of questions about a worker's required skills, we are able to generate skill portfolios on the individual as well as on the occupational level. The respondents were asked to report on skills that are required to perform their current job. If the respective skill is required at the workplace, the dummy variable takes the value of 1; 0 otherwise. The left panel of Figure 3.3, for example, shows the skill portfolio of an individual office clerk, that is, all the skills this particular office clerks requires.

Figure 3.3: Skill portfolio of office clerks: Individual and occupational level



Source: BIBB/BAuA 2005/2006, own calculations.

To determine the skill portfolio in an *occupation*, we aggregate all individual skill portfolios[17] of a particular occupation, leading to a weighted occupation-specific skill portfolio (see Figure 3.3, right panel). The occupational skill portfolio shows the relative frequency of the different skills required in that occupation. We build such occupational skill portfolios for all occupations in the sample. Thereby, we know the relative frequency of all skills in all occupations and are able to compare the different skill combinations.

3.4.3 Skill clusters

To determine how similar or dissimilar the skill combinations of different occupations are, we perform a cluster analysis including all occupations represented in the sample. A cluster

[17] To determine the skill portfolio of an occupation, we only look at workers who are still in the same occupation as during their apprenticeship training to ensure that we are indeed measuring the skills acquired and required for one particular occupation.

analysis maximizes the homogeneity of skill combinations within clusters and maximizes heterogeneity between clusters (Mardia et al. 1979, Aldenderfer and Blashfield 1984); therefore, it is an ideal statistical method to identify the similarity or dissimilarity of occupational skill clusters. We perform a cluster analysis using the 71 occupations as the units of analysis and the thirteen skills as the variables to define the clusters. We apply a two-stage procedure because research has shown that this approach increases the validity of solutions (Punj and Stewart 1983, Ketchen and Shook 1996). We first use a hierarchical algorithm, i.e., Ward's (1963) minimum variance method, to define the number of clusters. This result serves as the starting point for the second stage of subsequent non-hierarchical clustering, i.e., the K-means procedure (Bortz 1989).

Table 3.2: The relative importance of single skills per skill cluster

Relative importance		**Clusters**					
		(1)	(2)	(3)	(4)	(5)	(6)
Skills	Natural science	0.35	0.22	0.15	0.29	0.06	0.18
	Craft	0.41	0.83	0.75	0.40	0.04	0.14
	Technical	0.58	0.72	0.33	0.63	0.16	0.14
	Pedagogic	0.04	0.10	0.07	0.12	0.16	0.35
	Law	0.11	0.11	0.07	0.15	0.37	0.19
	Medical	0.00	0.05	0.03	0.03	0.05	0.34
	Project management	0.03	0.08	0.05	0.16	0.18	0.10
	Design/Layout	0.03	0.06	0.08	0.31	0.15	0.08
	Maths/Statistics	0.24	0.50	0.22	0.52	0.27	0.14
	German/Orthography	0.16	0.20	0.10	0.29	0.62	0.39
	Computer	0.06	0.17	0.04	0.48	0.55	0.09
	Commercial	0.17	0.06	0.09	0.03	0.39	0.19
	Foreign languages	0.03	0.06	0.07	0.22	0.28	0.09

Source: BIBB/BAuA 2005/2006, own calculations.

As a result, we find six distinct skill clusters,[18] each of which contains occupations with similar skill combinations. To summarize the characteristics of these clusters, Table 3.2 presents the relative importance of the single skills per skill cluster. For example, the most important

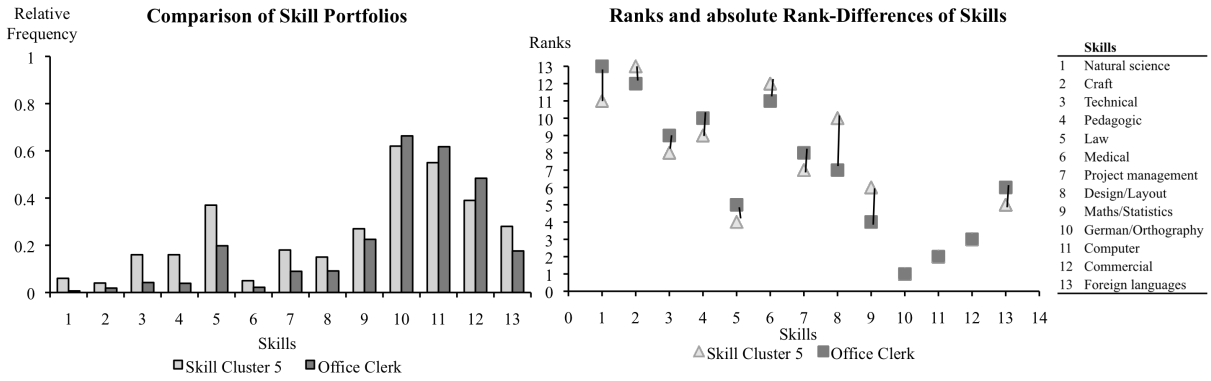
[18] We determine a candidate number of six clusters by examining the results of the first stage (visual inspection of the dendrogram that gives the distances between observations within clusters and distances between clusters (Wagschal 1999, Ketchen and Shook 1996) and use of Mardia et al.'s (1979: 365) rule of thumb, $g \sim (n/2)^{1/2}$ for the number of groups) and refine the clusters in the following second stage. Note that our research follows Osberg et al. (1987), who applied six labor market segments and is along the line of the six broad occupational groups according to the one-digit classification codes of occupational titles by Germany's Federal Employment Bureau in 1992. The cluster analysis fulfils the robustness check according to Wagschal's F-Test (1999: 272); 80% of the calculated F-values do not exceed the value of one, which means that the variance within the clusters is smaller than the total variance.

skills in skill cluster 5, which contains the office clerk, are German orthography, computer and commercial skills. Thus, these cluster-specific skill combinations represent the average skill-weights of a labor market segment.

3.4.4 Explanatory variables: Cluster specificity and total specificity

Knowing the relative frequencies of single skills per occupation and per skill cluster, we are able to quantify the specificity of skill combinations and generate our two explanatory variables. We use an index to measure the degree of specificity of occupations according to the skill-weights approach. Comparing the importance of single skills in an occupation with the relevant skill cluster (see Figure 3.4, left panel), we are able to derive the cluster specificity of a particular occupation. As expected, the skill portfolios of occupations in the same skill cluster show very similar frequencies of required skills.

Figure 3.4: Comparison of an occupation-specific skill portfolio with the skill portfolio of the relevant skill cluster



Source: BIBB/BAuA 2005/2006, own calculations.

We therefore rank the skills of each occupation and each skill cluster according to their relative frequencies. For each occupation, we calculate the distances between the ranks of single skills in the occupation portfolio and the respective skill cluster. An example of how these distances look is given in the right panel of Figure 3.4. Next, we weight these absolute rank-differences of all single skills with the corresponding relative frequency of the respective skill cluster and sum them. The larger this number is, the more atypical are the skills needed for a particular occupation even within its skill cluster. Thus, a large number indicates that the

skill-weights in the occupation are quite different from the skill-weights in its respective labor market segment. Therefore, the resulting variable provides us with a degree of specificity according to the skill-weights approach.

The total specificity is generated in the same manner, but the occupation-specific skill combination is compared to the total labor market of all apprenticeship graduates in our sample; that is, to the average skill combination of all occupations rather than to its respective skill cluster. Geel et al. (2011) describe the operationalization of the specificity index in greater detail.

3.5. Empirical results

3.5.1 Probability of occupational mobility

We now discuss the key results concerning occupational specificity and mobility (Table 3.3). In model 1, we analyze occupational mobility in total across the entire labor market and find a negative impact of occupational total specificity as expected according to hypothesis H1. To exemplify, an increase of a training occupation's total specificity of a standard deviation relative to those occupations with average specificity in the whole labor market results in a decrease in the probability of an occupational change of 4.8%. This means the more specific the apprenticeship training occupation as compared to the whole labor market, the lower occupational mobility after graduation (in line with Shaw 1987, Borghans and Golsteyn 2007).

In the next step, we are interested in differences in mobility patterns. To test hypothesis H2, we apply our labor market segmentation and only look at occupational changers to compare occupational mobility within and between skill clusters (model 2). In line with our hypothesis, we find that the higher the occupational total specificity, the more likely are occupational changes into occupations with relatively similar skill requirements (i.e., within a skill cluster) than changes into occupations with relatively dissimilar skill requirements (i.e., between skill clusters). An increase in total specificity of a standard deviation results in an increase in the probability of an occupational change within a skill cluster of 18.1% as compared to an occupational change between skill clusters. Therefore, although an occupation is very specific, a graduate is nonetheless able to change occupation after graduation into an occupation with similar skills within a labor market segment.

Table 3.3: Probability of occupational mobility (probit model)

	Specification					
Dependent variable	***Model 1:*** **Occupational change in total**		***Model 2:*** **Occupational change *within* skill clusters**		***Model 3:*** **Occupational change *within* skill clusters**	
Reference category	*Occ. stayers*		*Occ. changers between clusters*		*Occ. stayers*	
Focus	Overall labor market		Overall labor market		Labor market segment	
	dF/dx	Std. err.	dF/dx	Std. err.	dF/dx	Std. err.
Occupational total specificity	-0.024	0.004 ***	0.086	0.006 ***		
Occupational cluster specificity					-0.032	0.006 ***
Age	0.033	0.006 ***	-0.015	0.008 **	0.017	0.008 **
Age squared	0.000	0.000 ***	0.000	0.000 *	0.000	0.000
Married	-0.001	0.020	-0.018	0.024	-0.030	0.025
Children	0.002	0.020	0.021	0.024	0.013	0.025
Further training	-0.010	0.016	-0.036	0.020 *	-0.029	0.020
East Germany	0.026	0.023	0.006	0.028	-0.006	0.030
Ref. cat: Firm size ≥ 250 employees						
Firm size ≤ 9 employees	-0.072	0.028 **	0.031	0.034	-0.043	0.033
Firm size between 10 and 49 employees	-0.081	0.023 ***	-0.054	0.025 **	-0.105	0.026 ***
Firm size between 50 and 249 employees	-0.054	0.022 **	-0.003	0.024	-0.053	0.025 **
Ref. cat: Services						
Industry	0.003	0.022	0.096	0.024 ***	0.019	0.028
Handcraft	-0.277	0.026 ***	0.166	0.039 ***	-0.194	0.027 ***
Trade	0.064	0.026 **	-0.050	0.029	0.036	0.037
Other sector	-0.221	0.072 ***	-0.104	0.095	-0.246	0.044 ***
Ref. cat: Intermediate secondary school						
No school graduation	-0.036	0.100	0.262	0.123 **	0.056	0.119
Lower secondary school	-0.035	0.018 *	0.060	0.022 ***	-0.025	0.023
High school diploma	0.098	0.022 ***	0.022	0.026	0.164	0.033 ***
Number of observations	4'217		2'590		2'417	
Wald chi2 (17)	443.22		280.88		239.37	
Prob > chi2	0.00		0.00		0.00	
Pseudo R2	0.08		0.10		0.08	

Notes: Robust standard errors; all coefficients represent marginal effects.
*Statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

According to hypothesis H3, we finally analyze individual mobility behavior within a skill cluster (model 3). Although occupations grouped in a skill cluster have similar skill requirements, they nonetheless differ in specificity, as we have shown in the operationalization of the specificity degree. As expected, we find that even within a skill cluster, individuals with more cluster-specific occupations are less likely to change their occupations within their labor mar-

ket segment. An increase in cluster specificity of a standard deviation results in a decrease in the probability of an occupational change within a skill cluster of 5.9%.[19]

3.5.2 Income effects of occupational mobility

We now discuss the key results concerning the income effects of occupational specificity and mobility (Table 3.4). In model 4, we test our fourth hypothesis and analyze occupational changes *between* skill clusters. In accordance with hypothesis H4a, we find a negative impact of an occupational change between skill clusters on income. An occupational change between skill clusters is associated with a 5% reduction in hourly wages as compared to the wages of stayers (in line with the finding of Poletaev and Robinson, 2008, that switching skill portfolios generates wage losses; however, we further expect income gains if occupational changes occur within skill clusters). The coefficient of occupational total specificity is statistically insignificant, but the interaction term between total specificity and an occupational change between skill clusters – that shows the additional effect of specificity only for those who are mobile – is statistically significant and negative as expected according to hypothesis H4b. Thus, in the case of an occupational change between skill clusters, the more specific the skill portfolio of an occupation relative to the total labor market, the higher the wage loss that a cluster changer has to bear. Therefore, employees who change their skill clusters suffer a wage loss that increases with the specificity of the skill requirements of the former occupation.

[19] As a robustness check, we compute the regressions with occupational clusters to consistently estimate the standard errors and also obtain significant results; in models 1 and 3, the specificity effects were significant at the 10% level, and in model 2 at the 1% level.

Table 3.4: Income effects of occupational mobility (OLS regression)

	Specification					
Dependent variable: Hourly wage (ln)	***Model 4:* Occupational change *between* skill clusters**			***Model 5:* Occupational change *within* skill clusters**		
Reference category	*Occ. stayers*			*Occ. stayers*		
Focus	Overall labor market			Labor market segment		
	Coef.	Std. err.		Coef.	Std. err.	
Occ. change *between* skill clusters	-0.050	0.015	***			
Occ. total specificity	0.005	0.005				
Interaction term	-0.012	0.007	*			
Occ. change *within* skill cluster				0.068	0.017	***
Occ. cluster specificity				-0.010	0.004	**
Interaction term				0.002	0.009	
Age	0.035	0.005	***	0.030	0.006	***
Age squared	0.000	0.000	***	0.000	0.000	***
Married	0.054	0.015	***	0.036	0.017	**
Children	0.012	0.015		0.025	0.017	
Tenure	0.021	0.002	***	0.018	0.002	***
Tenure squared	0.000	0.000	***	0.000	0.000	***
German nationality	0.059	0.036		0.015	0.034	
Blue collar	-0.173	0.014	***	-0.132	0.016	***
East Germany	-0.285	0.019	***	-0.297	0.021	***
Further training	0.101	0.012	***	0.059	0.013	***
Ref. cat: Firm size ≥ 250 employees						
Firm size ≤ 9 employees	-0.225	0.024	***	-0.201	0.024	***
Firm size between 10 and 49 employees	-0.159	0.016	***	-0.142	0.018	***
Firm size between 50 and 249 employees	-0.091	0.015	***	-0.082	0.018	***
Ref. cat: Services						
Industry	0.181	0.018	***	0.052	0.021	**
Handcraft	0.077	0.021	***	-0.049	0.023	**
Trade	-0.024	0.022		-0.098	0.025	***
Other sector	0.009	0.057		-0.122	0.057	**
Ref. cat: Intermediate secondary school						
No school graduation	0.011	0.068		-0.064	0.064	
Lower secondary school	-0.052	0.013	***	-0.056	0.015	***
High school diploma	0.097	0.020	***	0.088	0.022	***
Constant	1.701	0.104	***	1.911	0.110	***
n		3427			2417	
F-Statistics		108.11			73.31	
Prob > F		0.00			0.00	
R-Squared		0.40			0.38	

Notes: Robust standard errors.

*Statistically significant at the .10 level; **at the .05 level; ***at the .01 level.

In the last step, we test our fifth hypothesis that focuses on labor market segments, and we analyze occupational changes within a skill cluster (model 5). As expected according to our hypothesis H5a, occupational changes within skill clusters have a significantly positive effect on income. An occupational change within a skill cluster is associated with a 6.8% increase in income relative to occupational stayers (similar to the realization of better income possibilities through occupational changes shown by Fitzenberger and Spitz (2004); however, their analysis neglects underlying skills). In line with hypothesis H5b, occupational cluster specificity has a negative and significant effect on income, while the coefficient of the interaction term is statistically insignificant. Therefore, an occupational change within a skill cluster is honored with a wage gain. However, the more specific the skill portfolio of the former occupation relative to the respective skill cluster, the smaller this wage gain.

3.6. Conclusions

Our analysis of occupational mobility shows that although vocational education and training (VET) is often criticized as too inert and inflexible and too focused on narrow skill requirements, VET does not severely restrict mobility but provides graduates with different types of flexibility. We find clear evidence supporting our theoretical predictions, and thus, occupational specificity can be analyzed according to Lazear's skill-weights approach (2009): particular skill combinations have implications on mobility and income. Our paper contributes to the literature in analyzing occupational mobility on the skill-level and providing a novel definition of specificity. Therefore, the acquired skill combination – and not the occupation per se – crucially determines the mobility of an employee.

Several conclusions can be drawn about the specificity of occupational skill combinations and their implications for occupational mobility and income. First, there is evidence of distinct segments within the labor market based on skills; skill clusters exist that contain occupations with similar skill-weights or skill combinations. These skill clusters are important in an analysis of occupational mobility after apprenticeship training.

Second, the required skill combination is a good measure of the employability of occupations and determines the degree of specificity of an occupation. The more specific an occupation is, the smaller the probability that employees will change their occupation not only across the total labor market but also within their skill cluster. Nonetheless, even employees in specific occupations can be mobile, as they have a comparatively higher probability of changing oc-

cupations *within* a skill cluster rather than *between* skill clusters. Therefore, within skill clusters, flexibility is facilitated, whereas between skill clusters, flexibility is constrained. Thus, the mobility of graduates of a particular apprenticeship training occupation can still be high even if the occupation is very small and does not offer many job opportunities as long as there are other occupations within the same skill cluster into which they can change without a substantial loss of human capital.

Third, an occupational change within skill clusters is possible without losing formerly acquired skills and, moreover, is honored with a wage gain. Since the required skill combination is quite similar, the return on the formerly acquired skills is not lost. However, occupational mobility into occupations with very different skill combinations - occupational mobility between skill clusters - is associated with a wage loss because the returns on formerly acquired skills are partially lost. Not surprisingly, the higher the degree of specificity of the former occupation, either the higher the resulting wage loss or the smaller the resulting wage gain depending on whether the change is between or within skill clusters, respectively. However, although occupational changes between skill clusters are associated with a wage loss, empirically, many employees change occupations between clusters. Obviously, occupational mobility is not only motivated by increased pay. We assume that these changes are, for example, related to health, family issues or general changes in one's personal situation.

Our findings lead to several implications for research and educational policy. Regarding educational policy, it is important to look not only at a single occupation when thinking about future competitiveness and mobility issues but also at the skill cluster within which a particular occupation is located because the cluster is as important for mobility and earnings as the occupation itself. Therefore, choosing a seemingly outdated and very specific occupation could be a better decision, if it is in a prosperous cluster, than choosing a seemingly general occupation that lies in a very small and less prosperous cluster.

Moreover, we find that the relevant parameter to evaluate the flexibility of an occupational system and the employability of its graduates is the specificity of the skill combination in comparison to similar occupations within the skill cluster and in comparison to the total labor market. Based on Lazear's skill-weights approach, we argue that the specificity of the skill combination of an occupation is the relevant issue to be analyzed, and these skill combinations can be quite similar, even though a multitude of occupations exist.

We show that dual education graduates are able to not only change jobs, but also change occupations within skill clusters and thus profit from beneficial career opportunities. Beyond occupational mobility and relying on existing skills, acquiring further qualifications and additional skills sustains employability. In the next chapter, we focus on educational mobility and investigate career consequences of further human capital investments in a dual education system.

CHAPTER 4

Career Success of Higher Education Graduates:

A Comparison of Vocational and Academic Tertiary Education

4.1. Introduction

With a general labor market trend towards higher education and higher training requirements, tertiary education becomes increasingly important. Certainly, it provides advantages over lower-level education during working life (e.g., Psacharopoulos 1994, Blöndal et al. 2002). Yet career entry after any education, along with first career steps determines an individual's future labor market success (Baker et al. 1994, Oreopoulos et al. 2008, Bachmann et al. 2010). Therefore, career entry after tertiary education is also a crucial issue.

Literature at the tertiary education level shows the existence of not only subject-specific labor market effects exist (i.e., distinguishing between different fields of study) but also of type-specific labor market effects (i.e., distinguishing between academic or vocational education). Research on subject-specific effects at career entry shows relative

advantages of certain fields of study (e.g. Falk and Reimer 2007)[20] while research on type-specific effects mostly focuses only on financial returns to education during the overall career, neglecting career entry[21]. What has not yet been studied is the effects on career entry and later career success of different types of tertiary education, i.e., vocational and academic. This chapter fills this gap by comparing short-term and longer-term labour market effects of vocational and academic tertiary education (ISCED 5A), across similar fields of study.

Our empirical results show that the type of tertiary education influences risk and return at career entry and later career success in different ways. Therefore, we consider endogenous educational choice and use parental academic tertiary education as an instrument because parental education influences a child's educational path (e.g. Björklund and Salvanes 2010). At career entry, we find the same unemployment risk for both types of education, while finding higher wages and a lower financial risk for vocational tertiary education graduates than for academic graduates. In the longer term, while the initial financial advantages of vocational graduates disappear, a lower unemployment risk compared to academic graduates appears. Therefore, the practical curriculum completed by vocational graduates is most advantageous at career entry.

Our study contributes to the literature in three ways. First, we show in a comparison of vocational and academic tertiary education across similar fields of study that different educational type-effects exist. The practical-oriented applied studies of vocational graduates are advantageous at career entry, compared to the theoretical knowledge of academic graduates. Second, we analyze different labor market outcomes. We investigate educational type-effects not only on income levels, but also on income risk and unemployment risk. Third, we examine different points in a graduate's career and analyze both career entry shortly after graduation and later career success.

[20] Further higher education surveys with a focus on subject-specific effects examine only the financial returns to education in the overall career, ignoring career entry (e.g. Blundell et al. 2000, Ammermüller and Weber 2005, Wahrenburg and Weldi 2007).

[21] For Switzerland, Weber (2003) finds lower returns of education for academic than for vocational graduates. Pätzmann (2005) analyzes type-specific career entry in her thesis, but only for graduates in architectural studies or management, and she focuses not only on income but also on difficulties during the job search and on adequacy of employment. For Germany, Riphahn et al. (2010) and Lauer and Steiner (2001) find higher labor market returns for academic education than for vocational education but do not analyze labor market risk.

A comparison of vocational tertiary and academic tertiary education is an important policy necessity, particularly in the international context of different educational systems. Whereas the educational system of the United States, for example, focuses on academic education (high school and college) and avoids early tracking, academic education and vocational education and training in Europe often coexist on the secondary and tertiary education levels. Within the US system of post-secondary education, most students acquire general academic skills at universities. The provision of vocational skills has been largely limited to community colleges, which offer vocational programs designed to prepare students for work immediately after graduation (Bailey and Berg 2010)[22]. In contrast, in many European countries, the educational system consists of parallel branches of vocational and academic education. On the tertiary level, academic universities provide students with academic skills, whereas vocational universities (called, for example, universities of applied sciences) provide students also with vocational skills, combining theory with practice. Therefore, the skills acquired depend on the type of education chosen within an educational system.

The remainder of this chapter is structured as follows. Section 4.2 derives testable hypotheses regarding career entry and success after different types of tertiary education. Section 4.3 explains our estimation methods, and Section 4.4 introduces the data set. Section 4.5 presents our empirical results, and Section 4.6 concludes.

4.2. Theoretical framework

Standard human capital theory (Becker 1964) states that investments in human capital increase productivity, resulting in additional returns in the labor market. Any formal education or practical (on-the-job) training augments human capital through the acquisition of knowledge, skills or experience. This augmentation increases productivity, which in turn leads to higher labor market outcomes.

Becker (1964) distinguishes general and specific human capital, both of which contribute to productivity. General (marketable) and specific human capital are complements in a firm's production function (Franz and Soskice 1995, Kessler and Lülfesmann 2006).

[22] About a third of all postsecondary students are enrolled in community colleges (Bailey and Berg 2010).

The interplay of both types of skills is necessary for productivity. Thus, specific skills are important, and individuals have to acquire them before their general skills can be effectively used.

We assume that skills and knowledge are heterogeneous in their contribution to productivity: occupation-specific human capital (Shaw 1987, Kambourov and Manovskii 2009) is directly applicable and immediately increases productivity. Specific skills are necessary for effectively using marketable general skills, as the general skills must be primarily transferred into productive ability. Thus acquired human capital translates differently into productivity.

When we compare the two types of human capital – general human capital acquired through formal education and specific human capital acquired through practical training – we expect to find that the general human capital is applicable in the workplace only after the worker has first acquired specific human capital. In other words, having job-specific skills is critical for the successful application of more general skills. Although formally very well educated, academic graduates sometimes need additional practical training to perform well and have to transfer their human capital into productive ability. They should be willing to bear part of the costs of the further learning opportunities they need, because both their marketable knowledge and subsequent income will increase (Rosen 1972).

During a hiring process, employers try to select those potential employees (for specific jobs) who they expect will best fulfill their assigned tasks at the lowest costs (Müller 2005). These costs include not only wages but also expected costs for additional training. These training costs depend on the extent to which the educational system provides qualifications that prepare workers to perform immediately without the need for further training. When the educational system is organized in different tracks, we can judge the applicability of the acquired skills. The more occupationally oriented (rather than general) the education is, the more skills should be of direct use in the labor market and the less instantaneous employer training investment is necessary.

We distinguish the type or applicability of skills according to the type of tertiary education in which they are acquired - vocational or academic. The two education types differ

in their educational goals (SKBF 2010, OPET 2010): vocational tertiary education places a greater emphasis on practical studies, includes elements of general vocational training and takes a more practice-oriented approach than academic tertiary education does. Therefore, vocational graduates gain more practical and directly usable human capital, whereas academic graduates acquire more abstract and analytical skills.

Employers searching for a highly qualified workforce can assess immediate further training costs for potential employees from the type of tertiary education completed. As the practice-oriented approach gives vocational graduates some expertise in the necessary work tasks, they need less additional practical training than academic graduates. In contrast, academic graduates need to complement their high general knowledge with occupation-specific human capital. Therefore, vocational graduates can apply their acquired human capital faster than academic graduates while imposing fewer training costs on a potential employer. The increased productive ability of vocational graduates results in higher labor market returns at career entry than those for academic graduates, who face lower outcomes but further learning opportunities.

The empirical literature supports our expectations. Research on the secondary educational level points out the advantage of vocational education over academic education at career entry (e.g. Winkelmann 1996, Ryan 1998, Müller 2005). Furthermore, employers often consider the missing practical experience of academic tertiary education as a large shortcoming (BFS 2008, Lödermann and Scharrer 2010), so that for academic student developing employability skills during their studies is important for later employment opportunities (Wilton 2011). These considerations lead us to our first hypothesis:

H1 *At career entry, vocational tertiary education graduates have higher labor market outcomes than academic tertiary education graduates.*

Although academic graduates need some practical training after graduation, their acquired academic knowledge shows a high general cognitive capacity for learning new skills and adapting to a new technical environment (Rosen 1972). In the longer term after gaining some practical experience that complement their general human capital,

they make up for their initially slower skill applicability and reach the same productive ability as their vocational counterparts. We expect that the type of education or the type of the acquired human capital has a stronger impact at career entry than later. Therefore, labor market outcomes of these two types of tertiary education should equalize in the longer term.

H2 *In the longer term, vocational and academic tertiary education graduates have the same labor market outcomes.*

4.3. Estimation methods

In our empirical analysis, we investigate the risk and return of educational types in both the short-term at career entry after graduation as well as in the longer term later in the career. For labor market outcomes we analyze the unemployment risk, earning level and earning risk, and apply different specifications. The basic equation for testing educational type effects can be written as

$$y_i = \alpha_1 + \beta_1 VocTertEduc_i + \gamma_1 X_i + \varepsilon_i, \qquad [4.1]$$

where y stands for the labor market outcomes. The main explanatory variable *VocTertEduc* is a dummy representing vocational tertiary education, so β_1 is the influence of vocational tertiary education on the outcome variable and the reference group in our analysis is academic tertiary education. Additionally, *X* is a vector of control variables and ε represents an unobservable error.

However, to avoid endogeneity problems (Angrist and Krueger 2001), we instrument the variable vocational tertiary education with the parent's education in our analysis. As previous literature shows, a parent's educational path influences the child's path (for an overview, see Björklund and Salvanes 2010; for Switzerland, see Cattaneo et al. 2007, Bauer and Riphahn 2007). Parental education is therefore clearly related to a child's educational path and especially to the type of education the child chooses, i.e., vocational or academic tertiary education (Vellacott/Wolter 2004). However, parental educa-

tion is not directly related to a child's career, because individual characteristics prevail[23]. Thus, given that the parental education is highly correlated with an individual's educational path but not with its labor market outcome (Hoogerheide et al. 2010), we can use the parent's highest educational degree as an instrumental variable (IV) following Riphahn et al. (2010)[24]. As an IV we include a dummy taking the value of 1 if one or both of the parents graduated from university, and thus chose academic tertiary education, or 0 if neither of the parents graduated from university. The IV equation as our main specification can thus be written as

$$y_i = \alpha_2 + \beta_2 VocTertEduc_i^* + \gamma_2 X_i + \varepsilon_i, \quad [4.2]$$

$$VocTertEduc_i^* = \alpha_3 + \delta_3 ParentAcadTertEduc_i + \gamma_3 X_i + \mu_i. \quad [4.3]$$

After estimating these IV regressions with a full set of control variables, we then estimate them without career-related variables that occurred after graduation. With this approach, we intend to measure the whole effect of the tertiary education type because all post-graduation variables are part of the type effect and thus would bias the main effect[25]. We estimate IV probit regressions for unemployment risk and the negative income risk. The earnings equations are an extended Mincer (1974) earnings equation specified as an IV regression.

4.4. Educational system, data and variables

This section gives an overview of the Swiss educational system, which consists of parallel tracks of vocational and academic education. As the focus on vocational tertiary education is very pronounced in Switzerland, this country provides a particularly useful

[23] Hoogerheide et al. (2010) show that, even in the case of moderate direct effects of family background variables as instruments on the dependent variable, the bias in the results is very small. They argue that the criticism of family background variables as instruments is unjustified and that using them is a viable option for solving the endogeneity problem with regards to education.

[24] Riphahn et al. (2010) use the parents' educational attainment, among other variables, to predict graduation from university compared to graduation from a university of applied sciences. A university degree held by either parent significantly increases the probability that the child will attend university.

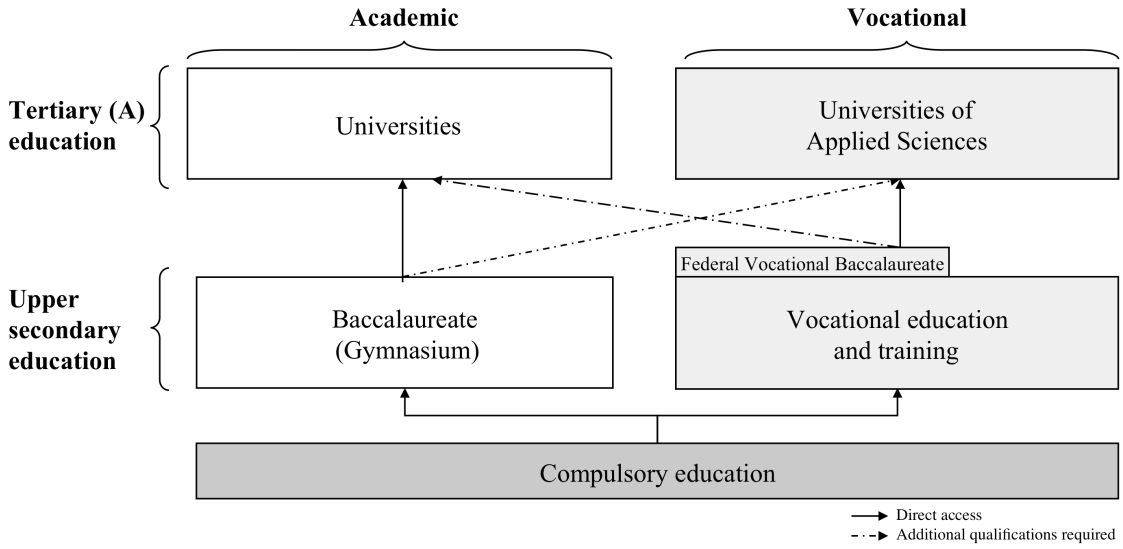
[25] Pereira and Martins (2001) show that including covariates that represent post-educational decisions results in an underestimation of the impact of education.

context for our investigation. We also describe the data and variables used in the analysis.

4.4.1. Swiss educational system

The educational system in Switzerland is based on different tracks of vocational and academic education. Having completed nine years of compulsory schooling, youth face two upper secondary educational choices. They can pursue either a vocational or an academic education. Youth choosing vocational secondary education (two thirds of each youth cohort do so in Switzerland (OPET 2009)) pursue vocational education and training and earn a nationally approved vocational baccalaureate upon successful completion. They have the option of leaving the school system and entering the labour market or of continuing their education by attending a university of applied sciences (higher education institutions that focus on practically oriented studies and conduct applied research (OPET 2010)), i.e., vocational tertiary education.

Figure 4.1: Simplified diagram of the Swiss educational system



Source: OPET 2009

After completing compulsory schooling youth can also choose the academic secondary education track. By attending a gymnasium (a university preparatory upper secondary

school) they may obtain an academic baccalaureate. This certificate grants access to academic tertiary education, i.e., to all academic universities at the tertiary education level. Switching tracks within the educational system - and thereby combining academic and vocational education - is possible but usually only after the acquisition of additional qualifications. Figure 4.1 gives a simplified diagram[26].

In Switzerland, the institutes of tertiary education thus fall into two categories: academic universities and universities of applied sciences (SKBF 2010, OPET 2010). They have the same status but different educational goals. Academic universities carry out basic research and teaching providing students with abstract theoretical and analytical skills, whereas universities of applied sciences place a greater emphasis on practically oriented studies and on applied research. They combine theory with practice and offer degree programs that provide students with practical skills and competencies by combining theory and scientific methods with practical aspects. Therefore, universities of applied sciences incorporate elements of general vocational training and take a more practice-oriented approach through a close link between teaching and applied research. Thus the two different educational goals can result in different labor market values of these two educational types.

4.4.2. Data

In our empirical analysis, we use data from a representative survey of Swiss graduates of tertiary education (ISCED 5A[27]), conducted by the Swiss Federal Statistical Office. The cohort we examine graduated in 2000 and was surveyed for the first time one year after graduation (2001) and a second time five years after graduation (2005). This panel design allows us to analyse educational type effects both at career entry and in the longer term. The survey is well suited for our analysis because it contains detailed and unique information on each graduate's educational path at the secondary and tertiary levels, as well as on his or her career path before, during and after studies.

[26] A detailed description of the educational system in Switzerland can be found in Weber et al. (2001: 285-287).

[27] Tertiary-type A programs (ISCED 5A) are largely theory-based and designed to provide qualifications for entry into professions with high skill requirements and advanced research programs . Tertiary-type B programs (ISCED 5B) are classified as being at the same competency level but are more occupationally oriented and usually of shorter duration (OECD 2009).

For our analysis, we exclude all graduates who reported having been part-time students in the final years of their tertiary studies[28]. To study the educational type effects within fields if study, we include only graduates in similar fields that are taught at both types of tertiary education institutes (i.e. business/economics, technical sciences, natural and social sciences). We thus exclude graduates from fields of study offered either only at a university of applied sciences (e.g. arts or design) or only at an academic university (e.g. medicine or law). Furthermore, we exclude individuals who reported being self-employed. After eliminating observations with missing data, a sample of 1,920 individuals remained in our first analysis of unemployment risk. Because the further equation estimates are conditional on working, graduates who were unemployed at the times of the surveys - one year and/or five years after graduation - are excluded from further analysis. Thus we use a smaller sample (1,446 individuals) for the income analyses.

4.4.3. Variables

We analyze several dependent variables as labor market outcomes. First, we analyze the *unemployment risk* after different types of tertiary education. We are interested in the unemployment incidence after graduation. As the graduates had to declare their employment status one year after graduation, we generate a dummy variable indicating unemployment with 1 if unemployed one year after graduation and 0 otherwise. The same applies to unemployment in the longer term, five years after graduation.

Second, we investigate the *income* of tertiary education graduates. We not only analyze the level of income one year after graduation but also the income risk because education both raises expected wages and influences wage variances (Christiansen et al. 2007, Hartog and Vijverberg 2007). The survey collected self-reported annual gross earnings in 2001, one year after graduation[29]. We first use the logarithm of yearly wages as a

[28] This requirement applies only to vocational tertiary education. The studies offered at universities of applied sciences are either full-time three-year courses or four-year courses if the student studies only part-time (SKBF 2010, Bonassi and Wolter 2002). The main activity of part-time students is working. Their employers often partly or fully finance their studies, and these students are contractually bound to remain employed with the firm for a certain time after graduation. As career entry after graduation for part-time and full-time vocational graduates is not comparable, we focus exclusively on full-time students in our analysis.

[29] We use the information at the level of employment to calculate the corresponding full-time salaries of part-time workers. Furthermore, we drop observations with earnings above the 99th percentile or below the 1st percentile for each year so that the results are not determined by outliers.

dependent variable to analyze the level of income. Second, to investigate the income risk, we compute for each graduate the variance of earnings following Firpo et al. (2007: 24)[30]:

$$\text{var}\, y_i = (y_i - \bar{y})^2 \qquad [4.4]$$

Hence, we are able to investigate the bandwidth within which the wages are spread. However, the income variance does not indicate whether individuals are more likely to be low-paid or high-paid. If the variance were larger because more individuals are paid above the average income, we would not judge this larger variance as negative. We would do so only if more individuals were paid below the average. Therefore, we create a third measure to analyze the probability of someone's being paid below the mean of the income distribution, the negative income risk. To do so, we compare the individual wage with the mean wage separately for both educational types. We generate a dummy that takes the value of 1 if the individual wage is less than the respective mean wage and 0 otherwise. We do the same for the income and income risk five years after graduation. In the 2005 interview, the graduates had to report their actual monthly gross earnings. To obtain comparable annual gross earnings, we multiply the monthly earnings by thirteen (BfS 2006), as thirteen months of pay is common in Switzerland[31].

Our primary explanatory variable is *vocational tertiary education*, which indicates the type of tertiary education an individual has successfully completed. The dummy takes the value of 1 for vocational tertiary education (studies at a university of applied sciences) and 0 for academic tertiary education (studies at an academic university). Our sample consists of 30% vocational and 70% academic tertiary education graduates, shares representative of the tertiary student population in Switzerland (BFS 2006).

We also use a full set of controls (see table A4.1 in the appendix). We include socio-demographic factors, various characteristics about the graduate's studies, a motivation

[30] For ease of interpretation we transform the resulting variance, dividing it by 1000.

[31] Unfortunately, this calculation is only an approximation as the survey did not clarify the components of the income. We assume, however, that earning a thirteenth paycheque is systematically correlated not with the type of tertiary education completed, but rather with the position of an employee, for which we can control.

proxy as an individual intrinsic characteristic[32], and the respective local unemployment rate as a labor market control. We also include post-graduation career-related variables (except in our second specifications, where we deliberately exclude post-graduation variables)[33].

Looking at the descriptive statistics (table A4.1), we can compare the characteristics of vocational and academic tertiary education graduates. Vocational graduates are generally younger and more likely to come from vocational secondary education. Overall, the parents' education is lower for vocational than for academic graduates. Parents of vocational graduates have often only completed vocational secondary education, whereas parents of academic graduates are more likely to have an academic tertiary degree. Parental education clearly influences a child's educational path. Therefore, we account for endogenous educational choice, using parental academic tertiary education as the IV.

For the career entry outcome variables, we find a lower unemployment risk, more favorable job characteristics (such as having a permanent contract or being in a managerial position) and a higher wage for vocational than for academic tertiary education graduates. Thus a look at the descriptive statistics shows that the career entry of vocational graduates is advantageous. In the longer term, five years after graduation, still more favorable job characteristics remain, although their wage is by then lower than that of academic graduates. We further check the findings of this basic descriptive analysis in the next chapter in a multivariate analysis.

4.5. Empirical results

We now discuss the key results of our instrumental variable analysis on educational type effects in the short-term at career entry and in the longer term later in the career. We use various labor market outcomes to test our hypotheses and apply our two differ-

[32] Motivation may affect a graduate's later labor market success (Wenz and Yu 2009). We choose a variable indicating the importance of a new challenge as a desire for personal achievement. This variable is measured on a five-point scale. It takes the value of 1 if a new challenge is not at all important and a value of 5 if it is very important. As a result, the higher the value of this variable, the greater the importance of a new challenge and the greater the motivation of the individual.

[33] The variable experience after graduation is observed as a categorical variable. To simplify the interpretation, we assigned midpoints to these categories and treated the variables as continuous (following DiNardo and Pischke 1997).

ent specifications with and without post-graduation career controls. Columns marked "A" contain estimations with our full set of controls and columns marked "B" contain estimations without post-graduation career-related variables. This latter approach reduces bias if post-graduation variables are part of the educational type effect.

In our specifications, we instrument the variable vocational tertiary education to account for potential endogeneity of the educational path chosen (tables 4.1 and 4.2)[34]. The significant and strong negative effect in the first stage of the dummy *parents with academic tertiary education* on our main explanatory variable, *vocational tertiary education*, indicates that the instrument is a reasonably powerful predictor. If one or both parents graduated from academic tertiary education, the probability of the child's choosing vocational tertiary education compared to an academic one is much smaller.

The IV provides an estimate only for those individuals whose behavior can be influenced (local average treatment effect or LATE, Angrist and Krueger 2001), namely those graduates whose choice of educational type is influenced by their parents' education[35]. The IV estimate compares educationally disadvantaged individuals compared to educationally advantaged.

4.5.1. Educational type effects at career entry

We begin by studying educational type effects at career entry, that is the short-term labor market outcomes one year after graduation from tertiary education (table 4.1).

First, we investigate the unemployment risk, estimating an IV-probit model with the dependent variable of being unemployed one year after graduation. Our IV-regressions show no different unemployment risk for vocational or academic graduates, neither with

[34] As IV estimates of returns to education based on family background are systematically higher than corresponding OLS estimates (Card 1999), we interpret only the significance and direction of the IV estimates compared to the OLS full specification. IV estimates are upward-biased, partly because marginal returns to schooling for certain subgroups – particularly disadvantaged groups with low education outcomes – are higher than the average marginal returns to education in the population as a whole. Furthermore, because all the F-values of the first stage exceed the value of 10 for our regressions, we do not have a problem of weak instruments (Yogo 2004).

[35] The IV estimates apply only to those vocational education graduates who chose the vocational path because of their parents (who did not graduate from academic tertiary education), even though they would have been able to complete an academic tertiary education compared to those graduates who attended academic tertiary education because their parents did.

(column 1A) nor without post-graduation career controls (column 1B). No different probability of being unemployed appears one year after graduation for vocational compared to academic tertiary education. The fields of study and socio-demographic variables are more important factors than the educational type in determining the unemployment incidence at career entry.

Table 4.1: Educational type effects at career entry: IV estimates

		1. Unemployment Risk		2. Income					
	Vocational tertiary education	Unemployment Incidence	Unemployment Incidence	Income (in logs)	Income (in logs)	Income Variance	Income Variance	Probability of low pay	Probability of low pay
		(1A)	(1B)	(2A)	(2B)	(3A)	(3B)	(4A)	(4B)
	First Stage	IV-Probit	IV-Probit	IV-Reg	IV-Reg	IV-Reg	IV-Reg	IV-Probit	IV-Probit
Vocational tertiary education		-1.126	-1.269	0.798**	0.841***	-136,057**	-127,573**	-2.859*	-2.809**
		[1.376]	[1.328]	[0.335]	[0.317]	[58,876]	[51,536]	[1.658]	[1.391]
Field of study *(Ref. Cat.: Social Sciences)*									
Business/Economics	0.020	-0.432***	-0.418***	0.134***	0.186***	-2,311	-2,763	-0.704***	-0.901***
	[0.024]	[0.138]	[0.137]	[0.0350]	[0.0336]	[6,048]	[5,369]	[0.171]	[0.148]
Technical sciences	0.222***	-0.453	-0.414	-0.112**	-0.0806	15,899*	15,047	0.605**	0.402
	[0.024]	[0.341]	[0.328]	[0.0554]	[0.0592]	[9,420]	[9,275]	[0.274]	[0.262]
Natural sciences	-0.109***	-0.448**	-0.467**	0.0509	0.0520	-4,752	-2,068	-0.0498	-0.0799
	[0.023]	[0.201]	[0.196]	[0.0496]	[0.0482]	[8,659]	[7,780]	[0.246]	[0.212]
Motivation	-0.016*	-0.0325	-0.0251	0.0166	0.0201	-1,088	-132.2	-0.131*	-0.139**
	[0.009]	[0.0578]	[0.0593]	[0.0141]	[0.0141]	[2,412]	[2,226]	[0.0716]	[0.0648]
Local unemployment rate 2001	-0.074***	0.148	0.139	0.0479	0.0451	-9,993*	-8,757	-0.0989	-0.0845
	[0.010]	[0.119]	[0.118]	[0.0336]	[0.0336]	[5,757]	[5,336]	[0.162]	[0.145]
Post-graduation career controls									
Stay abroad after studies	-0.052***	0.138		0.0347		39.85		-0.211*	
	[0.016]	[0.117]		[0.0214]		[3,708]		[0.111]	
Job search duration after graduation				0.00636		-2,629**		-0.0173	
				[0.00626]		[1,046]		[0.0305]	
Permanent job				0.169***		-13,060**		-0.675***	
				[0.0310]		[5,130]		[0.153]	
Managerial function				0.0300		14,926***		-0.0815	
				[0.0306]		[5,282]		[0.149]	
Public sector				0.000497		-6,549		0.126	
				[0.0247]		[4,111]		[0.123]	
Parents with academic tertiary education	-0.066***								
	[0.017]								
Constant	0.982***			9.770***	9.649***	266,228**	240,258**		
	[0.285]			[0.668]	[0.635]	[109,129]	[97,011]		
Socio-demographic controls	yes	yes	yes	yes	yes	yes	yes	yes	yes
Study controls	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1,920	1,920	1,920	1,446	1,446	1,446	1,446	1,446	1,446
F-statistic: First Stage	16.09	16.09	17.24	11.03	14.46	11.03	14.46	10.56	13.32

Notes: * significant at 10%, ** at 5%, *** at 1%; probit coefficients represent marginal effects; robust standard errors; instrument used: parents with academic tertiary education.

Source: Swiss Graduate Study 2000; own calculations.

Second, we analyze income effects of the two tertiary education types and estimate IV-regressions. Examing endogenous educational choice, we find higher income level effects for vocational than for academic graduates in both specifications (columns 2A and 2B). Vocational graduates face higher income expectations at career entry. Our results further show that beneficial career attributes, such as having a permanent job, increase wage (column 2A). Thus if academic graduates enter employment with less beneficial job characteristics such as a temporary contract because of initially missing practical skills, their wage would be even lower than that of vocational graduates. The likely rea-

son for this difference is that academic graduates lack the occupation-specific skills for a permanent contract and have to start first as trainees.

Moreover, we analyze the income variance (deviation from the mean wage). We find a significantly lower income variance for vocational education than for academic education (columns 3A and 3B) and thus a smaller income bandwidth. Finally, to analyze the negative income risk, we investigate the probability of being paid below the mean income of the respective educational type. We find a significantly smaller probability of being low-paid for vocational graduates than for academic graduates (columns 4A and 4B) and thus a higher probability of being paid above the respective mean wage, or a lower negative income risk.

Summing up our empirical results on career entry, we find that educational type effects exist: accounting for intergenerational mobility, vocational tertiary education leads to better labor market outcomes with even lower risks than for academic tertiary education. Graduates of both types of tertiary education face the same (probably very low) unemployment risk in the short-term. However, vocational graduates have higher income expectations than academic graduates, with a lower income variance and even a lower negative income risk. These findings support our hypothesis H1, where we expect higher labor market outcomes of vocational tertiary education compared to academic tertiary education.

4.5.2. Educational type effects in the longer term

Using the IV approach to investigate the persistence of educational type effects, we now analyze longer-term labor market outcomes, five years after graduation (table 4.2).

First, we investigate the long-term unemployment risk and estimate an IV probit model with the dummy variable of being unemployed five years after graduation as the dependent variable. Accounting for intergenerational mobility, we find a lower unemployment risk for vocational than for academic tertiary education in both estimations with (column 1A) and without post-graduation career controls (column 1B). Vocational graduates thus face a lower probability of being unemployed in the longer term than academic graduates.

Table 4.2: Educational type effects in the longer term: IV estimates

		1. Unemployment Risk		2. Income					
	Vocational tertiary education	Unemployment Incidence	Unemployment Incidence	Income (in logs)	Income (in logs)	Income Variance	Income Variance	Probability of low pay	Probability of low pay
	(1A)	(1B)	(2A)	(2B)	(3A)	(3B)	(4A)	(4B)
	First Stage	IV-Probit	IV-Probit	IV-Reg	IV-Reg	IV-Reg	IV-Reg	IV-Probit	IV-Probit
Vocational tertiary education		-3.071*	-3.066*	0.113	0.218	-6,198	-7,643	-0.744	-1.298
		[1.821]	[1.695]	[0.156]	[0.181]	[41,194]	[40,900]	[1.247]	[1.216]
Field of study *(Ref. Cat.: Social Sciences)*									
Business/Economics	0.032	-0.00304	-0.153	0.118***	0.152***	22,482***	23,424***	-0.841***	-0.989***
	[0.024]	[0.206]	[0.191]	[0.0178]	[0.0189]	[5,131]	[4,870]	[0.131]	[0.125]
Technical sciences	0.229***	0.875*	0.704*	-0.0337	-0.0160	2,509	4,088	0.217	0.108
	[0.024]	[0.456]	[0.411]	[0.0300]	[0.0340]	[7,921]	[7,897]	[0.241]	[0.235]
Natural sciences	-0.110***	-0.0393	-0.0592	0.0209	0.0285	8,632	9,572	-0.235	-0.254
	[0.023]	[0.275]	[0.254]	[0.0243]	[0.0280]	[5,804]	[5,844]	[0.183]	[0.182]
Motivation	-0.013	-0.129*	-0.128*	0.0185***	0.0239***	2,527	3,103*	-0.140**	-0.159***
	[0.009]	[0.0759]	[0.0727]	[0.00700]	[0.00773]	[1,919]	[1,862]	[0.0545]	[0.0540]
Local unemployment rate 2005	-0.053***	-0.179	-0.133	0.00381	0.00657	552.4	597.9	-0.00327	-0.0221
	[0.006]	[0.112]	[0.103]	[0.0106]	[0.0126]	[2,779]	[2,810]	[0.0858]	[0.0846]
Post-graduation career controls									
Stay abroad after studies	-0.051***	-0.199		0.0210*		3,267		-0.0489	
	[0.016]	[0.161]		[0.0120]		[3,367]		[0.0954]	
Employer change	-0.001	-0.248**		-0.00978		3,481		0.103	
	[0.014]	[0.113]		[0.00931]		[2,573]		[0.0759]	
Experience after graduation	-0.029***	-0.575***		0.0375***		2,231		-0.198**	
	[0.008]	[0.0751]		[0.00970]		[2,279]		[0.0784]	
Permanent job				0.128***		-7,737*		-1.032***	
				[0.0185]		[4,411]		[0.148]	
Managerial function				0.0556***		5,337*		-0.403***	
				[0.00971]		[2,729]		[0.0777]	
Public sector				0.00208		-1,402		-0.109	
				[0.0120]		[2,988]		[0.0936]	
Parents with academic tertiary education	-0.066***								
	[0.016]								
Constant	1.158***			10.30***	10.24***	-8,525	-7,118		
	[0.357]			[0.334]	[0.359]	[92,974]	[89,513]		
Socio-demographic controls	yes	yes	yes	yes	yes	yes	yes	yes	yes
Study controls	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1,920	1,920	1,920	1,446	1,446	1,446	1,446	1,446	1,446
F-statistic: First Stage	16.74	16.74	17.14	14.42	14.43	14.42	14.43	13.24	13.33

Notes: * significant at 10%, ** at 5%, *** at 1%; probit coefficients represent marginal effects; robust standard errors; instrument used: parents with academic tertiary education.

Source: Swiss Graduate Study 2000; own calculations.

Second, we investigate educational type effects on the longer-term income. Our IV estimations show that the income level effects of vocational and academic graduates are no longer significantly different, neither in the estimation with post-graduation career controls (column 2A), nor in the estimation without them (column 2B). Analyzing the income bandwidth, we find that the expected income variance is statistically the same for vocational and academic tertiary education in the long run (columns 3A and 3B). Moreover, the probability of being paid below the respective average income is not statistically different for the two tertiary education types (columns 4A and 4B). Thus no different educational type effects on financial outcomes exist five years after graduation.

Summing up our longer-term results, although we still find educational type effects on unemployment risk, the financial effects have disappeared. Vocational graduates have a lower probability of being unemployed in the longer-term than academic graduates. We

no longer find income differences, that is in the longer-term vocational graduates face the same income expectations and income risks as academic graduates. Therefore, we can partially confirm our second hypothesis H2, where we expect the same labor market outcomes of tertiary education types in the longer term.

Moreover, the IV analysis shows a strong influence of parental educational background, emphasizing the socio-economic component of educational choices. Individuals of less-well educated social classes choosing the vocational path have attractive career opportunities upon graduating from vocational tertiary education. We further conclude that for avoiding endogeneity problems accounting for intergenerational mobility and examining endogenous educational choice is important. Neglecting them in an educational type-effects analysis and simply estimating OLS and probit models would lead to substantially different results and conclusions (see tables A4.2 and A4.3 in the appendix for OLS and probit calculations).

4.6. Conclusions

In this chapter, we analyze career entry and later labor market success after tertiary education and distinguish two types of education (i.e. vocational and academic) with equal standards but different approaches. We investigate how the type of tertiary education across similar fields of study influences individual labor market outcomes at career entry after graduation and whether possible educational type effects still exist in the longer term.

Our empirical results show that the type of tertiary education influences labor market outcomes at career entry and in the later career in different ways. At career entry, we find the same unemployment risk but higher wages and a lower wage risk for vocational tertiary education graduates compared to academic graduates. Therefore, career entry of vocational graduates compares favorably to that of academic graduates. Employers appear to favor tertiary education with a practice-oriented approach, as those graduates have already acquired occupation-specific skills that are directly usable. The practically-related human capital acquired during vocational tertiary education appears to result in higher labor market outcomes at career entry, whereas academic tertiary education

graduates need first to complement their high general knowledge with occupation-specific qualifications.

Analyzing longer-term educational type effects, five years after graduation, we see a different picture. Our results no longer show income differences in the two educational types, that is they show the same income expectations and the same income risk. Therefore, the initial financial advantages of vocational graduates fade over time as academic graduates with experience accumulate more occupation-specific skills. Thus the practical component of the curricula completed by vocational graduates is advantageous mostly at career entry. After some time in the labor market, academic graduates, whose studies were more theoretical than practical, reach the same productivity level as their vocational education counterparts.

Moreover, our results show a lower unemployment risk in the longer term for vocational graduates than for academic graduates. One explanation may be the more favorable career entry for vocational graduates, starting in employments with beneficial job characteristics such as security (e.g. a permanent contract) and status (e.g. a managerial position) compared to academic graduates, who rather have to change employment status following initial training positions.

While vocational tertiary education graduates often have a lower socio-economic background than academic graduates do, they can recoup their initial status through a less risky career path by completing vocational tertiary education. Individuals with a lower educational background thus encounter advantageous career prospects after graduating from vocational tertiary education. An open question remains for future studies, whether educational type effects persist even much later in a graduate's career, for example ten years or more after graduation.

Hence, dual education – or the acquisition of both vocational and academic skills – at the tertiary education level eases career entry. In the next chapter, we analyze whether student employment during tertiary education can be seen as a special form of dual education and also generates such positive career consequences.

Appendix

Table A4.1: Descriptive statistics

	All		Vocational Graduates		Academic Graduates	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Vocational tertiary education	0.30	0.46	1.00	0.00	0.00	0.00
Labor market outcomes						
Unemployment duration after graduation (in months)	1.7	2.3	1.3	2.0	1.9	2.5
Employee with managerial function 2001	0.15	0.36	0.19	0.39	0.13	0.34
Employee with managerial function 2005	0.43	0.49	0.51	0.50	0.39	0.49
Permanent job 2001	0.72	0.45	0.87	0.34	0.65	0.48
Permanent job 2005	0.84	0.36	0.95	0.21	0.80	0.40
Annual wage 2001 (CHF)	73'369	16'883	74'900	11'059	72'703	18'828
Annual wage 2005 (CHF)	92'123	17'566	88'714	14'176	93'605	18'663
Socio-demographic controls						
Male	0.68	0.47	0.84	0.36	0.61	0.49
Age at graduation	26.7	3.4	25.7	3.0	27.2	3.5
Children in 2001	0.05	0.22	0.04	0.19	0.06	0.24
Children in 2005	0.19	0.39	0.16	0.37	0.20	0.40
Swiss nationality	0.92	0.26	0.95	0.22	0.91	0.28
Study controls						
Business/Economics	0.21	0.41	0.24	0.42	0.20	0.40
Social sciences	0.28	0.45	0.04	0.19	0.38	0.49
Natural sciences	0.18	0.39	0.08	0.27	0.23	0.42
Technical sciences	0.33	0.47	0.65	0.48	0.19	0.39
Duration of study (in terms)	10.3	4.1	6.3	0.9	12.0	3.7
Final grade	0.55	0.20	0.48	0.18	0.58	0.20
Practical training during studies	0.37	0.48	0.25	0.44	0.41	0.49
Student employment (in years)	2.1	2.4	0.7	1.0	2.7	2.6
Stay abroad during studies	0.29	0.45	0.15	0.36	0.35	0.48
Previous schooling						
Secondary vocational education	0.25	0.43	0.76	0.42	0.02	0.14
Secondary academical education	0.71	0.45	0.17	0.38	0.95	0.22
Secondary mixed education	0.02	0.14	0.04	0.20	0.01	0.09
Tertiary education	0.04	0.19	0.01	0.11	0.05	0.21
Career controls						
Stay abroad after studies	0.29	0.45	0.30	0.46	0.28	0.45
Civil service 2001	0.30	0.46	0.13	0.34	0.38	0.48
Civil service 2005	0.35	0.48	0.19	0.40	0.42	0.49
Experience after graduation	4.37	0.73	4.28	0.76	4.41	0.72
Employer change after graduation	0.59	0.49	0.56	0.50	0.61	0.49
Motivation						
Importance of a new challenge	4.18	0.76	4.16	0.69	4.18	0.79
Labor market controls						
Local unemployment rate 2001	1.80	0.77	1.55	0.58	1.90	0.82
Local unemployment rate 2005	3.95	1.23	3.53	0.95	4.14	1.29
Parental education						
Parents with academic tertiary education	0.24	0.43	0.12	0.32	0.30	0.46
Parents with vocational tertiary education	0.02	0.13	0.01	0.12	0.02	0.13
Parents with other higher education	0.28	0.45	0.33	0.47	0.26	0.44
Parents with vocational secondary education	0.35	0.48	0.43	0.50	0.32	0.47
Parents with academic secondary education	0.02	0.16	0.02	0.15	0.03	0.16
Parents with lower education	0.08	0.27	0.08	0.28	0.08	0.26

Source: Swiss Graduate Study 2000; own calculations.

Table A4.2: Educational type effects at career entry: Basic equation (without considering endogenous educational choice)

	1. Unemployment Risk		2. Income					
	Unemployment Incidence (1A) Probit	Unemployment Incidence (1B) Probit	Income (in logs) (2A) OLS	Income (in logs) (2B) OLS	Income Variance (3A) OLS	Income Variance (3B) OLS	Probability of low pay (4A) Probit	Probability of low pay (4B) Probit
Vocational tertiary education	0.0522	0.0478	-0.0385*	-0.00994	-21,433***	-21,599***	0.151***	0.147**
	[0.0370]	[0.0385]	[0.0218]	[0.0233]	[3,777]	[4,627]	[0.0531]	[0.0577]
Field of study *(Ref. Cat.: Social Sciences)*								
Business/Economics	-0.100***	-0.102***	0.119***	0.191***	3,376	-128.5	-0.189***	-0.340***
	[0.0366]	[0.0376]	[0.0203]	[0.0211]	[4,842]	[3,720]	[0.0381]	[0.0401]
Technical sciences	-0.157***	-0.161***	0.0202	0.0737***	-507.3	-2,404	0.0202	-0.0591
	[0.0438]	[0.0444]	[0.0218]	[0.0233]	[4,181]	[3,709]	[0.0365]	[0.0416]
Natural sciences	-0.0711**	-0.0755**	-0.0286	-0.0188	9,485**	10,493***	0.0661*	0.0530
	[0.0323]	[0.0336]	[0.0232]	[0.0253]	[4,438]	[4,070]	[0.0389]	[0.0429]
Previous schooling *(Ref. Cat.: Secondary academic education)*								
Secondary vocational education	-0.0699*	-0.0718	0.0577***	0.0708***	4,960	3,662	-0.129***	-0.184***
	[0.0424]	[0.0440]	[0.0198]	[0.0212]	[3,213]	[4,562]	[0.0473]	[0.0549]
Secondary mixed education	-0.153	-0.165	0.110***	0.132***	7,311	6,927	-0.185**	-0.260***
	[0.103]	[0.108]	[0.0309]	[0.0340]	[8,949]	[9,513]	[0.0843]	[0.0984]
Tertiary education	-0.125*	-0.136*	0.110***	0.113***	549.1	380.5	-0.165***	-0.175**
	[0.0681]	[0.0709]	[0.0262]	[0.0311]	[7,197]	[5,789]	[0.0598]	[0.0706]
Study controls								
Practical training during studies	-0.0418*	-0.0441*	-0.0159	-0.00379	5,788**	5,002**	0.00486	-0.0114
	[0.0225]	[0.0233]	[0.0129]	[0.0143]	[2,305]	[2,421]	[0.0215]	[0.0265]
Student employment	-0.0140**	-0.0145**	0.0155***	0.0207***	202.8	184.7	-0.0216***	-0.0330***
	[0.00575]	[0.00592]	[0.00322]	[0.00345]	[579.6]	[639.7]	[0.00598]	[0.00671]
Stay abroad during studies	0.0210	0.0251	0.0248*	0.0328**	-1,503	-1,432	-0.0226	-0.0381
	[0.0179]	[0.0188]	[0.0137]	[0.0150]	[2,714]	[2,541]	[0.0223]	[0.0278]
Motivation	-0.000614	0.00210	-0.00331	-0.000518	1,689	2,386*	-0.0148	-0.0236
	[0.0106]	[0.0110]	[0.00773]	[0.00819]	[1,381]	[1,352]	[0.0133]	[0.0164]
Local unemployment rate 2001	0.0457***	0.0485***	-0.0217**	-0.0266***	1,214	2,081	0.0414**	0.0536***
	[0.0123]	[0.0126]	[0.00926]	[0.00991]	[1,839]	[2,069]	[0.0175]	[0.0195]
Post-graduation career controls								
Stay abroad after studies	0.0402**		0.00957		3,874*		-0.0308	
	[0.0187]		[0.0130]		[2,150]		[0.0218]	
Unemployment duration after graduation			-0.00411		-936.2**		0.00613	
			[0.00252]		[398.1]		[0.00436]	
Permanent job			0.210***		-20,158***		-0.226***	
			[0.0185]		[3,038]		[0.0339]	
Managerial function			0.0593***		9,250**		-0.0543*	
			[0.0143]		[3,697]		[0.0300]	
Public sector			-0.0140		-4,341		0.0463	
			[0.0171]		[2,959]		[0.0298]	
Constant			10.82***	10.62***	107,638*	108,817*		
			[0.259]	[0.274]	[60,012]	[57,985]		
Socio-demographic controls	yes	yes	yes	yes	yes	yes	yes	yes
Study controls	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1,920	1,920	1,446	1,446	1,446	1,446	1,446	1,446
R-squared	0.098	0.094	0.327	0.192	0.125	0.088	0.187	0.120

Notes: * significant at 10%, ** at 5%, *** at 1%; probit coefficients represent marginal effects; robust standard errors col. 1, 2, 4; bootstrapped standard errors col. 3.

Swiss Graduate Study 2000; own calculations.

Table A4.3: Educational type effects in the longer term: Basic equation (without considering endogenous educational choice)

	1. Unemployment Risk		2. Income					
	Unemployment Incidence	Unemployment Incidence	Income (in logs)	Income (in logs)	Income Variance	Income Variance	Probability of low pay	Probability of low pay
	(1A) Probit	(1B) Probit	(2A) OLS	(2B) OLS	(3A) OLS	(3B) OLS	(4A) Probit	(4B) Probit
Vocational tertiary education	0.0445	0.0663**	-0.0977***	-0.0998***	-16,777***	-17,918***	0.0339	0.0856*
	[0.0306]	[0.0321]	[0.0190]	[0.0202]	[4,135]	[4,800]	[0.0214]	[0.0478]
Field of study *(Ref. Cat.: Social Sciences)*								
Business/Economics	-0.0253	-0.0513	0.129***	0.165***	23,469***	24,477***	-0.100***	-0.322***
	[0.0302]	[0.0325]	[0.0160]	[0.0158]	[5,154]	[3,929]	[0.0338]	[0.0405]
Technical sciences	0.0244	-0.00596	0.00948	0.0473***	3,623	5,260	-0.00490	-0.0755**
	[0.0256]	[0.0257]	[0.0165]	[0.0164]	[4,192]	[4,661]	[0.0139]	[0.0342]
Natural sciences	0.0450**	0.0423*	0.0118	0.0106	8,122**	9,255**	-0.0242*	-0.0603*
	[0.0221]	[0.0221]	[0.0161]	[0.0170]	[3,402]	[4,331]	[0.0140]	[0.0335]
Previous schooling *(Ref. Cat.: Secondary academic education)*								
Secondary vocational education	-0.0811**	-0.0801**	0.0459***	0.0516***	1,792	1,708	-0.0279	-0.0782*
	[0.0354]	[0.0358]	[0.0169]	[0.0182]	[2,969]	[2,495]	[0.0187]	[0.0447]
Secondary mixed education	-0.00204	-0.00218	0.00685	0.0296	475.6	546.3	-0.0106	-0.0651
	[0.0454]	[0.0468]	[0.0339]	[0.0375]	[866.9]	[718.3]	[0.0288]	[0.0807]
Tertiary education	-0.0110	-0.0134	0.0431*	0.0459*	175.6	370.1	-0.0250	-0.0643
	[0.0412]	[0.0414]	[0.0231]	[0.0258]	[2,438]	[3,061]	[0.0205]	[0.0557]
Study controls								
Practical training during studies	-0.000	0.00152	-0.00491	-0.00353	6,014	5,912	0.0111	0.0217
	[0.0163]	[0.0158]	[0.00955]	[0.0103]	[4,078]	[5,087]	[0.00965]	[0.0230]
Student employment	-0.00506	-0.00898*	0.0101***	0.0131***	839.8	1,061	-0.00867**	-0.0274***
	[0.00425]	[0.00488]	[0.00255]	[0.00270]	[1,730]	[1,552]	[0.00358]	[0.00604]
Stay abroad during studies	0.0238	0.0145	0.00257	0.00780	-133.8	933.7	-0.00313	-0.0115
	[0.0163]	[0.0161]	[0.0101]	[0.0109]	[4,987]	[6,009]	[0.00885]	[0.0234]
Motivation	-0.0133	-0.0112	0.0150**	0.0177***	2,306	2,892	-0.0136*	-0.0389***
	[0.00930]	[0.00962]	[0.00625]	[0.00632]	[2,064]	[1,767]	[0.00709]	[0.0146]
Local unemployment rate 2005	-0.00533	0.00260	-0.00452	-0.00783*	370.5	470.0	0.00321	0.0125
	[0.00687]	[0.00611]	[0.00407]	[0.00436]	[975.7]	[1,059]	[0.00405]	[0.00985]
Post-graduation career controls								
Stay abroad after studies	-0.00631		0.0141		3,380		-0.00148	
	[0.0177]		[0.00988]		[2,510]		[0.00872]	
Employer change	-0.0392*		-0.0119		3,330		0.0115	
	[0.0208]		[0.00872]		[2,559]		[0.00932]	
Experience after graduation	-0.0723***		0.0298***		2,004		-0.0169**	
	[0.0201]		[0.00607]		[1,513]		[0.00811]	
Permanent job			0.135***		-8,007**		-0.114***	
			[0.0159]		[3,818]		[0.0330]	
Managerial function			0.0524***		5,088*		-0.0412**	
			[0.00917]		[2,716]		[0.0167]	
Public sector			0.00131		-1,661		-0.0115	
			[0.0113]		[3,015]		[0.00920]	
Constant			10.50***	10.56***	-2,971	-2,731		
			[0.225]	[0.232]	[67,550]	[73,455]		
Socio-demographic controls	yes	yes	yes	yes	yes	yes	yes	yes
Study controls	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1,920	1,920	1,446	1,446	1,446	1,446	1,446	1,446
R-squared	0.183	0.051	0.285	0.176	0.064	0.057	0.179	0.106

Notes: * significant at 10%, ** at 5%, *** at 1%; probit coefficients represent marginal effects; robust standard errors col. 1, 2, 4; bootstrapped standard errors col. 3.

Swiss Graduate Study 2000; own calculations.

CHAPTER 5

Earning While Learning: When and How Student Employment is Beneficial

5.1. Introduction

Student employment ('earning while learning') is the norm for a substantial proportion of university students (OECD, 2009). The effects of student employment on later labor market outcomes have already been investigated. Many studies consider the effects of employment during high school (see, e.g. Ruhm, 1997, for an overview), finding mostly positive outcomes. However, less research exists into the effects of employment during tertiary education, i.e. at a university (e.g. Schrøter Joensen, 2009; Häkkinen, 2006; Light, 2001), even though work experience acquired during university studies is probably a more important determinant of labor market success than early work experience. Therefore, not only the highest level of education (e.g., Card, 1999; Cohn and Addison, 1998; Psacharopoulos, 1994) but also the student employment status crucially determines an individual's later labor market success.

Yet even though labor market prospects after graduation vary enormously across fields of study (Buonanno and Pozzoli, 2009; Ballarino and Bratti, 2009), student employment literature neglects information about these fields. Moreover, previous studies do not use information about the relation of student employment to the field of study. Thus the question of whether systematic differences exist in the labor market outcomes of different types of stu-

dent employment status during tertiary education – including information about its relation to the field of study – has not yet undergone thorough analysis.

This paper investigates how different student employment status during tertiary education systematically affects labor market returns to education. We focus first on differences between non-working students (*full-time students*) and students who work part-time while studying (*part-time working students*) during tertiary education. Second, and more importantly, we differentiate between part-time work related to the studies (*field-related student employment*) and part-time work not related to the studies (*field-unrelated student employment*). For example, an economics student working part-time in a bank shows field-related student employment, whereas an economics student working part-time as a waiter in a fast-food restaurant shows field-unrelated student employment.

Our empirical results show that student employment related to the field of study has significantly positive effects on both short-term and long-term labor market outcomes compared to full-time studies and compared to unrelated student employment. These returns consist of a lower unemployment risk, lower job search duration, higher wage effects and greater job responsibility. Thus the positive labor market effects of field-related student employment continue over the long-term.

Our study contributes to the literature in three ways. First, we show that differentiating those students working part-time in terms of whether their employment is related or unrelated to their field of study is crucial. Only a few studies have examined the effect of the type of student employment on academic performance[36] but ignored its effect on later labor market returns. By examining the various labor market effects of different types of student employment (field-related versus field-unrelated), our study helps answer the question of whether different types of student employment constrains later labor market entrance and career development or ultimately rewards part-time working students.

Second, we consider different labor market outcomes. We go beyond immediate post-graduation labor market effects to investigate the longer-term career development of gradu-

[36] McNeal (1997) shows that the job type has a significant effect on dropping out. Wenz and Yu (2009) find higher grades for students working for career-specific skills. Ehrenberg and Sherman (1987) differentiate on-campus and off-campus student employment, finding that only the latter (partially) adversely affects academic achievement.

ates, because whether student employment generates only transitory advantages (i.e. improving only initial outcomes) or has longer-lasting career effects is not clear. In contrast to previous studies (e.g. Light, 2001; Hotz et al., 2002), we focus not only on wage effects but also on further returns of student employment status, such as the job search duration after graduation, unemployment risk and job responsibility. Third, to solve the endogeneity problem of the work-study decision, we are able to use a large number of control variables that directly control for the three most important (and, for researchers, usually unobservable) endogenous sources for the work-study decision: ability, motivation and liquidity constraints.

The remainder of this chapter is structured as follows. Section 5.2 derives testable hypotheses for the labor market effects of different student employment status. Section 5.3 explains our estimation methods, and Section 5.4 introduces the data set. Section 5.5 presents our empirical results, and Section 5.6 concludes.

5.2. Previous evidence and hypotheses

In the literature on the effects of student employment on later labor market outcomes, many studies on student employment consider the effects of working during high school. In an overview of this literature, Ruhm (1997) concludes that employment in high school is associated with increased future earnings.

Fewer studies consider the effects of working during tertiary education, i.e. at a university. Yet not only is work experience acquired during university studies probably a more important determinant of later labor market success than early work experience, but it is also more common. Light (2001) identifies separate wage effects of schooling and of in-school work experience. Applying proxy and IV estimations, she finds that male graduates who were employed during studies have higher earnings at career entry than their counterparts who were not. Hotz et al. (2002) investigate the wage effects of working while in high school or college for men and argue that positive effects diminish when they control for unobserved heterogeneity and sample selectivity.

Häkkinen (2006) examines how the employment decisions of university students affect their labor market success after graduation. IV estimations show that while student employment has no effects on later employment probabilities, it increases annual earnings after graduation,

although the effect is only transitory. Schrøter Joensen (2009) finds in a dynamic stochastic model that moderate student employment increases future wages. In sum, student employment during tertiary education has no negative wage effects; rather, it increases or does not influence later wages.

Standard human capital theory (Becker, 1964) could explain this empirical evidence as follows: all types of experience, skills or knowledge increase productivity, so that additional labor market experience while studying (as compared to full-time studies) leads to additional returns on the labor market. As a result, student employment has a positive effect on returns to education, because student employment complements the education received, augmenting skills and knowledge and increasing future productivity. Learning is thus a dynamic process, as "skill begets skill" (Heckman, 2000) and student employment increases human capital.

In addition to human capital theory, social network theory (Granovetter, 1973) or social capital theory (Coleman, 1988) can help to explain the positive labor market effects of student employment at career entry. Investment in social networks and personal relationships is valuable for labor market outcomes. Therefore, because the previously built social relationships can help finding better employment, student employment facilitates career entry as it increases social capital. Moreover, according to signaling theory (Spence, 1973) students can signal their ability to potential employers with their student employment status as an observable characteristic. In turn, as hiring is an investment decision under uncertainty, employers can use this signal to sort and screen workers according to their unobserved abilities (Stiglitz, 1975). Student employment thus signals high ability, as only students with high ability can manage to both work and study successfully. In the signaling theory, however, student employment does not augment human capital as opposed to Becker (1964). Considering all described theoretical approaches, we derive our first empirical testable hypothesis:

H1 *Student employment ('earning while learning') has positive labor market effects.*

Furthermore, as labor market prospects after graduation vary enormously across fields of study (Häkkinen, 2006; Buonanno and Pozzoli, 2009; Ballarino and Bratti, 2009), the field of study constitutes an important factor in measuring labor market success after graduation.

However, what has not yet been taken into account – either theoretically or empirically – is the relationship between the field of study and student employment. We argue that this relationship is critical to later labor market outcomes and derive implications from a learning perspective following Carr et al. (1996), who suggest including more information on the type of student employment. Rosen (1972) and Mincer (1962) state that learning and working are complementary; working offers alternative opportunities to learn and accumulate valuable skills. We argue that, in case of student employment, this complementary effect only occurs if the employment is related to the field of study, thus further human capital accumulates.

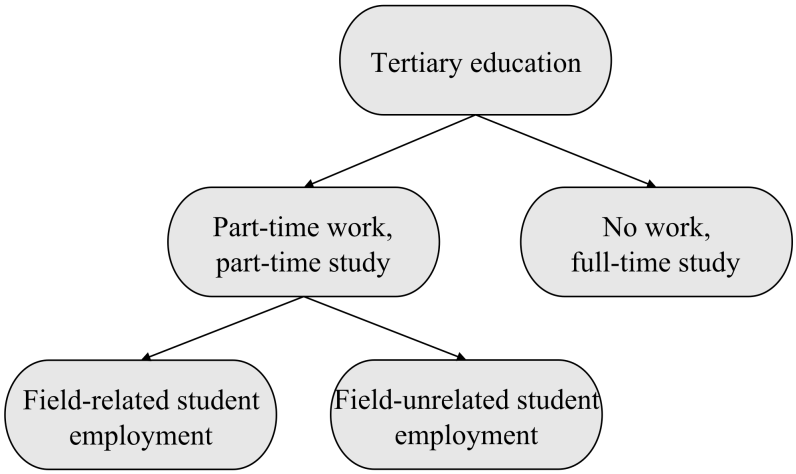
Nonetheless, students have to trade study time for working time within a given time budget. Therefore, student employment could effectively prevent students from acquiring human capital during their educational years and thus lead to less augmentation of skills and knowledge. In other words, student employment could interfere with learning and academic performance if it crowds out study time and thus detracts from potentially more productive educational investments.

We argue that the returns to 'earning while learning' depend on whether student employment is related to the field of study: for field-related student employment, we expect the negative effects stemming from time-use trade-offs to be rather small and the positive effects stemming from complementarities to be rather large. Thus related student employment strengthens the complementary effects and helps to offset potential negative effects from trade-offs in time use acquiring more skills and knowledge. However, for unrelated student employment, we expect the negative effects from time-use trade-offs to be larger and the positive effects from complementarities to be smaller. Hence, we anticipate differences in returns to different types of student employment depending on the relation between student employment and field of study. As a result, we expect that, for example, working at a fast-food restaurant while studying economics has different returns to education than working at a bank. Therefore, we derive our second empirical testable hypothesis:

H2 *Field-related student employment has larger positive labor market effects than field-unrelated student employment.*

Put together, these theoretical considerations show that various types of student employment status matter for later labor market outcomes. As a result, as Figure 5.1 shows, we can distinguish amongst several types of student employment status: student employment status per se (non-working or part-time working) and, for those who work, the type of the student employment (related or unrelated to the field of study).

Figure 5.1: Types of student employment status



Moreover, from a human capital perspective, student employment benefits represent permanent gains; student employment has long-term positive effects through increased investments in human capital. Empirically, however, many studies focus on the period immediately after graduation, without considering career development. Furthermore, most of the studies on 'earning while learning' during tertiary education neglect later labor market outcomes other than income. In contrast, our analysis focuses on different types of student employment, investigating both short-term and long-term effects on several labor market outcomes, such as unemployment risk, job-search duration, wage, and job responsibility.

5.3. Estimation methods

The effects of student employment on later labor market outcomes are traditionally estimated with the following model (Ruhm 1997):

$$y_i = \alpha + \beta StE_i + \delta X_i + \varepsilon_i, \quad [5.1]$$

where *y* stands for graduate *i*'s labor market outcomes, *StE* for student employment, *X* is a vector of control variables and ε represents an unobservable error. However, as this model ignores the potential bias introduced by an individual's decision to both work and study simultaneously, it may suffer from selection problems.

To test the causal effects of different student employment status on various labor market outcomes, we have to account for potential biases, because who works while studying and who does not is not random. Not only students' observable characteristics influence their decision to work and study but also intrinsic (and, for the researcher, mostly unobservable) characteristics such as ability, motivation and liquidity constraints. These intrinsic characteristics may bias the results, as they all affect both the work-study decision and later labor market success. For example, more able students choose to work while studying (because they better cope with the dual burden) and earn higher wages later on. However, the positive wage effect largely comes form ability standing behind the decision to work. Therefore, we have to adequately control for this decision by directly including such characteristics. Otherwise, the estimated effects might merely reflect pre-existing differences that influence both the likelihood of working during tertiary education and later success in the labor market (Stern et al., 1990a).

In our methodological approach, we correct for these biases by including for a large set of variables that directly control for intrinsic and otherwise mostly unobservable characteristics. The basic equation we estimate is our first specification

$$y_i = \alpha + \beta StE_i + \gamma P_i + \delta X_i + \varepsilon_i, \quad [5.2]$$

where *y* stands for graduate *i*'s various labor market outcomes such as earnings, unemployment, duration of job search, and a measure for great responsibility on the job. *StE* is a continuous variable representing student employment in years; therefore, β is the influence of an additional year of student employment on the outcome variable. The reference group in our analysis is thus composed of non-working full-time students. Moreover, we include *P*, three proxies for individual "unobservable" characteristics such as ability, motivation and liquidity

constraints. Additionally, we include *X*, a vector of further control variables. ε represents an unobservable error.

We then extend our basic equation and differentiate between related and unrelated student employment in our second specification:

$$y_i = \alpha + \beta_1 StEw_i + \beta_2 StEwo_i + \gamma P_i + \delta X_i + \varepsilon_i. \quad [5.3]$$

StEw is a continuous variable representing student employment *with* a relation to the field of study in years; therefore, β_1 is the influence of an additional year of field-related student employment on the outcome variable. Similarly, *StEwo* is a continuous variable representing student employment *without* a relation to the field of study in years. Therefore, β_2 is the effect of an additional year of field-unrelated student employment on the outcome variable.

Although we try to control for student's self-selection into working while studying by adding proxies and controls, this may not be enough. Genuinely unobservable controls may remain a problem that a non-experimental empirical design cannot address, at least not unless convincing instruments are available.

We estimate probit regressions for unemployment risk and responsibility. The earnings equation is basically an extended Mincer (1974) earnings equation specified as an OLS regression. As the duration of an individual's job search constitutes a corner-solution problem, we use a Tobit model.

5.4. Data

In our empirical analysis, we use data from a representative survey on Swiss graduates of tertiary education (ISCED 5A[37]) conducted by the Swiss Federal Statistical Office. The cohort we look at graduated in 2000 and was first surveyed one year after graduation (in 2001) and again five years after graduation (in 2005). This panel design allows us to analyze both short-

[37] Tertiary-type A programs (ISCED 5A) are largely theory-based and designed to provide qualifications for entry into professions with high skill requirements and advanced research programs, as compared to tertiary-type B programs (ISCED 5B), which are classified at the same competency level but are more occupationally oriented and usually of shorter duration (OECD, 2009).

term and longer term labor market success of different student employment status. The survey is well suited for our analysis because it contains detailed and unique information on each graduate's student employment status (e.g., the duration of student employment and its relation to the field of study), studies, transition to the labor market, and employment both one year and five years after graduation. The survey also includes individual socio-demographic variables.

We exclude all individuals who report being self-employed[38]. After eliminating observations with missing data, we have a sample of 1,930 individuals in our first analysis of unemployment risk. As the further analyses are conditional on working, we then exclude graduates who are unemployed at the time of the surveys – either one year or five years after graduation – leaving a slightly smaller sample. Table A5.1 in the Appendix gives descriptive statistics of the variables in our analysis for all employed graduates and differentiates between non-working full-time students and part-time working students.

As dependent variables we use several labor market outcomes. We first analyze the *unemployment incidence.* Because the graduates had to declare their employment status in the surveys, we generate two dummy variables for the respective years indicating unemployment (1 if unemployed in 2001 or 2005, respectively, and 0 otherwise). Second, we examine the *duration of job search.* The graduates had to indicate how many months their job search after graduation lasted. We thus generate a continuous variable indicating the months graduates spent looking for their first post-graduation employment. This variable can take the value of 0 (if employment is already found during the studies), thus presenting a corner-solution problem.

Third, we investigate the *yearly income.* The survey contains self-reported annual gross earnings in 2001, one year after graduation. In the second interview in 2005, five years after graduation, the graduates had to report their actual monthly gross earnings. To obtain comparable annual gross earnings, we multiply the monthly earnings by a factor of thirteen (BfS 2006), as a thirteenth month pay is common in Switzerland. We use the logarithm of yearly

[38] We exclude self-employed individuals because they are in a different situation than employed as regards wages and job security. However, the results remain stable with or without this category.

wages in the first and fifth years after graduation, respectively, as dependent variables[39]. Fourth, we explore a measure of *job responsibility*. Graduates had to report how much responsibility for their own tasks they had in their employment five years after graduation. We generate a dummy indicating great responsibility with the value equaling 1 if the graduate responded "great" or "very great responsibility" and 0 otherwise.

Our main explanatory variable is *student employment* (in years). Depending on the course of study, students are able to choose studying full-time without working or working part-time while studying[40]. The type of student employment can differ because student employment can be *related* or *unrelated* to the field of study. This information has typically been unavailable to previous researchers, despite its importance already having been pointed out (Stone and Mortimer, 1998; Stern et al., 1990b). In the survey the graduates were asked if and how many months they worked either in a student employment with or without a relation to their field of study[41]. We thus can compute years of student employment for three different variables: student employment per se, field-related employment and field-unrelated employment[42]. Table A5.2 in the Appendix provides further descriptive information only for part-time working students, differentiated between student employment related and unrelated to the field of study. For example we find (purely descriptively) that field-related student employment, compared to field-unrelated student employment, leads to higher short-term and longer-term wages and a lower job search duration after graduation. We further run a preliminary analysis (table A5.3 in the appendix) on our explanatory variables, a multinomial logit model relating the student employment status to our control variables. The results show that it is not com-

[39] We use the information at the level of employment to calculate the corresponding full-time salaries of part-time workers. Moreover, we drop observations with earnings above the 99th percentile or below the 1st percentile for each year so that the results are not determined by outliers.

[40] The studies offered at universities of applied science (vocational tertiary education) are mostly either full-time three-year courses or four-year courses if the student only studies part-time (Bonassi and Wolter, 2002). University studies (academic tertiary education) are regarded as full-time studies; in other words, technically, no part-time university studies exist. Nonetheless, combining work and study is possible, as no strict limits on the duration of studies are imposed. In our paper, we therefore define university students who are employed while studying as part-time working students. Moreover, tertiary vocational education is usually associated with a lower full-time equivalent of study than tertiary academic education.

[41] The wording of the survey questions (translated from German) was „Have you been engaged in full- or part-time employment while studying that was related (unrelated) to your field of studies?" and "How long have you been engaged in such an employment while studying (in months)?"

[42] Unfortunately, we do not know how many hours per week a student worked. However, while we have no individual information about the extent of student employment, we are able to include the field of study and the number of semesters as the most important determinants of time availability.

pletely random who works in a field-related employment and who in a field-unrelated employment.

To avoid biased returns to the student employment status (following Light, 2001; Blackburn and Neumark, 1993; Stern et al., 1990a), we use proxy variables for various *individual characteristics* that are otherwise mostly unobserved. First, we choose the grade at the secondary education level as a proxy for unobserved *ability*, which possibly affects both the work-study decision and later labor market success[43]. If the more able students choose to both work and study, because they are better able to cope with the dual burden, simple estimates of student employment are biased upwards, as the positive effect largely comes from the ability standing behind the decision to work. Therefore, we use the grade at the secondary education level, which is unaffected by the study on tertiary education level, as an ability proxy. We standardize the grades[44] so that they range from 0 to 1, where 0 corresponds to the minimum passing grade and 1 corresponds to the maximum achievable grade on the respective scales.

Second, we include a proxy variable for underlying *motivation* and thus choose a variable indicating the importance of a new challenge as a desire for personal achievement and ambitions. Motivation may affect a student's decision to work during study as well as his or her later labor market success (Wenz and Yu, 2009). As the more motivated students choose to both work and study to gain additional work experience, simple estimates of student employment may again be biased upwards. The variable indicating the importance of a new challenge is measured on a five-point scale. It takes the value of 1 if a new challenge is not at all important and a value of 5 if it is very important. A higher value of this variable indicates the greater importance of a new challenge or the greater motivation of the individual.

Third, as a proxy variable for individual *liquidity constraints*, we choose parental education (a dummy that equals 1 if one or both of the parents graduated from tertiary education, 0 otherwise). The education of the parents determines their income and thus the educational budget

[43] Similarly, other studies use test scores as proxies to control for unobserved characteristics (e.g. Hotz et al., 2002; Ruhm, 1997: Armed Forces Qualifying Test (AFQT) scores; Light, (2001); Blackburn and Neumark 1993: Armed Services Vocational Aptitude Battery (ASVAB) test scores). Moreover, controlling for prior educational attainment is important (Callender, 2008).

[44] As we know the individual grade achieved (g_i), the maximum achievable grade (g_{max}) and the minimum passing grade (g_{pass}), we use the following formula (Schweri, 2004: 12) to standardize the grades:
$grade = (g_i - g_{pass}) / (g_{max} - g_{pass})$. [5.4]
This transformation allows us to compare grades of different grade scales.

for their children. Financial needs of students with lower educated parents can drive them into part-time employment[45].

In addition, we use a full set of *control variables.* We include *socio-demographic factors* such as being male (dummy), age and age squared (in years), having children (dummy), Swiss nationality (dummy) and a dummy indicating if the graduate lived with the parents while studying[46]. Furthermore, we include the respective local unemployment rate as *labor market controls*.

Moreover, we control for various characteristics of the *graduate's study*. We control for the field of study to ensure that the returns to student employment are not driven by field-specific labor market characteristics, as opposed to real returns (Häkkinen, 2006; Buonanno and Pozzoli, 2009; Livanos and Pouliakas, 2009). We differentiate between five study fields: business and economics, social sciences, natural sciences, technical sciences, and other subjects (five dummies). Furthermore, we control for the type of university attended (dummy), for having spent time abroad during studies (dummy) and for the earlier educational path (dummies for secondary vocational education, secondary academic education, mixed secondary education, and a possible already existing tertiary education).

We deliberately do not include career-related variables that occurred after graduation. With this approach we intend to measure the whole effect of the student employment decision because all post-graduation variables are part of the education effect and thus would bias the main effect (Pereira and Martins 2001). Furthermore, we do not include the final grades of the studies because they may be endogenous if they are affected through the work-study-decision and bias the student employment effect. We moreover do not control for the duration of the studies and just measure labor market outcomes of graduates one or five years after graduation, irrespective of the time they needed to graduate as the duration may also be affected through the work-study-decision.

[45] In Switzerland, scholarships are difficult to obtain (BFS, 2007): only 4% of all students working part-time are awarded a scholarship. While we have no information about individual grants, we are able to include more crucial determinants of a student's budget into our analysis, e.g. the social background (parents with higher education), the type of university (academic universities or universities of applied sciences), the age of a student, and the housing situation.

[46] Students who live on their own and have to pay for a rent and living have greater financial needs than students who live with their parents (BFS, 2007). The household status can thus indicate the necessity of having to work for a living (Metcalf, 2003).

5.5. Empirical results

We now discuss the key results of the labor market effects of different student employment status during tertiary education, and use various labor market outcomes to test our hypotheses. The first specifications in each case contain student employment per se according to equation [5.2], whereas in the second specifications we differentiate between field-related and field-unrelated student employment according to equation [5.3], thus including information about the type of student employment.

5.5.1. Short-term labor market effects

We begin by studying the *short-term labor market effects* (one year after graduation). Estimation results with robust standard errors appear in Table 5.1.

In model A, we analyze the short-term unemployment risk and estimate a probit model with the dependent variable of being unemployed one year after graduation. In our first specification, we find that student employment per se reduces the probability of being unemployed one year after graduation, compared to having been a non-working student. This finding supports our first hypothesis, in which we expect positive labor market effects of student employment. In our second specification, we differentiate information about the type of student employment into field-related and field-unrelated employment. We again find that field-related student employment reduces unemployment risk compared to having been a non-working student. Furthermore, field-unrelated student employment also reduces the unemployment risk. Consequently, students working part-time in jobs related to their studies have a significantly lower short-term risk of being unemployed than both non-working students and students working part-time in jobs unrelated to their studies.

In the following models, we reduce the sample and focus exclusively on employed graduates. In model B, we analyze the effects of different student employment status on the job search duration after graduation. According to specification 1, student employment significantly reduces job search duration compared to full-time studies. Moreover, after including information about the type of student employment, we still find that field-related student employment significantly reduces job search duration but we do not find a significantly different effect for field-unrelated student employment compared to full-time studies. Therefore, in line with our

second hypothesis, related student employment significantly decreases the duration of the job search after graduation.

Table 5.1: Short-term labor market effects of student employment

	(A) Unemployed 2001 (dummy) *Probit*		(B) Job search duration (in months) *Tobit*		(C) Wage 2001 (ln) *OLS*	
	(1)	(2)	(1)	(2)	(1)	(2)
(1) Student employment (Y)	-0.0143***		-0.130***		0.0152***	
	[0.00414]		[0.0389]		[0.00367]	
(2) Field-related student employment (Y)		-0.0236***		-0.290***		0.0248***
		[0.00692]		[0.0546]		[0.00481]
(2) Field-unrelated student employment (Y)		-0.00875*		-0.0136		0.00790
		[0.00463]		[0.0475]		[0.00483]
Proxy: Ability (grade on secondary education level)	-0.0515	-0.0491	-0.170	-0.128	0.0905**	0.0880**
	[0.0359]	[0.0358]	[0.405]	[0.404]	[0.0407]	[0.0405]
Proxy: Motivation (importance of a new challenge)	-0.00922	-0.00940	-0.151	-0.135	0.00680	0.00579
	[0.00958]	[0.00954]	[0.105]	[0.105]	[0.0104]	[0.0104]
Proxy: Liquidity constraint (parents with higher education)	0.0387**	0.0378**	0.0192	-0.000388	-0.0265*	-0.0254
	[0.0152]	[0.0151]	[0.162]	[0.161]	[0.0155]	[0.0155]
University of applied sciences (tertiary vocational education)	0.00819	0.0142	-0.826***	-0.694**	0.0773***	0.0682***
	[0.0269]	[0.0269]	[0.306]	[0.307]	[0.0236]	[0.0240]
Technical sciences	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Business/Economics	0.0360	0.0411	-0.552**	-0.449*	0.120***	0.114***
	[0.0266]	[0.0269]	[0.264]	[0.264]	[0.0164]	[0.0165]
Social sciences	0.0848***	0.0858***	0.130	0.135	-0.117***	-0.117***
	[0.0262]	[0.0262]	[0.277]	[0.276]	[0.0241]	[0.0240]
Natural sciences	0.0753***	0.0755***	-0.283	-0.283	-0.0805***	-0.0807***
	[0.0267]	[0.0268]	[0.318]	[0.317]	[0.0287]	[0.0286]
Other subjects	0.0247	0.0266	0.0957	0.143	-0.207***	-0.209***
	[0.0265]	[0.0267]	[0.277]	[0.276]	[0.0307]	[0.0307]
Stay abroad during study	0.0224	0.0236	0.318*	0.331*	0.0758***	0.0752***
	[0.0161]	[0.0161]	[0.184]	[0.183]	[0.0179]	[0.0178]
Secondary academic education	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Secondary vocational education	-0.0534*	-0.0534*	0.0130	0.0471	-0.00501	-0.00671
	[0.0313]	[0.0312]	[0.322]	[0.321]	[0.0254]	[0.0254]
Secondary mixed education	-0.0677	-0.0677	-0.954*	-0.935*	0.0269	0.0251
	[0.0605]	[0.0601]	[0.532]	[0.531]	[0.0364]	[0.0369]
Tertiary education	-0.00177	0.00112	-0.512	-0.376	0.0824**	0.0746**
	[0.0485]	[0.0484]	[0.462]	[0.461]	[0.0322]	[0.0331]
Local unemployment rate in 2001	0.0228**	0.0226**	0.303***	0.312***	-0.0237*	-0.0242**
	[0.00922]	[0.00918]	[0.113]	[0.113]	[0.0123]	[0.0122]
Constant					9.585***	9.645***
					[0.281]	[0.283]
Socio-demographic controls	yes	yes	yes	yes	yes	yes
Observations	1930	1930	1574	1574	1574	1574
Pseudo R^2 / R^2	0.08	0.08	0.01	0.01	0.22	0.22
Prob > Chi^2 / F	0.00	0.00	0.00	0.00	0.00	0.00

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%; robust standard errors; probit and tobit coefficients represent marginal effects.

Source: Swiss Graduate Study 2000; own calculations.

In model C, we analyze short-term effects on income and find a positive impact of student employment per se. Therefore, in line with our hypothesis H1, students working part-time can expect higher wages than non-working students. Again, when we differentiate the type of student employment we find that only field-related student employment, compared to full-time studies, generates such positive effects, but not field-unrelated student employment.

In summary, we find in a first step that student employment per se, compared to full-time studies, has significant positive effects on short-term labor market outcomes. In a second step, however, the evidence indicates that the type of student employment is important, as related student employment has significantly more positive effects compared to unrelated student employment. These results confirm our learning argument, i.e., that related student employment augments skills and knowledge and complements formal education. More precisely, students who have worked part-time with a relation to their field of study have significantly lower unemployment risks, shorter job search duration and higher wage effects than either non-working students or students working part-time without a relation to their field of study. Moreover, field-unrelated student employment has a lower unemployment risk than full-time studies, although the effect is smaller than for field-related employment.

Furthermore, in line with our results in chapter 4, we find that vocational tertiary education graduates have a shorter job search duration and higher wage expectations than academic graduates in the short-term.

5.5.2. Long-term labor market effects

We now analyze *long-term labor market effects* (five years after graduation). Estimation results with robust standard errors appear in Table 5.2.

Starting with the long-term unemployment risk (model D), we find that student employment per se significantly reduces the probability of being unemployed five years after graduation, as compared to full-time studies. This finding supports our first hypothesis H1, that student employment has positive labor market effects. Including information about the type of student employment in the second specification, we find an even stronger impact of field-related student employment on the unemployment risk, as compared to field-unrelated student employment. Thus students working part-time have a significantly lower long-term risk of being unemployed compared to non-working students, whereas field-related student employment has even larger effects than field-unrelated student employment.

In the following models, we reduce the sample to employed graduates. In model E, we analyze the long-term effects on income. With our first specification, we find a positive impact of student employment per se on wages. Again, the second specification shows that only related

student employment, compared to full-time studies, generates these positive effects, not unrelated student employment.

Table 5.2: Long-term labor market effects of student employment

	(D) Unemployed 2005 (dummy) *Probit*		(E) Wage 2005 (ln) *OLS*		(F) Great job responsibility (dummy) *Probit*	
	(1)	(2)	(1)	(2)	(1)	(2)
(1) Student employment (Y)	-0.0127***		0.00730***		-0.00110	
	[0.00337]		[0.00217]		[0.00559]	
(2) Field-related student employment (Y)		-0.0176***		0.0117***		0.0161**
		[0.00553]		[0.00299]		[0.00775]
(2) Field-unrelated student employment (Y)		-0.00963**		0.00399		-0.0131*
		[0.00391]		[0.00265]		[0.00680]
Proxy: Ability (grade on secondary education level)	-0.0832***	-0.0830***	0.0596**	0.0584**	-0.0601	-0.0643
	[0.0308]	[0.0309]	[0.0244]	[0.0243]	[0.0581]	[0.0577]
Proxy: Motivation (importance of a new challenge)	-0.00769	-0.00789	0.0199***	0.0195***	0.0367**	0.0349**
	[0.00772]	[0.00776]	[0.00610]	[0.00608]	[0.0147]	[0.0146]
Proxy: Liquidity constraint (parents with higher education)	0.0137	0.0141	-0.0171*	-0.0167*	0.0267	0.0287
	[0.0125]	[0.0124]	[0.00936]	[0.00935]	[0.0233]	[0.0232]
University of applied sciences (tertiary vocational education)	0.00229	0.00546	-0.0578***	-0.0618***	0.0290	0.0144
	[0.0219]	[0.0221]	[0.0159]	[0.0160]	[0.0447]	[0.0448]
Technical sciences	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Business/Economics	-0.0610**	-0.0588**	0.145***	0.142***	0.0648*	0.0537
	[0.0244]	[0.0246]	[0.0141]	[0.0141]	[0.0375]	[0.0375]
Social sciences	0.00235	0.00301	-0.0443***	-0.0445***	0.125***	0.124***
	[0.0207]	[0.0208]	[0.0152]	[0.0152]	[0.0401]	[0.0402]
Natural sciences	0.0348	0.0347	-0.0299	-0.0300	0.118**	0.118**
	[0.0223]	[0.0223]	[0.0203]	[0.0202]	[0.0464]	[0.0463]
Other subjects	0.0195	0.0202	0.0416**	0.0403**	-0.125***	-0.130***
	[0.0200]	[0.0201]	[0.0170]	[0.0170]	[0.0381]	[0.0381]
Stay abroad during study	0.000929	0.00173	0.0196*	0.0193*	-0.0161	-0.0176
	[0.0133]	[0.0134]	[0.0108]	[0.0108]	[0.0260]	[0.0259]
Secondary academic education	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Secondary vocational education	-0.0588**	-0.0586**	0.0294*	0.0287*	0.00519	0.00272
	[0.0256]	[0.0255]	[0.0165]	[0.0165]	[0.0461]	[0.0458]
Secondary mixed education	0.00461	0.00436	-0.0125	-0.0132	0.00554	-0.00193
	[0.0362]	[0.0361]	[0.0301]	[0.0304]	[0.0779]	[0.0786]
Tertiary education	-0.0250	-0.0221	0.0226	0.0189	0.0556	0.0413
	[0.0380]	[0.0381]	[0.0204]	[0.0206]	[0.0656]	[0.0653]
Local unemployment rate in 2005	0.00719	0.00690	-0.00680	-0.00676	0.0135	0.0135
	[0.00466]	[0.00465]	[0.00416]	[0.00414]	[0.0106]	[0.0105]
Constant			10.46***	10.52***		
			[0.253]	[0.256]		
Socio-demographic controls	yes	yes	yes	yes	yes	yes
Observations	1,930	1,930	1,574	1,574	1,574	1,574
Pseudo R^2 / R^2	0.08	0.08	0.19	0.19	0.05	0.05
Prob > Chi^2 / F	0.00	0.00	0.00	0.00	0.00	0.00

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%; robust standard errors; probit coefficients represent marginal effects.

Source: Swiss Graduate Study 2000; own calculations.

In our last model F, we analyze the effects on the job responsibility of graduates in their employment five years after graduation. According to our first specification for student employment per se, we find no significantly different effects on responsibility compared to full-time studies. Nonetheless, when we differentiate the type of student employment, we find a significant positive impact on responsibility for field-related student employment, whereas field-

unrelated student employment does generate a significantly negative effect when compared to full-time studies.

To summarize, we again find significant positive effects of student employment on long-term labor market outcomes compared to full-time studies. Our results thus also support our hypothesis for the long term. Furthermore, field-related student employment has significantly positive effects on long-term labor market outcomes, compared to field-unrelated student employment or full-time studies, supporting our learning argument. More specifically, students who have worked part-time in a job related to their studies have a significantly lower unemployment risk, higher wage effects and greater job responsibility in their post-graduation employment. Again, part-time working students without a relationship to their field of study have almost the same effects as non-working students, except for a lower unemployment risk in the long-term. Therefore, field-unrelated student employment does not cause the same positive labor market effects as field-related student employment.

5.5.3. Sensitivity analysis

To test our findings, we compute a first robustness check and estimate the regressions including all variables that we explicitly excluded in our main analysis (see tables A5.4 and A5.5 in the appendix). We include the final grade (standardized in the same way as previously described as our ability proxy, the grades at the secondary education level), the duration of the studies (by semester) as well as career-related variables that occurred after graduation such as a stay abroad after studies (dummy), being in a managerial position (dummy), working in civil service (dummy) or working in different industries (seven dummies). This analysis including all controls leads to very similar student employment effects and confirms our findings.

In a second robustness check we use a different sample. As the type of university could influence labor market entry and career development differently (Dearden et al., 2002; Tuor and Backes-Gellner, 2010), we estimate all models only for tertiary academic education, dropping graduates of universities of applied sciences (see tables A5.6 and A5.7 in the appendix). This robustness check shows very similar effects of ‘earning while learning’ as in our basic analysis and thus confirms our findings.

We use a further different sample in a third robustness check. Students working in a field-related employment might remain in their job after graduating from tertiary education. This continued employment relationship might bias the effect of field-related student employment. Therefore, we want to separate the two channels – field-related knowledge and the effect of tenure – and drop all graduates that continued working for the same employer after graduation. This analysis (tables A5.8 and A5.9 in the appendix) reveals stable results. The effects remain robust throughout the analysis; only the effect on the job search duration is not significant anymore. Nonetheless, the unemployment risk and the wage effects remain stable, thus confirming the findings of our main empirical analysis and showing the positive effect of field-related knowledge and experience.

Moreover, we have to consider that our analysis is restricted to individuals who finished their tertiary education. If, on the one hand, student employment lowers the probability of graduating, that is, leads to a higher drop-out probability (Marsh, 1991; Ehrenberg and Sherman, 1987), the effects are lower than estimated in our models. The observed positive labor market returns could therefore be partially offset by an incompletely accounted for negative effect of student employment on educational achievement. If, on the other hand, student employment increases the probability of graduating (Garasky, 1996; Steel, 1991), the labor market returns to student employment are even higher. Unfortunately, the existing literature on this issue does not reach consent and our data do not allow us to analyze this relationship.

5.6. Conclusions

In this chapter, we investigate how different student employment status during tertiary education systematically affects short-term and long-term labor market returns. Beyond focusing on differences between non-working full-time students and part-time working students ('earning while learning'), we include information about the type of student employment and distinguish between student employment with and without a relation to the field of study.

Our results show that student employment during tertiary education is an investment in job skills, knowledge and experience, thereby generating higher labor market outcomes after graduation. We find significant positive labor market effects of 'earning while learning' compared to full-time studies. Hence, student employment is a complement to schooling. How-

ever, the impact of student employment unrelated to the field of study shows the importance of the learning perspective and it particularly shows that student employment per se is not generally favorable. Differentiating types of student employment shows that field-unrelated employment does not generate the same positive effects as field-related student employment. Only field-related student employment therefore complements formal education and offers an opportunity to accumulate further valuable skills.

Thus information about the relationship of student employment to the field of study is important in an "earning while learning" analysis because field-related student employment generates positive labor market outcomes. These consist of lower unemployment risks, shorter job search duration, higher wage effects and greater job responsibility. In contrast, although field-unrelated student employment also reduces unemployment risk compared to full-time studies, it does not bring about the same positive labor market effects. This finding shows that students working in an employment without a relation to their field of study can also profit and are making rational choices. Beyond earning money (probably because of high consumer orientation or liquidity constraints), they reduce their unemployment risk compared to non-working students and thus ease their career entry. Therefore, any student employment can provide students with valuable income, work experience and a potential stepping-stone to employment after graduation.

Our empirical analysis shows that the combination of tertiary education and student employment is not disadvantageous to career development. To the contrary, it is rewarded in the labor market. Compared to full-time studies, student employment is an investment in skills that generate higher labor market outcomes after graduation – but only if the student employment is related to the studies. Field-related student employment complements formal education and augments skills and knowledge. Consequently, our results promote dual education that naturally combines academic with relevant vocational skills.

Our results lead to several policy implications. Both firms and various industries could profit from student employment. If firms provide adequate part-time opportunities for students, allowing them to augment relevant skills and knowledge, they could provide benefits for students, themselves, and perhaps even their industry as a whole. Furthermore, our results seem to highlight the importance of labor market experience *before* graduation from tertiary education. While our example of student employment obviously benefits graduates, other types of

work experience, such as a traineeship or vocational training, can also contain similar benefits. Consequently, our findings could be applied to the dual track education system, emphasizing the importance of work experience *before* studies (i.e. apprenticeship training) or *between* studies (i.e. a traineeship between bachelor and master studies).

Appendix

Table A5.1: Descriptive statistics (all graduates)

	All		Part-time working students		Non-working students	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Student employment						
Student employment per se (in years)	2.4	2.4	2.9	2.4	0.0	0.0
Related student employment (in years)	1.2	1.6	1.5	1.7	0.0	0.0
Unrelated student employment (in years)	1.1	1.9	1.4	2.0	0.0	0.0
Labour market outcomes						
Annual wage 2001 (CHF)	72'717	19'539	73'395	19'740	69'395	18'198
Annual wage 2005 (CHF)	94'267	18'239	94'925	18'437	91'047	16'905
Job search duration after graduation (in months)	2.32	2.73	2.34	2.85	2.24	2.03
Great job responsibility	0.70	0.46	0.70	0.46	0.69	0.46
Proxies for individual characteristics						
Ability (grade on secondary education level)	0.49	0.20	0.45	0.20	0.48	0.19
Motivation (importance of a new challenge)	4.15	0.75	4.16	0.75	4.11	0.73
Liquidity constraint (parents with higher education)	0.50	0.50	0.49	0.50	0.51	0.50
Socio-demographic controls						
Male	0.62	0.49	0.58	0.49	0.81	0.39
Age at graduation	27.4	4.2	27.7	4.3	25.9	2.8
Children in 2001	0.08	0.27	0.09	0.28	0.03	0.17
Children in 2005	0.21	0.41	0.23	0.42	0.13	0.33
Swiss nationality	0.93	0.25	0.93	0.25	0.95	0.21
Living with parents while studying	0.28	0.45	0.23	0.42	0.50	0.50
Study controls						
University of applied science (tertiary vocational education)	0.31	0.46	0.26	0.44	0.53	0.50
Business/Economics	0.16	0.37	0.17	0.38	0.11	0.31
Social sciences	0.29	0.45	0.33	0.47	0.09	0.28
Natural sciences	0.10	0.30	0.10	0.30	0.10	0.30
Technical sciences	0.24	0.43	0.19	0.39	0.50	0.50
Other subjects	0.20	0.40	0.20	0.40	0.20	0.40
Duration of study (in semesters)	10.4	3.9	10.8	3.9	8.5	3.0
Final grade	0.53	0.20	0.54	0.21	0.49	0.19
Stay abroad during studies	0.27	0.45	0.29	0.45	0.18	0.39
Stay abroad after studies	0.23	0.42	0.23	0.42	0.24	0.43
Secondary vocational education	0.24	0.43	0.20	0.40	0.45	0.50
Secondary academical education	0.72	0.45	0.75	0.43	0.52	0.50
Secondary mixed education	0.03	0.17	0.03	0.17	0.02	0.12
Tertiary education	0.03	0.18	0.03	0.18	0.02	0.15
Employment controls						
Employee with managerial function 2001	0.13	0.34	0.14	0.35	0.08	0.27
Employee with managerial function 2005	0.38	0.49	0.38	0.49	0.40	0.49
Civil service 2001	0.38	0.49	0.41	0.49	0.26	0.44
Civil service 2005	0.44	0.50	0.46	0.50	0.34	0.48
Labour market controls						
Local unemployment rate during studies	3.39	1.04	3.47	1.02	3.00	1.06
Local unemployment rate 2001	1.76	0.76	1.78	0.78	1.69	0.68
Local unemployment rate 2005	3.89	1.21	3.92	1.23	3.77	1.15

Source: Swiss Graduate Study 2000; own calculations.

Table A5.2: Descriptive statistics (only part-time working students)

	Field-related student employment		Field-unrelated student employment	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Labour market outcomes				
Annual wage 2001 (CHF)	74'814	18'873	70'232	20'339
Annual wage 2005 (CHF)	95'699	18'334	93'477	18'311
Job search duration after graduation (in months)	2.30	2.94	2.52	2.83
Great job responsibility	0.72	0.45	0.68	0.47
Proxies for individual characteristics				
Ability (grade on secondary education level)	0.45	0.20	0.45	0.20
Motivation (importance of a new challenge)	4.16	0.76	4.15	0.75
Liquidity constraint (parents with higher education)	0.50	0.50	0.51	0.50
Socio-demographic controls				
Male	0.58	0.49	0.52	0.50
Age at graduation	27.9	4.4	27.4	3.8
Children in 2001	0.09	0.29	0.07	0.25
Children in 2005	0.24	0.43	0.21	0.41
Swiss nationality	0.93	0.25	0.93	0.25
Living with parents while studying	0.21	0.40	0.24	0.43
Study controls				
University of applied science (tertiary vocational education	0.28	0.45	0.15	0.36
Business/Economics	0.19	0.39	0.13	0.34
Social sciences	0.33	0.47	0.37	0.48
Natural sciences	0.10	0.30	0.11	0.32
Technical sciences	0.19	0.40	0.15	0.36
Other subjects	0.19	0.39	0.24	0.42
Duration of study (in semesters)	10.8	3.9	11.6	4.1
Final grade	0.56	0.20	0.54	0.21
Stay abroad during studies	0.30	0.46	0.31	0.46
Stay abroad after studies	0.23	0.42	0.22	0.41
Secondary vocational education	0.20	0.40	0.13	0.34
Secondary academical education	0.74	0.44	0.84	0.37
Secondary mixed education	0.04	0.19	0.02	0.13
Tertiary education	0.04	0.19	0.02	0.15
Employment controls				
Employee with managerial function 2001	0.15	0.36	0.11	0.32
Employee with managerial function 2005	0.39	0.49	0.36	0.48
Civil service 2001	0.41	0.49	0.43	0.50
Civil service 2005	0.47	0.50	0.49	0.50
Labour market controls				
Local unemployment rate during studies	3.48	0.99	3.51	1.03
Local unemployment rate 2001	1.77	0.76	1.80	0.79
Local unemployment rate 2005	3.90	1.20	3.96	1.28

Source: Swiss Graduate Study 2000; own calculations.

Table A5.3: Multinomial Logit Model: Probability of Student Employment Status

	No student employment	Field-unrelated student employment
Male	0.0816***	-0.000841
	[0.0204]	[0.0203]
Age at graduation	-0.0483**	-0.0177
	[0.0193]	[0.0169]
Age at graduation squared	0.000627**	0.000205
	[0.000304]	[0.000251]
Swiss nationality	0.0165	-0.0388
	[0.0355]	[0.0341]
Living with parents while studying	0.0723***	0.0564***
	[0.0175]	[0.0210]
University of applied science (tertiary vocational education)	0.112***	-0.150***
	[0.0308]	[0.0406]
Business/Economics	-0.118***	-0.0234
	[0.0277]	[0.0340]
Social sciences	-0.0872***	0.0947***
	[0.0290]	[0.0298]
Natural sciences	0.00764	0.0359
	[0.0295]	[0.0345]
Other subjects	0.0152	0.0678**
	[0.0273]	[0.0302]
Stay abroad during studies	-0.0323	-0.0515**
	[0.0205]	[0.0206]
Proxy: Ability (grade on secondary education level)	0.0197	-0.0103
	[0.0438]	[0.0470]
Proxy: Motivation (importance of a new challenge)	-0.0254**	0.0146
	[0.0113]	[0.0122]
Proxy: Liquidity constraint (parents with higher education)	0.00794	-0.0361*
	[0.0171]	[0.0187]
Secondary vocational education	0.00661	0.0666
	[0.0313]	[0.0439]
Secondary mixed education	-0.00828	-0.00948
	[0.0638]	[0.0787]
Tertiary education	-0.0456	-0.0167
	[0.0549]	[0.0577]
Observations	1,930	
Pseudo R^2	0.09	
Prob > Chi^2	0.00	

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%;

Ref. Cat: Field-related student employment. Robust standard errors; coefficients represent marginal effects.

Source: Swiss Graduate Study 2000; own calculations.

Table A5.4: Short-term labor market effects of student employment: Robustness-check including all controls

	(A) Unemployed 2001 (dummy) *Probit*		(B) Job search duration (in months) *Tobit*		(C) Wage 2001 (ln) *OLS*	
	(1)	(2)	(1)	(2)	(1)	(2)
(1) Student employment (Y)	-0.0172***		-0.115***		0.0131***	
	[0.00445]		[0.0406]		[0.00446]	
(2) Field-related student employment (Y)		-0.0238***		-0.273***		0.0199***
		[0.00694]		[0.0558]		[0.00559]
(2) Field-unrelated student employment (Y)		-0.0133***		-0.00793		0.00816
		[0.00500]		[0.0479]		[0.00556]
Proxy: Ability (grade on secondary education level)	-0.0476	-0.0479	-0.380	-0.406	0.0518	0.0532
	[0.0398]	[0.0398]	[0.425]	[0.423]	[0.0461]	[0.0459]
Proxy: Motivation (importance of a new challenge)	-0.00800	-0.00813	-0.0867	-0.0695	0.00603	0.00514
	[0.0100]	[0.0100]	[0.104]	[0.103]	[0.0112]	[0.0112]
Proxy: Liquidity constraint (parents with higher education)	0.0388**	0.0381**	0.102	0.0811	-0.0338**	-0.0329**
	[0.0159]	[0.0159]	[0.160]	[0.159]	[0.0165]	[0.0166]
University of applied sciences (tertiary vocational education)	0.0653*	0.0691*	-0.902**	-0.768**	0.0596*	0.0537
	[0.0358]	[0.0358]	[0.382]	[0.382]	[0.0360]	[0.0363]
Technical sciences	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Business/Economics	0.0597**	0.0640**	-0.480*	-0.374	0.104***	0.0991***
	[0.0281]	[0.0284]	[0.255]	[0.255]	[0.0196]	[0.0197]
Social sciences	0.139***	0.138***	0.318	0.274	-0.166***	-0.162***
	[0.0296]	[0.0297]	[0.295]	[0.295]	[0.0304]	[0.0306]
Natural sciences	0.114***	0.114***	-0.226	-0.247	-0.0858***	-0.0838***
	[0.0287]	[0.0288]	[0.307]	[0.306]	[0.0296]	[0.0295]
Other subjects	0.0603**	0.0616**	0.0855	0.128	-0.260***	-0.260***
	[0.0291]	[0.0293]	[0.276]	[0.275]	[0.0415]	[0.0415]
Duration of study (terms)	0.00466	0.00478	0.0274	0.0331	0.00759**	0.00736**
	[0.00322]	[0.00322]	[0.0349]	[0.0349]	[0.00349]	[0.00351]
Final grade	0.00254	0.00716	-0.0211	0.158	0.121***	0.115***
	[0.0420]	[0.0422]	[0.428]	[0.428]	[0.0421]	[0.0419]
Stay abroad during study	0.0120	0.0126	0.218	0.211	0.0661***	0.0665***
	[0.0168]	[0.0168]	[0.182]	[0.181]	[0.0188]	[0.0188]
Stay abroad after study	0.0532***	0.0543***	-0.0357	0.00224	0.0397**	0.0376**
	[0.0172]	[0.0173]	[0.187]	[0.187]	[0.0180]	[0.0181]
Secondary academic education	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Secondary vocational education	omitted	ommited	0.264	0.308	0.0162	0.0140
			[0.351]	[0.350]	[0.0324]	[0.0324]
Secondary mixed education	-0.0310	-0.0289	-0.996	-0.932	-0.0128	-0.0155
	[0.0650]	[0.0646]	[0.608]	[0.607]	[0.0475]	[0.0474]
Tertiary education	-0.0353	-0.0329	-0.146	0.0112	0.116***	0.109***
	[0.0543]	[0.0546]	[0.475]	[0.475]	[0.0358]	[0.0363]
Local unemployment rate in 2001	0.0241**	0.0237**	0.307***	0.316***	-0.0260*	-0.0261*
	[0.0101]	[0.0101]	[0.115]	[0.114]	[0.0136]	[0.0136]
Employee with managerial function					0.149***	0.148***
					[0.0176]	[0.0175]
Civil service					-0.00980	-0.0102
					[0.0256]	[0.0256]
Constant					9.705***	9.763***
					[0.413]	[0.413]
Industry controls	no	no	yes	yes	no	no
Socio-demographic controls	yes	yes	yes	yes	yes	yes
Observations	1,718	1,718	1,404	1,404	1,404	1,404
Pseudo R^2 / R^2	0.09	0.09	0.01	0.02	0.26	0.26
Prob > Chi^2 / F	0.00	0.00	0.00	0.00	0.00	0.00

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%; robust standard errors; probit and tobit coefficients represent marginal effects.

Source: Swiss Graduate Study 2000; own calculations.

Table A5.5: Long-term labor market effects of student employment: Robustness-check including all controls

	(D) Unemployed 2005		(E) Wage 2005		(F) Great job responsibility	
	(dummy)		(ln)		(dummy)	
	Probit		*OLS*		*Probit*	
	(1)	(2)	(1)	(2)	(1)	(2)
(1) Student employment (Y)	-0.0140***		0.00757***		0.00505	
	[0.00359]		[0.00257]		[0.00637]	
(2) Field-related student employment (Y)		-0.0180***		0.0144***		0.0244***
		[0.00527]		[0.00333]		[0.00844]
(2) Field-unrelated student employment (Y)		-0.0117***		0.00259		-0.00798
		[0.00416]		[0.00309]		[0.00746]
Proxy: Ability (grade on secondary education level)	-0.0661*	-0.0668*	0.0387	0.0402	-0.0877	-0.0843
	[0.0346]	[0.0346]	[0.0276]	[0.0275]	[0.0661]	[0.0656]
Proxy: Motivation (importance of a new challenge)	-0.00696	-0.00726	0.0137**	0.0127**	0.0251	0.0226
	[0.00811]	[0.00812]	[0.00654]	[0.00648]	[0.0155]	[0.0155]
Proxy: Liquidity constraint (parents with higher education)	0.00760	0.00793	-0.0159	-0.0150	0.0325	0.0341
	[0.0129]	[0.0128]	[0.00996]	[0.00991]	[0.0247]	[0.0245]
University of applied sciences (tertiary vocational education)	0.0125	0.0144	-0.0683***	-0.0745***	-0.0555	-0.0729
	[0.0303]	[0.0304]	[0.0213]	[0.0212]	[0.0581]	[0.0584]
Technical sciences	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Business/Economics	-0.0691***	-0.0670***	0.144***	0.139***	0.0350	0.0216
	[0.0251]	[0.0253]	[0.0152]	[0.0151]	[0.0389]	[0.0390]
Social sciences	0.00343	0.00342	-0.00641	-0.00307	0.150***	0.157***
	[0.0225]	[0.0227]	[0.0187]	[0.0188]	[0.0477]	[0.0480]
Natural sciences	0.0439**	0.0435*	-0.00543	-0.00379	0.124**	0.127**
	[0.0224]	[0.0224]	[0.0201]	[0.0200]	[0.0496]	[0.0494]
Other subjects	0.0238	0.0243	0.0788***	0.0787***	-0.106**	-0.109**
	[0.0208]	[0.0209]	[0.0204]	[0.0203]	[0.0436]	[0.0434]
Duration of study (terms)	0.00240	0.00242	-0.00329	-0.00350*	-0.0101*	-0.0107**
	[0.00250]	[0.00248]	[0.00211]	[0.00209]	[0.00526]	[0.00521]
Final grade	-0.0529	-0.0494	0.0746***	0.0680**	0.00800	-0.0148
	[0.0340]	[0.0343]	[0.0265]	[0.0264]	[0.0653]	[0.0648]
Stay abroad during study	0.00672	0.00727	0.0173	0.0176	-0.0160	-0.0157
	[0.0137]	[0.0137]	[0.0112]	[0.0112]	[0.0279]	[0.0277]
Stay abroad after study	0.0178	0.0190	0.0160	0.0139	0.0253	0.0194
	[0.0147]	[0.0147]	[0.0119]	[0.0119]	[0.0296]	[0.0295]
Secondary academic education	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Secondary vocational education	omitted	ommited	0.0608	0.0570	-0.00967	-0.0220
			[0.0432]	[0.0427]	[0.0976]	[0.101]
Secondary mixed education	-0.0443	-0.0442	0.0361*	0.0345*	0.0227	0.0183
	[0.0295]	[0.0294]	[0.0195]	[0.0193]	[0.0534]	[0.0535]
Tertiary education	-0.00855	-0.00818	-0.0183	-0.0207	0.0312	0.0197
	[0.0449]	[0.0448]	[0.0373]	[0.0378]	[0.0898]	[0.0908]
Local unemployment rate in 2005	-0.0118	-0.00880	0.0389*	0.0320	0.0662	0.0447
	[0.0386]	[0.0389]	[0.0233]	[0.0232]	[0.0707]	[0.0695]
Employee with managerial function			0.0576***	0.0585***	0.182***	0.184***
			[0.00995]	[0.00992]	[0.0257]	[0.0255]
Civil service			-0.0202	-0.0218	0.0267	0.0235
			[0.0149]	[0.0150]	[0.0279]	[0.0277]
Constant			10.46***	10.52***		
			[0.253]	[0.256]		
Industry controls	no	no	yes	yes	no	no
Socio-demographic controls	yes	yes	yes	yes	yes	yes
Observations	1,718	1,718	1,404	1,404	1,404	1,404
Pseudo R^2 / R^2	0.09	0.09	0.23	0.24	0.07	0.08
Prob > Chi^2 / F	0.00	0.00	0.00	0.00	0.00	0.00

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%; robust standard errors; probit coefficients represent marginal effects.

Source: Swiss Graduate Study 2000; own calculations.

Table A5.6: Short-term labor market effects of student employment: Robustness-check with only academic tertiary education

	(A) Unemployed 2001 (dummy) *Probit*		(B) Job search duration (in months) *Tobit*		(C) Wage 2001 (ln) *OLS*	
	(1)	(2)	(1)	(2)	(1)	(2)
(1) Student employment (Y)	-0.0167***		-0.0831*		0.0181***	
	[0.00478]		[0.0448]		[0.00451]	
(2) Field-related student employment (Y)		-0.0227***		-0.215***		0.0295***
		[0.00765]		[0.0646]		[0.00629]
(2) Field-unrelated student employment (Y)		-0.0134**		0.000550		0.0107*
		[0.00550]		[0.0535]		[0.00557]
Proxy: Ability (grade on secondary education level)	-0.0786*	-0.0771*	-0.433	-0.388	0.124**	0.120**
	[0.0449]	[0.0448]	[0.491]	[0.490]	[0.0533]	[0.0529]
Proxy: Motivation (importance of a new challenge)	-0.00733	-0.00748	-0.127	-0.113	0.00591	0.00462
	[0.0117]	[0.0117]	[0.126]	[0.126]	[0.0136]	[0.0137]
Proxy: Liquidity constraint (parents with higher education)	0.0333*	0.0327*	0.0711	0.0661	-0.0322	-0.0319
	[0.0190]	[0.0190]	[0.198]	[0.198]	[0.0210]	[0.0209]
Technical sciences	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Business/Economics	0.0902**	0.0913**	-0.805**	-0.766**	0.106***	0.102***
	[0.0436]	[0.0436]	[0.370]	[0.369]	[0.0252]	[0.0252]
Social sciences	0.177***	0.175***	-0.159	-0.217	-0.178***	-0.173***
	[0.0420]	[0.0420]	[0.367]	[0.367]	[0.0330]	[0.0330]
Natural sciences	0.164***	0.162***	-0.544	-0.596	-0.119***	-0.115***
	[0.0411]	[0.0411]	[0.383]	[0.382]	[0.0342]	[0.0342]
Other subjects	0.0893**	0.0881**	-0.123	-0.143	-0.237***	-0.235***
	[0.0410]	[0.0409]	[0.338]	[0.337]	[0.0340]	[0.0340]
Stay abroad during study	0.0304	0.0314	0.178	0.193	0.0895***	0.0883***
	[0.0193]	[0.0194]	[0.209]	[0.208]	[0.0211]	[0.0211]
Secondary academic education	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Secondary vocational education	omitted	ommited	1.385**	1.444**	-0.0183	-0.0218
			[0.700]	[0.698]	[0.0868]	[0.0864]
Secondary mixed education	0.0132	0.0111	-2.117*	-2.170*	0.126	0.131
	[0.101]	[0.100]	[1.124]	[1.124]	[0.113]	[0.114]
Tertiary education	-0.0338	-0.0318	-0.334	-0.186	0.0934*	0.0807
	[0.0648]	[0.0652]	[0.581]	[0.582]	[0.0504]	[0.0519]
Local unemployment rate in 2001	0.0167	0.0163	0.397***	0.393***	-0.0122	-0.0118
	[0.0114]	[0.0113]	[0.132]	[0.132]	[0.0155]	[0.0154]
Constant					8.448***	8.525***
					[0.730]	[0.742]
Socio-demographic controls	yes	yes	yes	yes	yes	yes
Observations	1,327	1,327	1,071	1,071	1,071	1,071
Pseudo R^2 / R^2	0.07	0.08	0.01	0.01	0.20	0.20
Prob > Chi^2 / F	0.00	0.00	0.00	0.00	0.00	0.00

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%; robust standard errors; probit and tobit coefficients represent marginal effects.

Source: Swiss Graduate Study 2000; own calculations.

Table A5.7: Long-term labor market effects of student employment: Robustness-check with only academic tertiary education

	(D) Unemployed 2005		(E) Wage 2005		(F) Great job responsibility	
	(dummy)		(ln)		(dummy)	
	Probit		*OLS*		*Probit*	
	(1)	(2)	(1)	(2)	(1)	(2)
(1) Student employment (Y)	-0.0171***		0.00695***		0.00449	
	[0.00406]		[0.00253]		[0.00642]	
(2) Field-related student employment (Y)		-0.0171***		0.0107***		0.0209**
		[0.00601]		[0.00361]		[0.00908]
(2) Field-unrelated student employment (Y)		-0.0171***		0.00451		-0.00547
		[0.00498]		[0.00303]		[0.00758]
Proxy: Ability (grade on secondary education level)	-0.126***	-0.126***	0.0563*	0.0550*	-0.0432	-0.0482
	[0.0386]	[0.0386]	[0.0304]	[0.0303]	[0.0689]	[0.0686]
Proxy: Motivation (importance of a new challenge)	-0.00831	-0.00831	0.0140*	0.0136*	0.0387**	0.0371**
	[0.00971]	[0.00971]	[0.00752]	[0.00749]	[0.0172]	[0.0171]
Proxy: Liquidity constraint (parents with higher education)	0.0125	0.0125	-0.0194	-0.0193	0.0271	0.0274
	[0.0159]	[0.0158]	[0.0119]	[0.0119]	[0.0281]	[0.0280]
Technical sciences	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Business/Economics	-0.0207	-0.0207	0.122***	0.120***	-0.0111	-0.0162
	[0.0373]	[0.0373]	[0.0211]	[0.0211]	[0.0524]	[0.0521]
Social sciences	0.0393	0.0393	-0.0578***	-0.0563***	0.0427	0.0492
	[0.0322]	[0.0323]	[0.0216]	[0.0216]	[0.0529]	[0.0528]
Natural sciences	0.0792**	0.0792**	-0.0453*	-0.0439*	0.0613	0.0674
	[0.0319]	[0.0319]	[0.0243]	[0.0242]	[0.0555]	[0.0553]
Other subjects	0.0615**	0.0615**	0.0297	0.0304	-0.202***	-0.199***
	[0.0303]	[0.0303]	[0.0210]	[0.0210]	[0.0461]	[0.0460]
Stay abroad during study	0.0150	0.0150	0.0272**	0.0268**	-0.0303	-0.0327
	[0.0163]	[0.0165]	[0.0123]	[0.0123]	[0.0291]	[0.0290]
Secondary academic education	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Secondary vocational education	omitted	ommited	0.0632	0.0624	0.0333	0.0287
			[0.0434]	[0.0430]	[0.0967]	[0.0975]
Secondary mixed education	-0.0258	-0.0258	-0.0285	-0.0264	0.265	0.273
	[0.0725]	[0.0725]	[0.0829]	[0.0839]	[0.206]	[0.208]
Tertiary education	-0.0184	-0.0184	0.0132	0.00894	0.0309	0.0125
	[0.0485]	[0.0487]	[0.0268]	[0.0272]	[0.0756]	[0.0758]
Local unemployment rate in 2005	0.00599	0.00599	-0.00583	-0.00553	0.00683	0.00781
	[0.00592]	[0.00591]	[0.00510]	[0.00508]	[0.0121]	[0.0120]
Constant			10.64***	10.67***		
			[0.387]	[0.392]		
Socio-demographic controls	yes	yes	yes	yes	yes	yes
Observations	1,327	1,327	1,071	1,071	1,071	1,071
Pseudo R^2 / R^2	0.08	0.08	0.15	0.15	0.06	0.07
Prob > Chi^2 / F	0.00	0.00	0.00	0.00	0.00	0.00

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%; robust standard errors; probit coefficients represent marginal effects.

Source: Swiss Graduate Study 2000; own calculations.

Table A5.8: Short-term labor market effects of student employment: Robustness-check excluding graduates continuing student employment

	(A) Unemployed 2001 (dummy) *Probit*		(B) Job search duration (in months) *Tobit*		(C) Wage 2001 (ln) *OLS*	
	(1)	(2)	(1)	(2)	(1)	(2)
(1) Student employment (Y)	-0.0110**		0.0252		0.0150***	
	[0.00487]		[0.0387]		[0.00476]	
(2) Field-related student employment (Y)		-0.0176**		-0.0218		0.0323***
		[0.00824]		[0.0584]		[0.00700]
(2) Field-unrelated student employment (Y)		-0.00727		0.0529		0.00479
		[0.00557]		[0.0465]		[0.00592]
Proxy: Ability (grade on secondary education level)	-0.0487	-0.0473	0.276	0.286	0.0983**	0.0948**
	[0.0430]	[0.0429]	[0.382]	[0.382]	[0.0478]	[0.0474]
Proxy: Motivation (importance of a new challenge)	-0.0119	-0.0121	-0.149	-0.147	0.000599	-9.19e-05
	[0.0115]	[0.0115]	[0.0993]	[0.0993]	[0.0120]	[0.0119]
Proxy: Liquidity constraint (parents with higher education)	0.0400**	0.0396**	-0.0678	-0.0700	-0.0267	-0.0260
	[0.0178]	[0.0178]	[0.150]	[0.150]	[0.0176]	[0.0175]
University of applied sciences (tertiary vocational education)	0.0255	0.0278	-0.368	-0.356	0.0817***	0.0775***
	[0.0316]	[0.0316]	[0.291]	[0.292]	[0.0268]	[0.0267]
Technical sciences	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Business/Economics	0.0557*	0.0588*	-0.321	-0.297	0.119***	0.111***
	[0.0311]	[0.0313]	[0.246]	[0.246]	[0.0177]	[0.0179]
Social sciences	0.120***	0.120***	0.455*	0.455*	-0.141***	-0.140***
	[0.0310]	[0.0311]	[0.264]	[0.264]	[0.0293]	[0.0292]
Natural sciences	0.103***	0.102***	0.107	0.100	-0.0870***	-0.0844***
	[0.0312]	[0.0312]	[0.291]	[0.291]	[0.0313]	[0.0312]
Other subjects	0.0311	0.0320	0.122	0.130	-0.215***	-0.218***
	[0.0307]	[0.0308]	[0.248]	[0.248]	[0.0325]	[0.0324]
Stay abroad during study	0.0234	0.0243	0.434**	0.438**	0.0677***	0.0660***
	[0.0188]	[0.0188]	[0.170]	[0.170]	[0.0203]	[0.0202]
Secondary academic education	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Secondary vocational education	-0.0584	-0.0584	0.143	0.151	-0.0146	-0.0177
	[0.0372]	[0.0372]	[0.311]	[0.311]	[0.0299]	[0.0298]
Secondary mixed education	-0.0624	-0.0638	-0.122	-0.127	-0.0101	-0.00855
	[0.0756]	[0.0752]	[0.563]	[0.563]	[0.0481]	[0.0477]
Tertiary education	0.0112	0.0133	0.224	0.261	0.0626	0.0489
	[0.0585]	[0.0584]	[0.477]	[0.478]	[0.0406]	[0.0408]
Local unemployment rate in 2001	0.0321***	0.0317***	0.384***	0.385***	-0.0249*	-0.0251*
	[0.0111]	[0.0111]	[0.108]	[0.107]	[0.0147]	[0.0146]
Constant					9.326***	9.359***
					[0.326]	[0.325]
Socio-demographic controls	yes	yes	yes	yes	yes	yes
Observations	1,620	1,620	1,271	1,271	1,271	1,271
Pseudo R^2 / R^2	0.07	0.07	0.01	0.01	0.21	0.22
Prob > Chi^2 / F	0.00	0.00	0.00	0.00	0.00	0.00

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%; robust standard errors; probit and tobit coefficients represent marginal effects.

Source: Swiss Graduate Study 2000; own calculations.

Table A5.9: Long-term labor market effects of student employment: Robustness-check excluding graduates continuing student employment

	(D) Unemployed 2005 (dummy) *Probit*		(E) Wage 2005 (ln) *OLS*		(F) Great job responsibility (dummy) *Probit*	
	(1)	(2)	(1)	(2)	(1)	(2)
(1) Student employment (Y)	-0.0111***		0.00737***		-0.00157	
	[0.00395]		[0.00264]		[0.00683]	
(2) Field-related student employment (Y)		-0.0154**		0.0127***		0.0131
		[0.00682]		[0.00392]		[0.0102]
(2) Field-unrelated student employment (Y)		-0.00877*		0.00421		-0.00981
		[0.00463]		[0.00321]		[0.00819]
Proxy: Ability (grade on secondary education level)	-0.0792**	-0.0792**	0.0608**	0.0597**	-0.0790	-0.0815
	[0.0355]	[0.0356]	[0.0278]	[0.0277]	[0.0671]	[0.0668]
Proxy: Motivation (importance of a new challenge)	-0.00460	-0.00468	0.0209***	0.0207***	0.0500***	0.0493***
	[0.00898]	[0.00897]	[0.00694]	[0.00690]	[0.0168]	[0.0167]
Proxy: Liquidity constraint (parents with higher education)	0.00714	0.00750	-0.0164	-0.0162	0.0451*	0.0455*
	[0.0143]	[0.0142]	[0.0104]	[0.0103]	[0.0264]	[0.0264]
University of applied sciences (tertiary vocational education)	0.00632	0.00752	-0.0693***	-0.0706***	-0.00568	-0.00881
	[0.0257]	[0.0257]	[0.0179]	[0.0178]	[0.0526]	[0.0526]
Technical sciences	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Business/Economics	-0.0650**	-0.0637**	0.139***	0.136***	0.0216	0.0145
	[0.0288]	[0.0289]	[0.0154]	[0.0154]	[0.0430]	[0.0431]
Social sciences	0.0160	0.0163	-0.0440**	-0.0440**	0.0898*	0.0900*
	[0.0243]	[0.0244]	[0.0181]	[0.0181]	[0.0471]	[0.0472]
Natural sciences	0.0455*	0.0448*	-0.0296	-0.0288	0.0835	0.0854
	[0.0259]	[0.0259]	[0.0225]	[0.0223]	[0.0522]	[0.0522]
Other subjects	0.0277	0.0280	0.0384**	0.0374**	-0.163***	-0.166***
	[0.0230]	[0.0231]	[0.0183]	[0.0183]	[0.0418]	[0.0418]
Stay abroad during study	0.00316	0.00391	0.0138	0.0133	-0.0310	-0.0326
	[0.0153]	[0.0154]	[0.0120]	[0.0120]	[0.0292]	[0.0291]
Secondary academic education	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
Secondary vocational education	-0.0523*	-0.0519*	0.0279	0.0269	0.000952	-0.00176
	[0.0301]	[0.0301]	[0.0191]	[0.0189]	[0.0552]	[0.0551]
Secondary mixed education	0.0134	0.0125	-0.0230	-0.0226	0.116	0.115
	[0.0479]	[0.0478]	[0.0439]	[0.0441]	[0.112]	[0.114]
Tertiary education	-0.0192	-0.0166	0.00793	0.00365	-0.0178	-0.0291
	[0.0452]	[0.0454]	[0.0261]	[0.0262]	[0.0790]	[0.0790]
Local unemployment rate in 2005	0.0107*	0.0104*	-0.00621	-0.00620	0.00848	0.00853
	[0.00555]	[0.00554]	[0.00484]	[0.00483]	[0.0121]	[0.0120]
Constant			10.37***	10.38***		
			[0.224]	[0.223]		
Socio-demographic controls	yes	yes	yes	yes	yes	yes
Observations	1,620	1,620	1,271	1,271	1,271	1,271
Pseudo R^2 / R^2	0.07	0.07	0.18	0.18	0.05	0.05
Prob > Chi^2 / F	0.00	0.00	0.00	0.00	0.00	0.00

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%; robust standard errors; probit coefficients represent marginal effects.

Source: Swiss Graduate Study 2000; own calculations.

CHAPTER 6

Final Remarks

The aim of this dissertation is to provide an elaborate analysis of the career consequences of dual education, which is often perceived as too focused on narrow skill requirements, thus limiting employability. Due to continuous technological change, the labor market increasingly demands flexibility and mobility of workers. Therefore, we investigate the employability of dual education graduates, which is contingent on their acquired skill bundles containing both specific vocational and general academic skills. We show that dual education graduates sustain employability on the one hand through their ability to adapt earlier acquired skills to new requirements and on the other hand through investments in different human capital. Consequently, dual education graduates are occupationally and educationally mobile.

First, we apply Lazear's skill-weights model (2009) to measure the specificity of dual education in a completely new empirical approach. We show that mobility depends on the specificity of the combination of acquired skills and define occupational specificity on the skill-level in an innovative way. Based on the skill-weights approach, we explore the career consequences of the specificity of the skill bundle acquired during dual education. We find that the more specific the acquired skill bundle, the smaller the probability of an occupational change. In the dual education system of apprenticeship training, the acquired skills are particularly bundled and vary strongly in their degree of specificity. Our findings thus demonstrate that we have to investigate the specific skill-combination of occupations to analyze occupational mobility.

Second, as occupational specificity reduces occupational mobility, we deepen our analysis of skills and occupational mobility. We investigate the resulting mobility and income effects of

the acquired occupational skill-combinations in detail on the level of single skills. We compare the different skill combinations of the former apprenticeship training occupations and the new occupations. We show that dual education graduates are mobile later in their careers even though they acquire seemingly narrow and specific skill bundles. We find that employees have a comparatively higher probability of changing into occupations with similar skill combinations than into occupations with completely different skill combinations. Moreover, the former occupational change results in wage gains because the earlier acquired skills can still be productively used, whereas the latter results in wage losses. Thus, the acquired skill combination, rather than the occupation per se, crucially determines employability. Therefore, dual education graduates are flexible and mobile; they are able to change occupations and profit from beneficial career opportunities.

Consequently, the skills acquired during dual education are adaptable to new requirements during the course of technological change. Furthermore, evaluations of the flexibility and employability of dual education graduates should be based on the specificity of the skill combination on the skill level. For educational policy, it is more important to study whether skill combinations are sustainable than to consider the occupation per se. When thinking about the future competitiveness and mobility of dual education graduates, we should not only look at individual occupations but also consider the acquired skill combinations, which are as crucial to mobility and earnings as the occupation itself. Considering the great importance of acquired skill combinations in labor market outcomes, future research should include detailed analyses of skill bundles.

Third, we focus on further human capital investments, that is, dual education on tertiary educational level, to sustain employability. We analyze the educational mobility of dual education graduates, whose further educational opportunities are often seen as limited compared to those of academic graduates. Moreover, early tracking or early specialization in a dual educational system is often criticized. We therefore compare career consequences after vocational (i.e. at a university of applied sciences) and academic tertiary education (i.e. at an academic university). Our results show that vocational graduates experience higher financial returns at career entry compared to academic graduates. In the longer term, the initial financial advantage of vocational education disappears, but a lower unemployment risk results.

Our findings show that early tracking in dual education still allows attractive further career options and is not an irreversible training path. Dual education graduates face advantageous

career prospects after graduating from vocational tertiary education, which opens the door to more demanding and interesting activities through less risky career paths. Therefore, vocational tertiary education is a natural career path for ambitious dual education graduates; it provides students with both the specific vocational skills they need to be productive at work and the general academic skills that they need to be prepared for further learning. In this way, dual education provides a wide range of career choices.

Fourth, we hypothesize that dual education could be quasi-replicated leading to similar labor market advantages. We examine student employment during tertiary education as a special form of dual education in which academic skills are acquired during formal education and vocational skills are acquired through parallel work experience. We find that student employment indeed has positive career consequences. Nonetheless, considering student employment from a learning perspective is crucial, as only student employment with a relationship to the studies augments human capital and enhances employability. Field-unrelated student employment does not generate these positive effects. Therefore, only field-related student employment constitutes a complement to formal education and can thus be seen as a form of dual education that allows students to acquire both academic and vocational skills and sustain employability.

Regarding policy implications, both firms and various industries could profit from student employment. If firms provide adequate part-time opportunities for students, allowing them to augment their relevant skills and knowledge, they could provide benefits for students, themselves, and perhaps even their industry as a whole. As for future research, our results suggest that the various combinations of educational paths need more in-depth analysis because they substantially matter to labor market outcomes. Our analysis emphasizes that distinguishing different types of student employment is necessary - an important issue that has not yet been considered in the literature.

In summary, dual education leads to labor market advantages, thus positive career consequences. The acquisition of both vocational and academic skills sustains employability and enhances flexibility and mobility. We show that an analysis on the skill level is important and leads to novel insights into career consequences. Moreover, we also show that not only the highest level of education is important for analyzing employability, but different educational types to reach this level.

Finally, we appreciate your interest in this dissertation and the time you have invested in reading it.

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