CAUSES AND CONSEQUENCES OF HIGHER-EDUCATION NON-COMPLETION IN GERMANY

The effect of pre-tertiary educational pathways on higher-education non-completion and the labour market outcomes of higher-education dropouts

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Vorgelegt von
Mirte Scholten

Dekan der Fakultät für Sozialwissenschaften
Prof. Dr. Michael Diehl

Gutachter/in
Prof. Dr. Irena Kogan (Universität Mannheim)
Prof. Dr. Steffen Schindler (Universität Bamberg)
Prof. Dr. Tobias Wolbring (Universität Mannheim)

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Chapter 1 Introduction

1.1. Motivation

Higher-education non-completion[1] has become a key topic in research and politics in Germany during the last few years. Currently, 30 per cent of all first-year bachelor students[2] drop out of higher education (Heublein 2014). Analysing the permanent dropout rates of students born in 1975-1984, Tieben finds that 14 out of 100 students in Germany ultimately end up without a higher-education degree (Tieben 2016).

In general, higher-education non-completion is often perceived as 'failure' and construed as a waste of resources at both the personal and institutional levels (Yorke 1998; Yorke 2002). At the institutional level, non-completion implies an inefficient use of public finances: investments in teaching capacities and educational programmes do not pay off for society when students drop out. At the individual level, attending higher education involves costs that can be seen as a poor investment if a student fails to complete his or her degree –including direct costs, such as administration fees, indirect costs (such as living costs, books and supplies) as well as opportunity costs of foregone labour market earnings. To reduce the inefficient use of public, institutional and personal resources, policy has made great efforts to address the rising dropout rates in Germany, under the assumption that non-completion is the result of specific conditions within higher-education institutions.

Yet this assumption fails to take into account two important perspectives (1) the effect of pre-tertiary educational pathways on higher-education non-completion and (2) the labour market outcomes of higher-education dropouts. These two perspectives will serve as the theme of this work, which explores the following questions: Which factors before higher education lead a student to ultimately drop out? And, is dropping out really just a waste of resources, or does it pay off somehow?

[1] The terms non-completion and dropout are used synonymously throughout this work.
[2] These are students who started their first bachelor course in the academic year 2001/2002.

According to Heublein (2014) in Germany higher-education non-completion takes place in different institutional contexts both inside and outside the higher-education system. He defines non-completion as a result "of a prolonged decision making and consideration process in which the different influencing factors accumulate in a constellation of problems that makes leaving the higher-education institution seem inevitable" (Heublein 2014, p. 503). Assuming that there is rarely only one reason for non-completion, he develops a complex theoretical model that explains higher-education non-completion as a decision process divided into different phases. One phase is the situation during higher education, in which non-completion decisions are influenced by internal factors (individual behavioural characteristics of the students) and external factors, conditions set by the higher-education institution. While internal factors can be theoretically explained by psychological concepts (e.g. Ethington 1990; Robbins et al. 2004) such as individual predispositions, intrinsic study motivation and academic self-concepts, the external factors refer to the individual–environment fit. The basic assumption here is that the more students are socially and academically integrated, in other words the better students fit into their higher-education system, the less likely they are to drop out. This sociological view is mainly based on Tinto's (1975, 1993) theoretical model. The processes that take place during higher education have been extensively analysed by German and international research (e.g. Bean and Eaton 2000; Bean 1985; Bean and Metzner 1985; Becker, Grebe and Bleikertz 2010; Cabrera, Nora and Castaneda 1993; Cech et al. 2011; Hadjar and Becker 2004; Heublein et al. 2010; Pascarella and Terenzini 2005; Seron et al. 2016; Wigfield 1994).

Despite the multitude of research on higher-education non-completion, less is known about the processes happening before entering and after leaving the higher-education system. Heublein's theoretical model also emphasizes the importance of pre-tertiary education pathways and the strength of the labour market for non-completion in Germany. He makes the following assumptions about pre-tertiary education pathways: the German education and training system provides ample opportunities to enter higher education, such as pathways through different types of secondary education system as well as the vocational training system. These equip students with different kinds of knowledge, skills, qualifications and certificates that students can use to enter the higher-education system. As a consequence, the group of students entering the higher-education

system is not homogeneous. The characteristics acquired before entering the higher-education system are assumed to have a direct impact on students' decisions to stay or leave, as they influence opportunities and decision-making processes inside and outside the higher-education system. For that reason, higher-education non-completion is not only a result of decision-making processes taking place *during* higher education; the reasons for higher-education non-completion in Germany can also be found in pre-tertiary educational pathways.

Concerning the labour market, Heublein's theoretical model stresses the importance of alternatives outside higher education, such as opportunities on the labour market. As mentioned above, non-completion is often perceived as 'failure' at the individual and societal levels, especially in politics. However, research also finds that non-completion can be an efficient, rational and natural selection process for individuals, enabling students to keep misinvestments low and to improve their educational biography. The question whether higher-education non-completion should be perceived as a failure or not can only be answered by analysing the actual consequences such as the labour market outcomes of a higher-education dropout. Until now, there has been little research on the actual consequences of non-completion in Germany, especially because of missing data: most data focusing on higher-education students do not include information on their subsequent labour market careers.

Taken together, decisions to drop out of higher education do not only take place during higher education; they also seem to be affected by pre-tertiary education pathways and the labour market. This dissertation contributes to the existing debate on higher-education non-completion by adding pre-tertiary educational pathways and the labour market to the analysis of non-completion in Germany.

The dissertation is divided into two parts. The first part analyses the pre-tertiary educational pathways and their relationship to higher-education non-completion. The second part assesses the labour market opportunities of higher-education dropouts. Each part comprises two chapters.

Part 1 contributes to the debate on the increased demand for academically qualified individuals in the German labour market across a whole range of industries – specifically tertiary-educated women in technical occupations. While there have been changes in the labour market structure in Germany in recent decades – namely growth

and differentiation in the service sector accompanied by a decline in manufacturing occupations (Kleinert and Jacob 2013) – there is a persistent gender gap in technical occupations (Solga and Pfahl 2009). To meet the rising demand for higher-education graduates in the labour market, pathways to higher education have been extended in Germany since 1970 (Schindler 2013). Despite increasing incentives to obtain a higher-education qualification, Germany shows a rise in higher-education dropout rates (Tieben 2016). Furthermore, despite German education policies that aim to make technical careers more attractive to women, female students less often graduate from technical fields in higher education than men (Solga and Pfahl 2009). In both empirical chapters of Part 1, the importance of pre-tertiary education pathways for higher-education non-completion will be examined.

Part 2 contributes to the debate on the consequences of higher-education non-completion for individuals and society. As mentioned before, students enter higher education with different knowledge, skills and qualifications. These resources have a considerable influence on the dropout probability as well as opportunities in the subsequent occupational pathway. In addition, first occupational outcomes are strongly dependent on labour market conditions at the time of entering the labour market. Both empirical chapters of Part 2 examine the labour market outcomes of higher-education dropouts, first in relation to acquired pre-tertiary education qualifications and experiences and second in relation to good vs. struggling labour market situations. In the following section I briefly outline the subsequent chapters of this dissertation.

1.2. Overview of the chapters

This dissertation comprises four empirical chapters, which are framed by three chapters that describe the theoretical framework, including a description of the institutional setting, and the dataset. It ends with a conclusion and discussion of the results.

Chapter 2 and 3 present the general theoretical framework and detail the institutional setting of the empirical chapters. Chapter 2 reviews the main theories and conceptual frameworks concerning higher-education non-completion in the fields of sociology, psychology and economics. After that the German education system is

described, including the pathways to a higher-education entrance qualification. Chapter 3 addresses the theoretical approaches that explain the relationship between educational attainment and labour market outcomes, followed by a description of the German labour market system. Both chapters are followed by a short overview of previous research on the causes and consequences of non-completion in Germany, ending with a summary and guiding research question.

Chapter 4 provides a description of the data and its advantages compared with other available data in Germany.

The subsequent four chapters are structured according to the above-mentioned distinction. In Chapters 5 and 6, I investigate specific pre-tertiary and in-college factors that influence higher-education non-completion, while Chapters 7 and 8 address the labour market outcomes of higher-education dropouts.

In Chapter 5, I empirically investigate the impact of pre-tertiary educational and vocational pathways on higher-education non-completion in Germany. Pathways into higher education in Germany are flexible, and many students acquire vocational skills prior to higher education, take detours or obtain their entry qualification to higher education outside general upper-secondary education. Arguing from a life course perspective, I suggest that prior educational and occupational pathways are important predictors of tertiary education decisions, as they imply specific resources and restrictions that determine individual success in higher education as well as the opportunity structures outside the educational system.

Chapter 6 examines the reasons for the high non-completion rate of female students in in higher-education fields such as science, technology, engineering and mathematics (STEM). Unlike the majority of existing studies, which focus either on pre-tertiary or in-college experiences (academic or social integration), this study contributes to the literature by examining the importance of both. Furthermore, it considers two types of pre-tertiary experiences: general college preparation and pre-tertiary field-specific experiences. Women's strong pre-tertiary academic achievement suggests that there must be other factors that explain the higher non-completion rate of female students in STEM subjects. It appears, however, that women are less likely to attend vocational training or upper-secondary education courses in physics, engineering and technology. Therefore, this chapter focuses on pre-tertiary field-specific experiences.

Chapter 7 focuses on the labour market outcomes of higher-education dropouts. In Germany, many dropouts enter the labour market with additional, non-tertiary vocational training certificates. Arguing that in the German case dropouts do not necessarily compete with higher-education graduates, but rather with graduates of the vocational training system, I compare higher-education dropouts to higher-education graduates and vocational training graduates in order to identify the potential risks of higher-education dropouts regarding their education-to-work transitions and occupational positions. I examine whether higher-education dropouts benefit from additional vocational qualifications obtained outside higher education, and whether they tend to use vocational credentials as a safety net.

Chapter 8, the last empirical chapter, examines how macro-level labour market conditions affect how long it takes higher-education graduates and dropouts, respectively, to get their first job, as well as the status of that job. This chapter focuses on whether higher-education dropouts are more affected than graduates by high or low unemployment rates in their first labour market outcomes. This chapter aims to clarify the importance of a higher-education degree during economic downturns in Germany.

The final chapter summarises the study's findings and draws overarching conclusions about the causes and consequences of higher-education dropout in Germany. It closes with an extensive discussion of methodological issues, persistence limitations of the dissertation and areas for further research.

Chapter 2 Part I – Causes of Higher-education Non-completion

2.1. Theory – Part I

Higher-education non-completion is one of the most extensively studied areas in higher-education research (Tinto 2006). In the United States, and to a lesser extent in Europe, there has been considerable theoretical work – and much debate – on the reasons for higher-education non-completion. The following section reviews the main theories and conceptual frameworks that have been developed in sociology, psychology and economics that are relevant to this discussion.

2.1.1. Sociological theories

The most widespread theory used to study non-completion of higher education is Tinto's interactionalist theory (Tinto 1975, 1982, 1993). In line with earlier and subsequent theoretical approaches of interactionalist theorists (Pascarella and Terenzini 2005; Spady 1970), Tinto assumes a strong relationship between the higher-education system and the student's departure decision. Thus, socialisation during higher education, or the person–environment fit, is one of the main explanatory factors in his model.

Tinto's Student Integration Model, developed in 1975 and further extended in 1982 and 1993, explains students' decisions to drop out based on the relationship between their individual attributes and the campus environment. According to Tinto's theory, students enter higher education with a range of different background characteristics that directly influence their initial commitment to the institution and to the goal of graduating – and thus their decisions about whether to complete higher education.

Tinto's model breaks down integration into the higher-education system into two types – academic and social. The former describes the match between the intellectual orientation of the student and that of the institution. The integration process occurs both according to explicit norms, such as the individual's academic performance, and the individual's identification with the norms and values of the academic system. The degree of social integration is mainly determined by the student's interactions with peers and faculty in the form of social communication, friendship support, faculty support and

collective affiliation. According to Tinto, the more students are integrated, the greater their commitment to higher education and completing their degree, which has a direct effect on their decisions about whether to drop out.

Despite its wide use in the field of higher education, the interactionalist model has been criticised for its strong focus on the in-college phase as the decisive period in which to explain the non-completion of higher education (e.g. Bean 1985; Bean and Metzner 1985; Cabrera, Nora and Castaneda 1993). Bean (1985) and Cabrera et al. (1993) emphasise the importance of students' personal characteristics as well as environmental factors outside the higher-education system that might also influence non-completion, such as finances and encouragement from family or friends. In addition to the academic and social–psychological factors included in Tinto's model (1975, 1993), environmental factors are assumed to have a negative impact on the integration into higher education and to directly affect students' decisions to leave the higher-education system. Furthermore, Bean and Metzner (1985) develop a model suitable for studies of non-traditional students by emphasising non-institutional variables, such as finances, hours of employment, outside encouragement and family responsibilities and their interaction with academic performance. This model acknowledges that, for example, non-academic responsibilities or commitments can compete for resources that otherwise could be invested in the study.

2.1.2. Psychological theories

Psychological theories, which emphasise the importance of students' personal attributes, have only played a marginal role in the research influenced by interactionalist models, such as Tinto's Student Integration Model discussed above (Bean and Eaton 2000). Psychological characteristics and processes that may encourage students to drop out of higher education include academic aptitude and skills, motivational states and personal traits.

Bean and Eaton (2000), for example, integrated four psychological theories into their Model of College Student Retention – attitude–behaviour theory, coping behavioural theory, self-efficacy theory and attribution theory – in order to explain academic and social integration by psychological processes. According to their model,

students enter the higher-education system with several characteristics, such as past behaviour, beliefs and normative beliefs, which have a decisive influence over how they perceive the higher-education environment. Interaction with the institutional environment thus results in psychological processes that affect a student's academic motivation. If these psychological processes are successful, they facilitate positive self-efficacy, reduced stress, increased efficacy and internal locus of control. In a process of continuous adjustment, the internal processes finally lead to academic and social integration, institutional fit and loyalty, intention to persist and persistence.

Another approach to explaining the non-completion of higher education is Ethington's Model of Student Persistence (1990), which draws on models of expectancy–value theory (Atkinson 1957; Eccles et al. 1983; Wigfield 1994; Wigfield and Eccles 1992). It explains educational and occupational choices, persistence and performance as a function of (1) students' expectations of success in a given activity and (2) the subjective value of the outcome – both of which are influenced by socialisation processes in various contexts. The central constructs of the expectancy–value theory are integrated into Ethington's model in terms of *expectations of success in college* and the *perceived value of college*. They are assumed to directly influence a student's persistence to complete their degree. All other constructs have only an indirect effect on persistence, which is mediated through *values* and *expectations*. While *expectations* and *values* are driven by *self-concept* and *anticipation of difficulty*, *values* are also directly influenced by *goals*. Testing the model shows that goals are important factors in determining whether individuals complete their higher education. Helping students formulate and articulate their goals – and to understand the value of a college education – might increase their likelihood of completing a degree.

Concerning subject-specific non-completion, career choice theorists developed models that account for professional socialisation (Cech et al. 2011; Holland 1959; Holland 1973; Seron et al. 2016; Super 1957). Interactions with faculty, mentors and peers – in short, *professional socialisation* – introduce students to the beliefs and behaviours of the profession to which they aspire. They deepen their technical knowledge and practical competencies, and start to identify with (and commit to) a profession's sentiments, values and collectively supported norms. In the words of Cech et al. (2011), they develop *professional role confidence*: confidence in the ability to perform the

professional role. The higher a student's professional role confidence, the more likely he or she is to persist in its professional career path. Occupational choice theories (Holland 1959, 1973; Super 1957) further assume that a clear occupational self-concept that is in line with the chosen college major is a strong predictor of persistence in the specific profession.

2.1.3. Economic theories

The main assumption of economic theories regarding the non-completion of higher education is that students weigh the costs and benefits of staying in college and participating in various activities. In accordance with the human capital approach (Becker 1964), the economic approach assumes that students stay in college as long as the social and economic benefits of remaining in higher education are believed to outweigh any costs and benefits associated with alternative activities, such as working full time. One decisive component of this cost–benefit analysis is the student's perception of his or her ability to pay for higher education. Thus, finances play an important role in the economic approach of explaining decisions about whether to remain in higher education.

Early economic studies on persistence were primarily interested in assessing the direct effect of financial aid on persistence in education (Cabrera, Stampen and Hansen 1990; Nora 1990; Voorhees 1985). Controlling for predictors such as pre-tertiary motivational factors, pre-tertiary academic ability and achievement, demographic factors, students' socioeconomic status and college performance, these studies determined the direct effect of prices and subsidies.

More recent studies (Cabrera et al. 1992; St. John 1994; St. John, Paulsen and Starkey 1996) modified the early models by accounting for the more complex effects of finances on the non-completion of higher education. They address the ways in which financial circumstances interact with other important factors of persistence. In addition, they take into account the importance of institutions by merging the economic perspective (Becker 1964) with Tinto's (1975, 1993) student–institution fit perspective. The nexus model of St. John et al. (1996) constitutes a link between college choice and persistence, and clarifies the role of finances in student matriculation into (and persistence in) higher education. In line with the model, a three-stage process shapes persistence in college. In

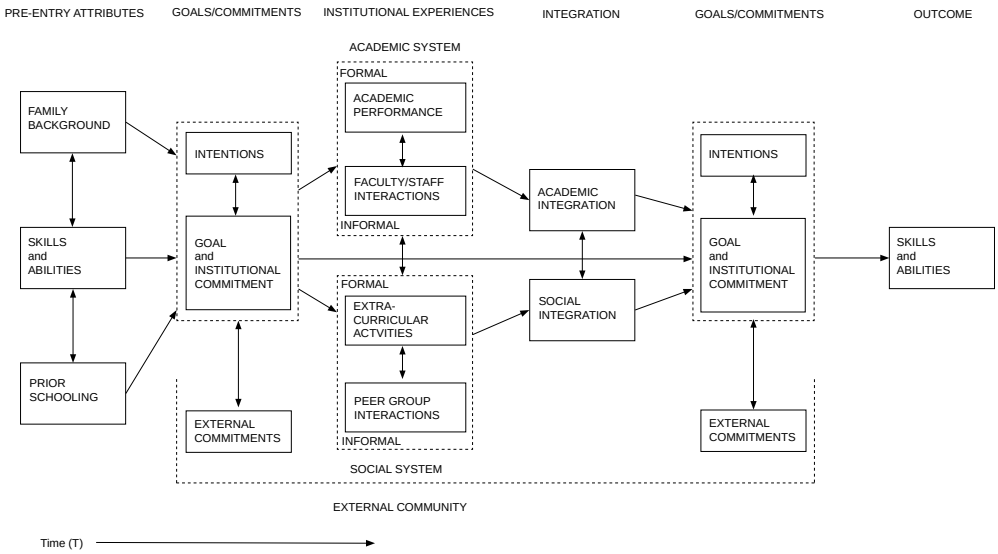
the first stage, socioeconomic factors and academic ability are assumed to affect a student's predisposition to pursue a college education as well as perceptions of their financial circumstances. In the second stage, a cost–benefit calculation associated with a specific higher-education institution takes place. In this pre-tertiary phase, financial aid is assumed to influence enrolment plans and the choice of a particular institution. The third stage can be described as the in-college period, during which social and academic experiences as well as academic performance modify educational aspirations. In the case of positive in-college experiences, students' perceptions of the economic and non-economic benefits associated with enrolment, and the institution in general, are enhanced. Concerning finances, the model predicts that financial aid will encourage students to remain in higher education, while an increase in tuition will push them toward non-completion.

Further economic models related to the non-completion of higher education focus on the impact of cost–benefit calculations on the type of enrolment (full- or part-time enrolment) (Stratton, O'Toole and Wetzel 2004) and the utilities of continuous enrolment, short-term enrolment and long-term enrolment to explain different in-college outcomes (Stratton, O'Toole and Wetzel 2008).

2.1.4. Summary

The above-mentioned theories on higher-education non-completion reveal that several major causes or roots typically influence an individual's decision to drop out of the higher education system. For an analysis of higher-education dropout, theoretical models are needed that account for a variety of causes. Tinto (1975, 1993) developed such a model for the United States (see Figure 1).

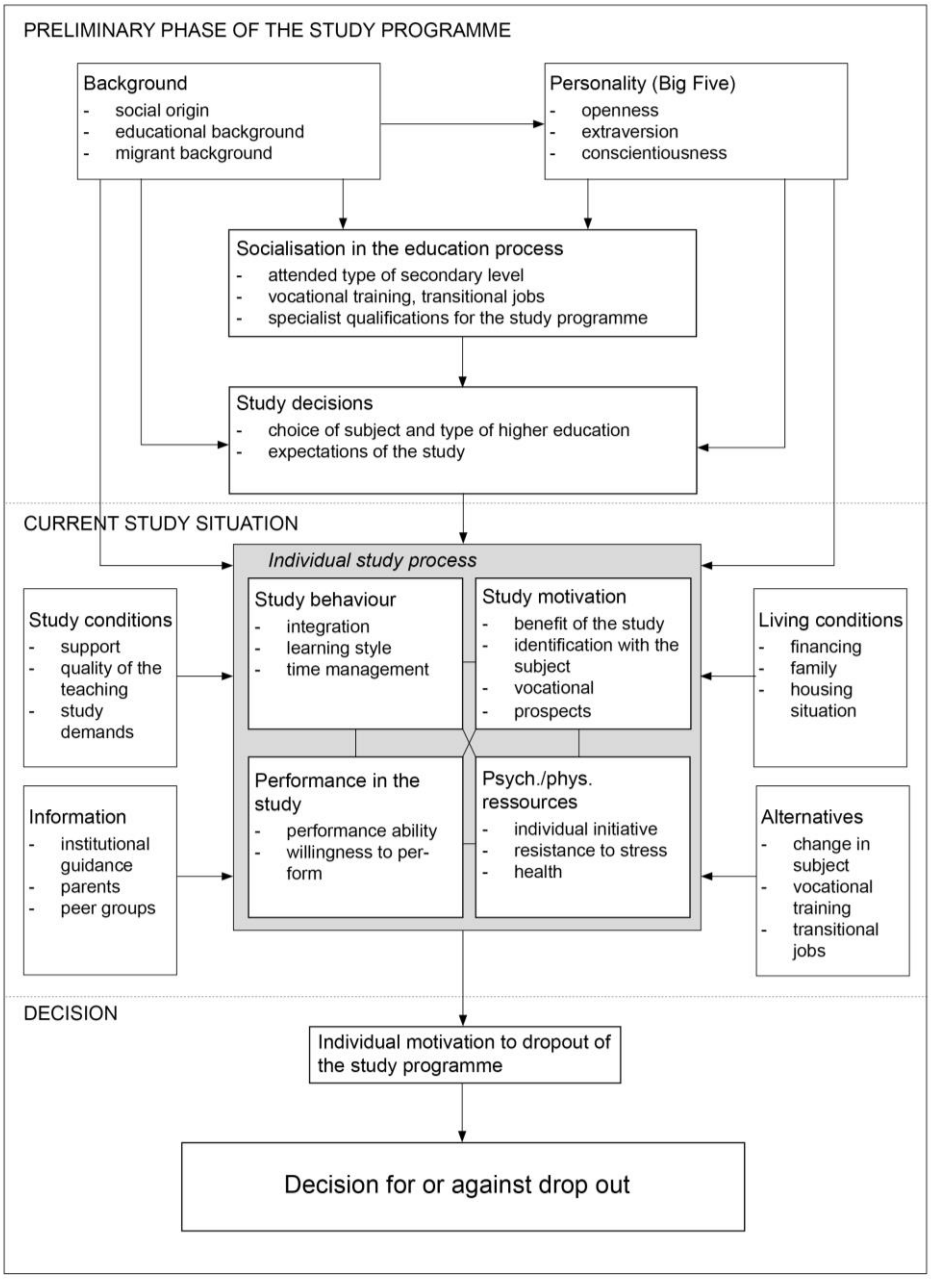
Figure 1: A longitudinal model of institutional departure



Source: Tinto (1993), p. 114.

His model describes non-completion on the basis of the dispositions with which individuals enter higher-education institutions, experiences they have after their entry and external forces that influence students' experiences within the institution. This model includes important factors from sociological, psychological and economical conceptual frameworks, although it is primarily sociological in character: the most important part is individuals' social and intellectual context. Heublein (2014: 530) applies Tinto's basic assumptions to develop a model that describes higher-education non-completion in the German context as the result of "a specific inter-relationship of individual qualifications and institutional conditions".

Figure 2: Model of the dropout process



Source: Heublein (2014), p. 504.

According to Heublein (2014), the process of deciding whether to drop out is based on different phases and includes different influencing factors. Like Tinto (1975, 1993), Heublein's (2014) theoretical 'Model of the dropout process' (see Figure 2) also draws

attention to conditions outside the higher-education system. These context conditions include structures imposed by the pre-tertiary education system and the labour market, which influence the resources and restrictions of higher-education students. They are assumed to have a direct influence on students' decisions to drop out of higher education. Despite this strong theoretical assumption, German empirical research on higher-education non-completion mainly focuses on factors other than prior educational and occupational pathways. Furthermore, research that takes the preliminary phase of the study programme into consideration finds inconsistent results.

To understand the importance of the context conditions outside the higher-education system, below I describe the structure of the German education and training system, including pathways to higher-education entry qualification. The German educational system provides many different educational opportunities and is well known for its vocational training system. Thus, it is much more flexible in allowing many different educational paths than the American system (Becker 2001). A considerable proportion of students enters higher education after periods of vocational training, labour force participation or via second-cycle qualifications (Heine, Krawietz and Sommer 2008; Jacob 2004; Jacob and Weiss 2008; Schindler and Reimer 2011). Therefore, German higher-education students form a heterogeneous group in terms of their educational and occupational qualifications and experiences, which are assumed to have a direct impact on higher-education non-completion in Germany. After the description of the institutional setting in the first part of this dissertation, the empirical results of previous research on higher-education non-completion in Germany will be explained, followed by the guiding research questions of the first part of the work, which relate to the *causes* of higher-education non-completion in Germany.

2.2. The institutional setting – Part I

2.2.1. German education and training system

The German secondary education system is characterised by a tripartite system (Müller, Steinmann and Ell 1998). The most demanding track is the *Gymnasium* (upper-secondary school), which is academically orientated and leads to an upper secondary qualification

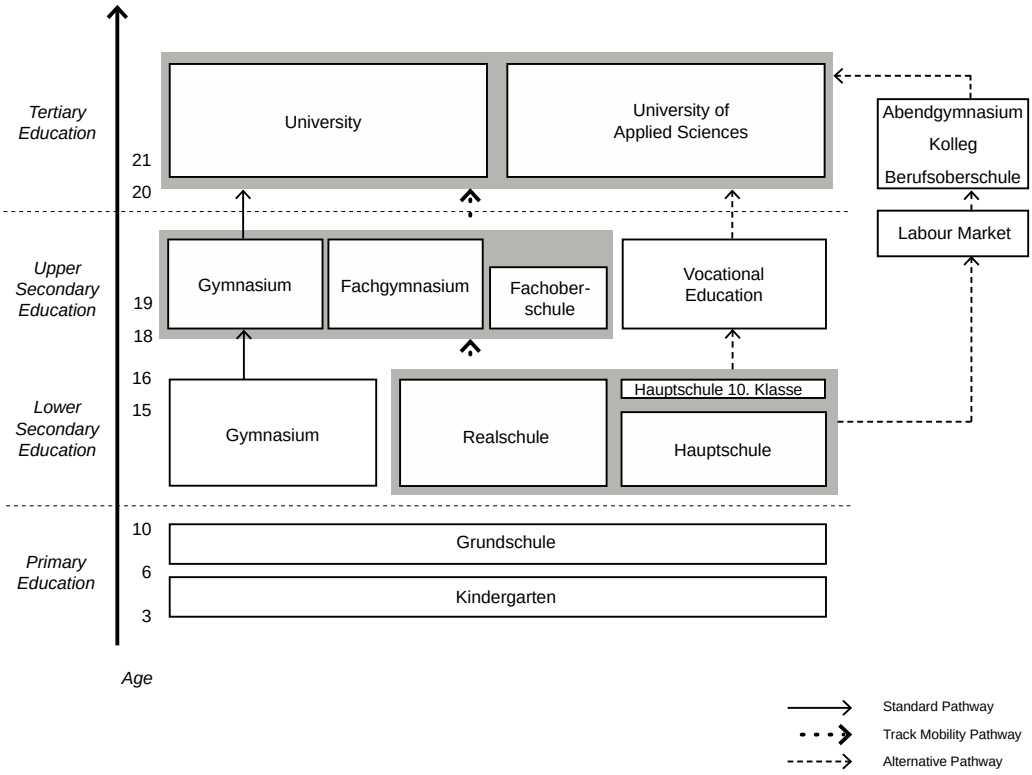
(*Abitur*) after 13 years of schooling. The second track is the slightly less demanding *Realschule* (intermediate secondary school). After 10 years of schooling, this track leads to a *Mittlere Reife* degree. The least demanding track is the *Hauptschule* (lower secondary school). This track provides a basic general educational qualification (*Hauptschulabschluss*) and represents the earliest exit – after nine years of schooling – from the general education system.

The German vocational training system comprises two main types. The core of vocational training in Germany is its so-called dual system of apprenticeship, which combines formal schooling with on-the-job training in the form of in-company apprenticeships (Müller, Steinmann and Ell 1998; Walden and Troltsch 2011). The second type is the purely school-based vocational training at vocational schools, which plays only a minor role in the overall vocational training system (Autorengruppe Bildungsberichterstattung 2014, 98ff.). After completing a vocational training degree, students are allowed to participate in further training programmes to become a *Meister* or *Techniker*. These additional qualifications are required to establish one's own craft enterprise.

2.2.2. Pathways to higher-education entry qualification

Although there are differences between the federal states in the final structure of the educational system, each has three main pathways for obtaining entry qualification for higher education. I refer to them as the *standard pathway*, the *track mobility pathway* and the *alternative pathway*. Figure 3 provides an overview of these pathways.

Figure 3: Pathways in the German education system



Source: Own diagram

The two *standard pathways* can be described as follows. Entering the *Gymnasium* (upper-secondary school) after primary school, obtaining an upper-secondary diploma (*Abitur*) and directly transferring to higher education is the most common pathway in the German educational system. Although it is possible to obtain a general entry qualification via comprehensive secondary education schools (*Gesamtschulen*),[3] most students attend a Gymnasium.

The second way in which to enter higher education is via *track mobility*. Under certain conditions, mainly based on performance and the foreign language curriculum in the lower-secondary school, *Hauptschule* or *Realschule* graduates may enter upper-secondary education and obtain a full university entry qualification. Students pursuing this track mostly attend *Fachgymnasien/berufliche Gymnasien* or *Fachoberschulen*,

[3] Comprehensive schools enrol students of all ability levels in the German secondary education system. The restructuring of the German threefold secondary education system started in the 1970s. However, the proportion of these comprehensive schools is rather small.

which provide general as well as field-specific training. While graduates of the former mostly obtain a general entry qualification (*allgemeines Abitur*), graduates of the latter are only permitted to enter universities of applied sciences, due to their restricted entry qualification.

The *alternative pathway* is mainly taken by students who left the general secondary education system but still want to obtain a higher-education qualification – often after a period of employment or vocational training. Given certain curricular and performance requirements, students who graduate from a vocational training course can be eligible for higher education after their final vocational training exam. The obtained entry qualification, however, is mostly restricted to universities of applied sciences (*Fachhochschulen*). Students who have undertaken additional specialist vocational training (*Meister/Techniker*) after their general vocational training also obtain restricted entry qualifications (*Fachhochschulreife*) for higher education and can enter a vocation-related field. This pathway is the second-most common way to obtain a higher-education entry qualification. Another way is to enter "second-cycle" educational institutions, such as full-time *Kollegs* courses or *Abendgymnasien* and *Abendschulen* evening schools, which can be attended by those in full-time employment. Overall, relatively few students enter higher education via second-cycle institutions (Schindler 2014).

In summary, there are several ways to obtain a higher-education entrance qualification in Germany. In addition to the pathways described above, an increasing proportion of general upper-secondary education graduates, who already meet the entry requirements for higher education, choose to enter vocational training first and then pursue higher education (Hillmert and Jacob 2004; Jacob 2004). Currently, one-fifth of all current higher-education students first attended vocational training (Autorengruppe Bildungsberichterstattung 2014).

2.3. Previous research – Part I

German higher-education research offers many reasons for higher-education non-completion, most of which refer to factors other than educational and occupational experiences outside higher education, as the following summary shows. In general, the

reasons for dropping out can be attributed either to a failure of the higher-education system or the student.

Research at the institutional level defines higher-education dropout mostly as a result of institutional failure, which tends to relate either to the provision of information or the quality of the study conditions. There is evidence, for example, that students are more likely to drop out if there is a mismatch between their expectations and the reality of higher education. Institutions can help reduce dropouts due to this reason by providing prospective students with information on the academic requirements, professional contents of the field of study and occupational prospects (Blüthmann, Thiel and Wolfgramm 2011; Hadjar and Becker 2004; Heublein et al. 2010). It is assumed that the better informed students are in advance, the lower the gap between expectations and reality. Research on the provision of information, however, shows inconclusive results, and there is little empirical evidence on whether the lack of information has a direct effect on the likelihood of dropping out (Klein and Stocké 2016).

The results concerning study conditions are somewhat clearer, although only small relative effects can be found. Heublein et al. (2010), for example, find no differences in the evaluation of technical and room equipment between higher-education graduates and dropouts. This is in line with the results of Hadjar and Becker (2004), who also find that study conditions have no effect on students' intentions to leave higher education. However, the quality of teaching seems to have some explanatory power (Blüthmann, Thiel and Wolfgramm 2011; Heublein et al. 2010; Schiefele, Streblow and Brinkmann 2007). The didactic quality of the faculty, as well as faculty support and the practical relevance of the study content seem to be important factors in explaining higher-education non-completion at the institutional level (Georg 2008; Heublein et al. 2010).

At the individual level, two main reasons for dropping out can be found in German higher-education research. First, research on individual background characteristics shows that sociodemographic factors such as gender, race and social background are decisive components for predicting the non-completion of higher education (Autorengruppe Bildungsberichterstattung 2014; Müller and Schneider 2013; Pohlenz and Tinsner 2004). Males, non-Germans and students from lower social backgrounds are more likely to drop out. Second, there is evidence that experiences during higher education are important predictors of higher-education non-completion.

Heublein et al. (Heublein et al. 2010; Heublein and Wolter 2011), for example, find that there are three main reasons for dropping out. The first reason refers to performance-related problems. On the institutional dimension, students who drop out complain about a too-heavy workload and too-high academic requirements. On the individual dimension, students who fail to complete higher education suffer from personal unsuitability and performance-related pressure. The second reason is financial problems, primarily difficulties in balancing study and work. The third reason Heublein et al. (Heublein et al. 2010, Heublein and Wolter 2011) find is a lack of study motivation. These students are more likely to drop out due to a lack of identification with their field of study and its vocational opportunities.

The above summary shows that considerable research has been conducted on higher-education non-completion in Germany, yet there are limitations in the research approaches used. For example, they strongly differ in their research questions, research design, methods and data. Thus the above-listed empirical results should be considered with caution for three reasons (Blüthmann, Lepa and Thiel 2008; Heublein 2014; Klein and Stocké 2016). First, it remains questionable whether the results have national validity, as much work focuses on only one higher-education institution, such as the University of Potsdam (Pohlenz and Tinsner 2004; Pohlenz, Tinsner and Seyfried 2007), the University of Bielefeld (Schiefele, Streblow and Brinkmann 2007) or the University of Berlin (Thiel, Blüthmann and Richter 2010). Second, the direct impacts of the factors of non-completion discussed above are uncertain, as the results are often based on bivariate analyses despite the obvious multivariate character of the underlying mechanisms (e.g., Heublein et al. 2010). Third, German research is often based on prospective data, which allows the examination of only *intended* dropout (Bargel, Ramm and Multrus 2008; Blüthmann, Thiel and Wolfgramm 2011; Fellenberg and Hannover 2006).

In addition to individual background characteristics and in-college experiences, there is some evidence that pre-tertiary vocational training experiences are also important for explaining higher-education dropout in Germany. While the results related to pre-tertiary experiences such as pathways to higher education, type of higher-education entrance qualification or pre-tertiary academic performance are more or less clear, the results on vocational certificates or labour market experiences obtained prior to higher

education are inconsistent. Concerning the former, Brändle and Lengfeld (2016), for example, find that non-traditional students perform worse than those who have a general higher-education entrance qualification. This result is in line with the findings of Müller and Schneider (2013), which show that pathways diverting from the general track to higher education – entering higher education directly after obtaining a higher-education entrance qualification from upper-secondary school – make completing higher education more likely. Concerning occupational experiences, they find that students with pre-tertiary vocational training qualifications have a high risk of leaving higher education before graduating. This has also been found by Heublein et al. (2010). In contrast, Meulemann (1991) and Tieben (2016) do not find evidence that prior vocational training is detrimental to success in higher education. Tieben (2016), for example, shows that first-year students with and without pre-tertiary vocational qualifications do not differ in their risk of dropping out of higher education in Germany.

In summary, much research has focused on the causes of higher-education dropout in Germany. This research mainly focuses on factors other than pre-tertiary educational and occupational experiences and has many limitations, such as a restricted focus, and inadequate methods and data. These limitations call into question the generalisability of the empirical results. Furthermore, despite the strong theoretical assumption of the importance of pre-tertiary vocational training experiences for higher-education non-completion (see 'Summary' in the 'Theory' section), research on pre-tertiary educational and occupational experiences is limited. Moreover, the results are inconsistent, especially concerning vocational certifications. This might be due to the fact that most studies perceive the non-completion of higher education as dropping out altogether (e.g. Griesbach et al. 1998; Lewin 1995; Müller and Schneider 2013). Non-completion, however, may also apply to students who change programmes at the same or a different institution, or those who take an extended break in their studies. In order to properly investigate student departure, there must be a distinction between students who leave higher education permanently and those who leave it temporarily. In addition, most literature focuses either on pre-tertiary experiences *or* in-college experiences. To identify the main mechanisms responsible for higher-education non-completion, it is important to consider both types of experiences. Otherwise, the research may be plagued by confounding or spurious relationships.

2.3.1. Guiding research question – Part I

In Part I, this dissertation contributes to the existing literature by addressing the following guiding research question: *How do pre-tertiary educational pathways affect higher-education non-completion in Germany?*

To answer this question, in Chapter 5 I will first analyse the impact of pre-tertiary experiences on different types of non-completion in Germany. Using data from the National Education Panel Study (NEPS), Starting Cohort 6 – Adult Education and Lifelong Learning, I am able to extend the notion of non-graduation by distinguishing between permanent dropout and non-completion that is followed by an later course in higher education. In a second step, in Chapter 6, I will examine the importance of pre-tertiary and in-college experiences for higher-education non-completion together. Using NEPS Starting Cohort 5 – First-Year Students, I am able to expand the analysis by including in-college factors such as academic and social integration.

Chapter 3 Part II – Consequences of Higher-education Non-completion

3.1. Theory – Part II

While the previous chapter focused on the theoretical concepts concerning the *causes* of higher-education non-completion, this section examines the theoretical concepts concerning the *consequences* of dropping out (i.e., the labour market outcomes of higher-education dropouts). Specifically, it reviews the theories and conceptual frameworks that have been developed to examine the impact of educational attainment on labour market outcomes.

3.1.1. Human capital theory

One dominant theoretical model to calculate the labour market returns from education is the human capital theory. The basic assumption of human capital theory (Becker 1964; Mincer 1958; Mincer 1989; Schultz 1962) is that differences in labour market returns can be explained by differences in productivity levels. Individuals invest in human capital by pursuing education and on-the-job training to enhance their productivity for the labour market: additional years of schooling or time spent in the labour market improve individuals' innate intellectual ability with skills that enhance their productivity at work, and for which employers are willing to pay extra. Thus, time spent in school or working increases wages by directly increasing an individual's productivity. The process of investment in human capital, however, involves potential costs and benefits. The former include the direct costs of schooling, such as tuition, books and other educational expenses, as well as indirect or opportunity costs – earnings from work that are foregone to attend school. The anticipated benefits include increased wages, more attractive employment opportunities, and higher status and social prestige.

In line with neoclassical labour economics, human capital theory claims that individuals behave rationally and must decide how best to optimise their investments in human capital. Hence, individuals invest in human capital as long as the benefits of additional schooling or training recoup the initial costs *and* yield a rate of return at least

as high as alternative investments of time and money. Furthermore, investment in human capital and the demand for qualifications produce a self-regulating equilibrium in the labour market according to the laws of supply and demand, which hold that, all else being equal, supply and demand adjust to each other through the price mechanism. For example, if the supply of educational qualifications exceeds the demand for such qualifications, wages (i.e., the price) will fall until a new equilibrium between supply and demand is reached. A similar adjustment occurs when demand exceeds supply, in the case of an undersupply of qualifications.

Gary Becker (1993) emphasises that there are two distinct forms of human capital – general and specific. Becker predominately refers to them as on-the-job training; however, a substantial portion of training takes place in the educational system before entering the labour market. While educational systems mainly provide general human capital, students can obtain general and specific human capital in the apprenticeship system. General human capital increases a worker's productivity, which is valuable to both the company providing it and to other companies in the labour market. Specific human capital increases the worker's productivity only for the company providing it. As specific human capital cannot be easily transferred to other firms, firms (but not employees) have an incentive to invest in specialised training.

Although human capital theory drops the assumption in the neoclassical labour economics literature that workers are perfectly homogeneous, it has been criticised for two other assumptions that do not capture real processes in the labour market. First, the assumption of perfect information stresses the applicability of human capital theory to the job search process. At the time of hiring, the employer is uncertain about each applicant's actual level of productivity (Bills 2003; Spence 1973; Spence 1981; Weiss 1995), and applicants do not have full information on all relevant labour market aspects in order to be sure of maximising their earnings in that job. The second assumption is about the homogeneous nature of the labour market. Sociological approaches in particular emphasise that labour markets are segmented due to differences in institutional regulations (Coleman 1991; Sørensen and Kalleberg 1981; Thurow 1979; Thurow 1975). Furthermore, the supply and demand of work is subject to structural changes, which in turn affect the arrangement of employment relationships and therefore should also be taken into account.

3.1.2. Signalling and screening theory

Signalling and screening theories (Arrow 1973; Spence 1973; Spence 1981; Stiglitz 1975; Weiss 1995) abandon another assumption of the neoclassical model – perfect information. In reality, economic agents have highly imperfect information about both the quality of jobs and work employment and about individuals' qualities. Since employers cannot assess an applicant's productivity levels, Spence (1973) describes the hiring process as an investment under uncertainty. Thus, strategies are needed to master the problem of asymmetric information. One such strategy is screening. According to Stiglitz (1975) and others (e.g. Chiswick 1973; Grubb 1993; Riley 1976; Riley 1979), employers can use screening (primarily education) to cope with the imperfect information about the qualities of job searchers. Arrow (1973), for example, defines higher education as the most important screening device to provide information about an applicant's productivity by sorting individuals by ability. In his model, higher education serves as a two-tier filter to signal productive ability: (1) gaining admission to a higher-education institution and (2) graduating from the institution. Thus, enrolment in higher education can serve as a positive signal for employers, and may enhance applicants' labour market chances even if they did not obtain a higher-education degree.

Broadly speaking, employers screen applicants on the basis of observable characteristics such as a college diploma to determine their productivity. As already indicated, labour market signalling complements the screening approach, which has its origins in Spence's signalling theory (1973, 1981). According to Spence, employers use observable characteristics – such as educational attainment, work experience, gender and other individual attributes – to evaluate an applicant's potential productivity. Concerning the observable characteristics, Spence distinguishes between indices (i.e., unalterable individual attributes, such as gender or race) and signals (i.e., observable characteristics that can be changed, such as education). A potential signal becomes active only if the signalling costs – the investment costs of acquiring a signal – are negatively correlated with the applicant's unknown productivity level (Spence, 1973: 358). This assumption is the premise for individual differences in signals such as education, which is ultimately valued on the labour market. Weiss (1993) also stresses the importance of education as a signal or filter for productivity differences between applicants. In his sorting model, he

combines the processes of signalling and screening of educational credentials, which serve to sort workers according to their unobservable abilities. The basic assumption is that firms value education because of the assumed relationship between applicants' observable characteristics (such as educational degree) and unobservable characteristics or traits (such as perseverance). Individuals with a higher level of perseverance are more likely to acquire higher-educational degrees, which in turn means that higher-educational degrees serve as a signal for perseverance. Similarly, Arkes (1999) finds that employers value higher-education degrees because "the acquisition of those credentials mark unobservable attributes such as motivation, character and perseverance" (140).

In conclusion, in both of these mainly supply-sided concepts, education plays a decisive role in either the form of a screening device (e.g. Arrow 1973) or in the form of observable signals (e.g. Spence 1973, 1981; Weiss 1993, Arkes 1999). However, once an individual has entered the labour market, employers can directly obtain information to determine their true productivity. At that point, observable characteristics other than education should become more important for determining an individual's value in the labour market (i.e., salary).

3.1.3. Matching and job competition theory

As mentioned above, one major criticism of human capital theory (but also the signalling and screening theories) is its one-sided focus on employees. The following concepts – the matching theory and the job competition theory – pay attention to both the supply and demand sides; the job competition theory, however, focuses more on the demand side. Hence, they demonstrate that employers as well as job seekers are important in the process of matching individuals to jobs (Sørensen 1977; Sørensen and Kalleberg 1981; Thurow 1979; Thurow 1975). It is assumed that a match occurs if two conditions are met simultaneously: (1) employers regard an applicant as suitable for the specific vacancy and (2) the applicant perceives the characteristics of the job as appropriate and in agreement with his or her preferences. In line with the job competition theory (Thurow 1975, 1979), two queues have to be matched to each other—the labour queue and the job queue. In the latter, jobs are ranked according to their rewards and attractiveness to employees. In the former, employees are ranked on the basis of their future training costs. In the dual-

queuing process, applicants will prefer the job that is foremost in the job queue, while employers will choose the applicant who is foremost in the labour queue. The basic assumption of the theory is that individuals always have to be trained on the job to perfectly fit its specific requirements. Thus, the employer's aim is to choose an applicant who can be trained to generate the desired marginal product of the job with the least investment in training costs (Thurow 1975:18). The individuals with background characteristics that signal the lowest training costs are the most highly desired. Once again, educational attainment is one of the primary signals. Contrary to the economic concepts described above, education does not signal productivity and thus does not determine an individual's wage expectancy. According to the concept of job competition, productivity and wages are determined by the requirements of the job. Educational degrees are used to indicate an applicant's trainability and therefore estimate his or her specific training costs. Therefore, the best jobs will go to the most-educated and the worst jobs to the least-educated applicants. However, individuals with the same educational degree are not always placed at the same position in the labour queue, and do not enter the labour market at the same position. Placement is strongly dependent on changes in supply and demand. Educational expansion, for example, is assumed to lead to a downward shift for all less-educated individuals in the labour queue. Occupational upgrading, however, might result in an upward shift for less-educated individuals, but only if educational expansion and occupational upgrading are not concurrent. Finally, education is argued to be a positional good: the extent to which education pays off in the labour market is dependent on the educational composition of the pool of job seekers.

In summary, the advantage of the job competition theory over the matching theory is that the former more realistically models the relationship between labour supply and demand, and takes into account structural changes such as educational expansion and occupational upgrading. Furthermore, both theories emphasise the importance of education as a positional good, meaning that an individual's job returns do not depend on the absolute amount of education he or she requires, but on the relative investment needed in relation to others. In addition to serving as a signal or positive good, education can also act as an entry requirement for specific positions in the labour market (Collins 1971; Collins 1979), which will be discussed in the next section.

3.1.4. Credentialism theory

According to credentialism theory, educational degrees function as a legitimate closure mechanism. People with specific educational levels can enter specific jobs that require these qualifications, regardless of their productivity (Weeden 2002). For example, if a certain profession requires a doctoral degree, employers do not consider applicants with other certificates; likewise, people without this qualification will not apply in the first place, knowing that they have no chance. Therefore, access to scarce, elite labour market positions is regulated through accreditation, certification or licensing (Bills 2004). Consequently, credentialism theory argues that credentials are only minimally associated with job skills, duties or worker productivity, but derive their value from their ability to be traded for lucrative jobs (Berg 1971; Bills 2003; Collins 1979). In other words, credentials have an exchange value (Labaree 1997; Labaree 2004): they can be exchanged for something, usually a job, irrespective of what was actually learned or gained during their acquisition. Thus, people gain degrees not in order to obtain the skills and knowledge that will help them in their future work life, but due to their exchange value in the labour market.

3.1.5. Summary

Thus it is clear that education plays an important role in determining occupational outcomes. Human capital approaches assume that educational investments, such as time spent in education, result in skills that increase individuals' productivity (and, consequently, their returns) in the labour market. Signalling and screening theory expect that employers screen potential employees on the basis of observable characteristics such as educational attainment. Matching theory and job competition theory define education as a positional good: the occupational returns are dependent on the individual's educational qualification in relation to others. And according to credentialism theory, education acts as an entry requirement for specific positions in the labour market.

Educational qualifications have a greater impact on occupational outcomes at the start of an individual's career, when they lack work experience. Thus employers can only rely on educational credentials to select the job applicant who best meets the requirements of an entry-level position with the least investment in on-the-job training.

Institutional conditions, however, strongly determine the signalling value of educational qualifications. Whether educational attainment can be used as a reliable and useful indicator of productivity depends on the configuration of the education and training system. The more clearly educational credentials indicate what individuals have learned, and the closer the link between specific qualifications and occupational requirements, the greater the signalling power of educational attainment and the higher the first labour market outcomes. It seems obvious that higher-education dropouts should obtain lower first occupational outcomes than higher-education graduates. As mentioned above, Germany is well known for its strong vocational training sector, which provides occupation-specific skills; almost 40 per cent of all dropouts hold a non-tertiary vocational qualification when they leave higher education (Tieben 2016). While research shows that a vocational training degree does not produce additional labour market benefits for higher-education graduates (Büchel and Helberger 1995; Hammen 2011), the impact of vocational qualifications for higher-education dropouts has not been examined.

In addition, the signalling value of educational qualifications is not only determined by institutional conditions; changing macroeconomic conditions, such as unemployment rates, also have an effect. Labour market entrants have been found to be the most affected by worsening macroeconomic conditions (Ryan 2001). Furthermore, changes in the business cycle are an important factor in explaining the poor labour market outcomes of low-skilled workers, especially in Germany (Klein 2015; Pollmann-Schult 2005). The impact of macro-level labour market conditions on the first jobs secured by higher-education dropouts in Germany has not yet been examined.

To understand the importance of educational and vocational qualifications for the first jobs secured by education leavers in Germany, the next section describes the institutional setting of the second part of the dissertation – the specificity of the German education system and labour market and how it has changed over time. This section is followed by a brief outline of the empirical results of previous research on the consequences of higher-education non-completion in Germany and ends with the guiding research question of the second part of the dissertation.

3.2. The institutional setting – Part II

3.2.1. Specificity of the German education and training system

Comparative research on the education-to-work transitions of education leavers has found that the three most important characteristics of the education and training system are the degree of stratification, standardisation and occupational specificity (Allmendinger 1989a; Allmendinger 1989b; Kerckhoff 2001; Müller and Shavit 1998). All three characteristics enhance the signalling capacity of educational credentials in the labour market. The *degree of stratification* measures whether there are clearly distinct tracks in the education system that offer different levels and kinds of requirements and training. Therefore, the more that education and training are organised into different institutions and tracks, the more accurately employers can determine leavers' education qualifications. *Standardisation* indicates the extent to which educational requirements are implemented nationwide: standardised teaching curricula provide more reliable signals of educational qualifications and therefore make hiring decisions less risky. *Occupational specificity* defines whether the educational system provides occupation-specific competences rather than more general knowledge or cognitive abilities. Students from education and training systems that provide highly occupation-specific skills are perfectly prepared for specific jobs and therefore require less training investment by employers.

The German education and training system is characterised by a high degree of stratification, standardisation and occupational specificity (Kerckhoff 2001; Müller, Steinmann and Ell 1998). The German vocational training system also shows a relatively high degree of standardisation and occupational specificity: the curricula, length of training, and examinations and certification are defined by the chambers of trades, industry and commerce, which ensures a high level of comparability between vocational training degrees. Consequently, employers can trust that vocational credentials represent well-defined skill sets (Shavit and Müller 2000). Furthermore, the vocational system provides occupation-specific skills for hundreds of occupations after a training phase of up to three and a half years (for a comprehensive description see Brauns 1998; Hamilton and Lempert 1996). These skills and knowledge are directly transferable to particular occupations and industries.

In the highly stratified German secondary education system, students are separated early on into three types of secondary schools, which differ greatly in their curricula. Occupational specificity is less pronounced within the higher-education system than within the vocational training system. However, the two main higher-education systems[4], universities and universities of applied sciences, offer terminal degrees that provide strong signals of occupational specificity in the labour market (Leuze 2010; Müller, Brauns and Steinmann 2002). In particular, universities of applied sciences engage in occupation-orientated training that provides the practical skills and know-how necessary for employment in a particular occupation (for example, architecture, engineering, management studies, etc.). Universities also provide courses that are specific to future professions, either for advanced research programmes (for example, history, philosophy, mathematics, etc.) or professions with high skill requirements (for example, medicine, dentistry, pharmacy, etc.) (Leuze 2010).

3.2.2. Specificity of the West German labour market system

Concerning institutional labour market characteristics, current comparative research on first labour market transitions identifies two relevant dimensions – the degree of occupationalisation and the degree of labour market flexibility in the transition system (Hannan, Smyth and McCoy 1999; Russell and O'Connell 2001). Occupationalisation refers to the extent to which students are trained for work in specific occupations. Labour market flexibility refers to the degree to which labour market regulation allows for the use of flexible types of work contracts (Gangl 2003a).

One common approach to explaining country differences in the degree of occupationalisation is to contrast countries that follow the occupational labour market tradition with those in which the internal labour market is predominant (Marsden 1990; Marsden 1999; Marsden and Ryan 1995). In countries with an occupational labour market, such as Germany, there is a strong link between the education system and the labour market. The education system provides occupationally specific skills that strongly determine access to labour market positions and patterns of labour market mobility. In

[4] Other higher education systems are universities of cooperative education (*Berufsakademie*), business academies (*Wirtschaftsakademien*) and academies of public administration (*Verwaltungsakademien*)

other words, the occupational labour markets are segmented along occupational lines. As a result, labour market entrants experience less job mobility, since they are generally guaranteed to find an adequate first job (Allmendinger 1989a). In general, occupational labour market systems are characterised by a strong orientation towards external recruitment patterns and inter-company mobility (Gangl 2003b). In internal labour markets, by contrast, the process of matching educational credentials and occupational positions is less pronounced. Due to the more general skills students obtain in the education system, recruitment occurs for entry-level positions, and a substantial amount of training and advancement happens in the workplace (Gangl 2003b; Marsden 1999).

One of the most relevant labour market regulations to education-to-work transitions is that strong employment protection legislation (Müller and Kogan 2010) on permanent employment in the German labour market increases the probability of staying in the same company, as it enhances the stability of work relations (Estevez-Abe, Iversen and Soskice 2001). Thus, the German labour market features high job stability and low turnover rates, and labour market outsiders are disadvantaged compared to insiders (Flanagan 1988; Lindbeck and Snower 1988). Thus it is somewhat more difficult for education leavers to enter the labour market, as they are in a weak competitive position compared to experienced workers (Müller and Kogan 2010).

3.2.3. Structural changes in the education and labour market system

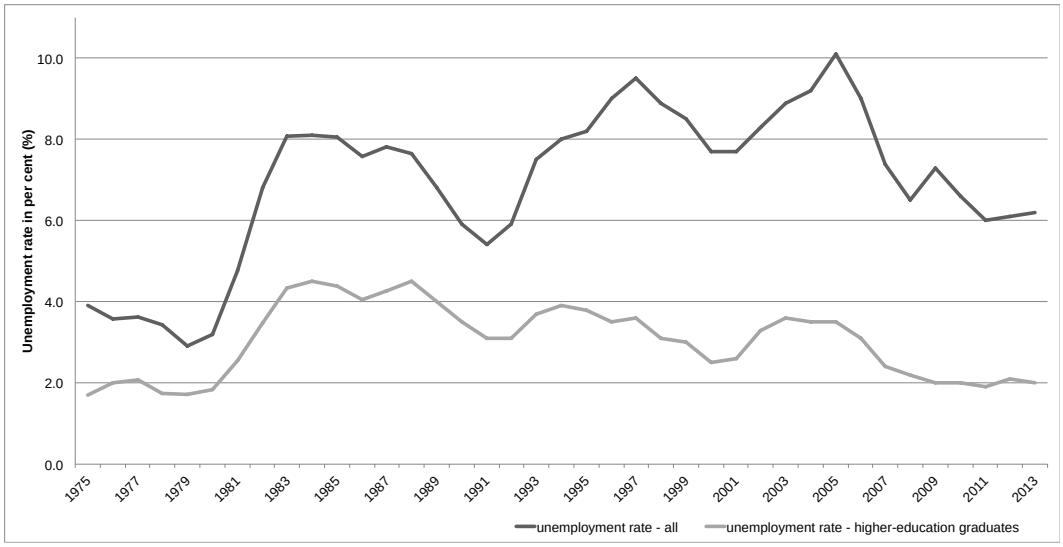
Education-to-work transitions, however, also depend on the educational supply and demand (Müller and Kogan 2010), which is mainly driven by changes in structural conditions, such as the speed of educational expansion, the change in demand for qualifications resulting from changes in occupational structures and economic cyclical changes (Gangl 2003a). Like other developed countries, Germany has experienced an expansion in higher education since the 1960s. However, its expansion has been rather modest compared to other countries (Müller et al. 2009; Müller and Wolbers 2003; OECD 2011). After a steady increase in the absolute number of higher-education students between 1960 and 1996, educational attainment has stagnated since the mid-1990s, with another sharp increase since 2002. It has thus not experienced credential inflation, as relatively few individuals obtain a higher-education degree.

Rapid structural changes occurred in the labour market alongside Germany's educational expansion. While there was continuous growth and differentiation within the service sector, occupations in manufacturing gradually disappeared. Along with technological and organisational changes (e.g. OECD 2008), the skill requirements for the workforce have shifted. Occupational fields with low educational requirements have declined – or even stagnated – over the years (Schmidt 2010), while jobs requiring academic qualifications have gradually increased (Acemoglu 2002; Katz 1999). This occupational upgrading has more or less paralleled the expansion of higher education (Oesch and Menes 2011).

The aggregate unemployment rate in the total labour force serves as an indicator of economic developments.[5] Figure 4 provides an overview of the unemployment rates in West Germany from 1975 till 2013. In contrast to the unemployment rate of higher-education graduates, which remained relatively stable over the last years, the unemployment rate in the total labour force shows a general increase between 1976 and 2013, with pronounced cyclical changes. The growth of the unemployment rate was very strong at the beginning of the 1980s and 2000s, with peaks in the mid-1980s and in 2005. The increase at the beginning of the 1990s, however, was rather moderate and peaked at the end of the decade. The second oil crisis was responsible for the increase in the unemployment rate in the 1980s, while the growth of unemployment in the 1990s was due to the post-reunification recession. The most recent increase in unemployment can be partly explained by the end of the information technology boom. All three economic downturns have been followed by an improvement in the economic conditions in the second half of the decade (Kleinert and Jacob 2013).

[5] Another comparable indicator is the gross domestic product (GDP).

Figure 4: Unemployment rates in West Germany



Source: IAB-Kurzbericht (Weber and Weber 2013)

3.3. Previous research – Part II

Research on the consequences of higher-education non-completion at the individual level shows both positive and negative tendencies. On the one hand, dropping out is often described in the literature as a personal failure (Schröder-Gronostay and Daniel 1999), and seems to put psychological, financial and social strain on students who have left higher education (e.g. Klein and Stocké 2016). On the other hand, other studies find that non-completion can be an efficient, rational and natural selection process for individuals, enabling students to minimise ill-advised investments in education and to improve their educational biography (Schnepf 2015).

There are inconclusive results concerning the labour market outcomes of dropping out of higher education. Dropouts do not have a higher risk of being unemployed than higher-education graduates, and have been found to be no worse off than upper-secondary school graduates who never enrolled in higher education (Lewin et al. 1995; Schnepf 2015; Stegmann and Kraft 1988). Yet the results are less positive regarding other occupational prospects, such as the quality of jobs attained or employment relationships. Previous studies have found that higher-education dropouts have a higher risk of working part time or on fixed-term contracts, and on average obtain

lower wages than higher-education graduates (Becker, Grebe and Bleikertz 2010; Griesbach, Lewin and Schacher 1977; Lewin et al. 1995). The German research institute HIS[6] has been particularly active in analysing the occupational outcomes of higher-education dropouts in Germany. Lewin et al. (Lewin et al. 1995) examine the labour market outcomes of dropouts, and find that only 8 per cent of all dropouts who left higher education in 1984 were unemployed, and that 36 per cent entered the labour market after leaving the higher-education system. Comparing the labour market outcomes of higher-education graduates and dropouts in 1974–75, Griesbach et al. (1998) find no difference in the unemployment rate after leaving the educational system: in both groups only 4 per cent are unemployed. While most graduates entered the labour market directly, 35 per cent of the dropouts entered the vocational training system, which might explain their low unemployment rate. On the contrary, higher-education dropouts who directly enter the labour market earn lower wages and obtain lower occupational status than graduates.

Similar results have been found in the more recent literature. For example, Becker et al. (2010) examined the labour market outcomes of higher-education dropouts and STEM graduates. Stegmann and Kraft (1988) compare the occupational outcomes of higher-education graduates and dropouts with those of upper-secondary education graduates with formal vocational qualifications from 1976. In line with the results of Griesbach et al. (1998), they find that higher-education dropouts are not more likely to be unemployed, but achieve lower occupational status and a lower income than higher-education graduates. Compared to upper-secondary education graduates who obtained a vocational qualification, higher-education dropouts achieve a slightly higher income but no higher occupational status. The most recent research finds that, in contrast to other countries, higher-education dropouts in Germany do not have an advantage in holding professional and managerial positions over upper-secondary education graduates who never entered higher education (Schnepf 2014; Schnepf 2015).

In summary, reviewing the previous research on the individual consequences of not completing higher education shows that recent empirical evidence on the labour market outcomes of higher-education dropouts is rather scarce in Germany. One reason for this shortcoming is that most data focusing on higher-education students do not

[6] *Hochschulinformationssystem*. In 2013 the institution changed its name to the German Centre for Higher Education Research and Science Studies (DZHW in German).

include information on their careers. Thus, labour market outcomes cannot be examined at all. Furthermore, data often only focus on individuals who have been enrolled in higher-education institutions (Becker, Grebe and Bleikertz 2010; Griesbach et al. 1998; Lewin et al. 1995). Consequently, a comparison of labour market outcomes of different groups is not possible, although necessary if one wants to clarify whether dropping out of higher education has a negative or positive impact on labour market outcomes. Those who also focus on individuals who have not been enrolled in higher-education institutions (Schnepf 2014; Schnepf 2015; Stegmann and Kraft 1988), however, do not take into account the possibility that higher-education dropouts may enter the labour market with additional non-tertiary vocational qualifications. Yet these vocational credentials might explain why the unemployment rates are the same for higher-education dropouts and graduates. Last but not least, the literature ignores the impact of macro-level conditions on first jobs that higher-education dropouts are able to attain. Prior research suggests that poor labour market conditions negatively affect employment outcomes, especially for the less-educated reference group (e.g. Klein 2015; Pollmann-Schult 2005). Whether this is also true for higher-education dropouts has not been examined yet.

3.3.1. Guiding research question – Part II

In Part II, this dissertation contributes to the existing literature by addressing the following guiding research question: *Are higher-education dropouts worse off in terms of first labour market outcomes compared to upper-secondary education leavers with additional formal qualifications, such as higher-education or vocational training credentials?*

To answer this question, Chapter 7 examines the first labour market outcomes of higher-education dropouts in Germany. Using the NEPS Starting Cohort 6 I assess whether dropouts benefit from additional vocational training outside higher education by comparing the occupational outcomes of education leavers with different educational qualifications. In Chapter 8 I analyse the consequences of favourable and poor labour market conditions on the first jobs secured by higher-education vs. graduates.

Chapter 4 Data

4.1. The National Educational Panel Study

All empirical analyses in this study are based on the National Educational Panel Study (NEPS). The Federal Ministry of Education and Research created this nationally representative database to study educational attainment in Germany, to assess the long-term consequences of education, and to describe central educational processes and trajectories from a life-course perspective (Blossfeld, von Maurice and Schneider 2011). Thus the NEPS provides longitudinal information on the educational careers of more than 60,000 individuals and follows a multi-cohort sequence design. It includes six different cohorts: early childhood, kindergarten children, 5th graders, 9th graders, first-year higher-education students and adults who have left the educational system. All participants are surveyed regularly over an extended period of time using questionnaires and competence tests.

In order to study higher-education non-completion and the first labour market transitions of higher-education dropouts, I use data from the Starting Cohort 6 (SC6) 'Adult Education and Lifelong learning' and the Starting Cohort 5 (SC5) 'First-Year Students' (Blossfeld, Roßbach and von Maurice 2011).

4.2. Starting Cohort 6

The NEPS SC6 data provide detailed retrospective life history data with comprehensive information on the education and employment biography of each respondent as well as important cross-sectional data on several subjects, such as competence development in adulthood, employment situation, family constellation, and educational choices and participation in further training. The SC6 sample[7] used here includes 17,135 respondents born in Germany between 1944 and 1986 who live in private households.[8] This sample is based on the 'Working and Learning in a Changing World (ALWA)' study conducted by

[7] doi:10.5157/NEPS:SC6:5.1.0.

[8] For more detailed information on the studies and sampling strategies, see Allmendinger et al. (2011), Antoni et al. (2010) and Aßmann et al. (2011).

the Institute for Employment Research (IAB) in Nürnberg beginning in 2007/2008 (Wave 1). These data are based on a sample that contains individuals from Germany's resident population from the birth cohort 1956 to 1986, and was collected by computer-assisted telephone interviews (CATI).

The NEPS (Wave 2) started in 2009/2010 with data collection by taking over respondents from the ALWA study, an augmentation sample of birth cohort 1944 to 1955 as well as a refreshing sample of birth cohorts 1956 to 1986. In Wave 4 (2011/2012) a second refreshing sample was conducted to acquire new respondents, which contained individuals from the birth cohort 1944 to 1986. The SC6 data was collected by CATI and computer-assisted personal interviews (CAPI). The NEPS sample is self-weighted to ensure a representative database (Aust et al. 2011). The SC6 data used in this dissertation comprise data from four annual follow-up surveys (Waves 2 to 5: data collection between 2009/2010 and 2012/2013) plus the data from the ALWA study (Wave 1, 2007/2008).

Table 1: Summary of waves, NEPS SC6

Wave	Survey mode	Period	Number of participants
1	CATI	2007/08	6,776[9]
2	CATI/CAPI	2009/10	11,649
3	CATI/CAPI	2010/11	9,320
4	CATI/CAPI	2011/12	14,104
5	CATI/CAPI	2012/13	11,696

Source: Hammon et al. (2016).

4.3. Starting Cohort 5

The SC5 'First Year Students' data provide detailed retrospective life history data with information on the students' pre-tertiary experiences, including secondary school trajectories, and pre-tertiary vocational training. The prospective panel data offer detailed information on educational decisions such as non-completion, including measurements of aspirations and attitudes to specific educational options as well as core concepts of costs, returns and subjective probabilities of success (Aschinger et al. 2011). The dataset also

[9] ALWA study respondents who were willing to participate in NEPS.

contains information about the students' social and academic integration (Tinto 1975, 1993). In this dissertation, I use data from the NEPS SC5[10] comprising 17,910 first-year bachelor students[11] enrolled for the first time in officially recognized and state-approved higher-education institutions in Germany, covering the period from 2010/2011 to 2012/2013. Within the randomly drawn sample,[12] students who are training to be teachers and students attending private higher-education institutions, that is, private universities and private universities of applied sciences, are oversampled. In Wave 1 a complete survey with non-traditional students[13] was conducted. The research design includes a yearly prospective panel, which was complemented by a retrospective life-course module in the first wave in 2010/2011. Several modes of data collection were used, such as self-administered questionnaires, CATI, online surveys, group-administered tests in classroom settings and online tests (Aschinger et al. 2011).

Table 2: Summary of waves, NEPS SC5

Wave	Survey mode	Period	Number of participants
1	CATI	Winter 2010/11	17,910
1	PAPI (competence test)	Winter 2010/11	5,949
2	CAWI	Autumn 2011	12,273
3	CATI	Spring 2012	13,113
4	CAWI	Autumn 2012	11,202
5	CATI	Spring 2013	12,698
5	PAPI (competence test)	Spring 2013	9,482
6	CAWI	Autumn 2013	10,185

Sources: Zinn et al. (2016); Roßbach, Maurice and Polgar (2016)
Notes: PAPI = paper and pencil interviews; CAWI = computer-assisted web interviewing. Additional modes were used, including: paper-based testing with electronic pens, computer-based testing with notebooks, computer-based online testing

[10] doi:10.5157/NEPS:SC5:6.0.0.
[11] The data also comprise students studying for a state examination in medicine, law studies, pharmacy or teaching, or a diploma or master's degree in Catholic or Evangelical theology.
[12] For more detailed information on the sampling strategies, see Aßmann et al. (2011).
[13] Students with vocational training qualifications but without higher-education entrance qualifications.

4.4. Why use the NEPS

Using the NEPS SC6 and SC5 data has several major advantages for the analysis of higher-education non-completion and the first labour market transitions of higher-education dropouts in Germany. In general, the datasets are suitable for examining the above-stated research questions for two reasons. First, the panel data allow the prospective observation of educational and occupational careers. Second, the retrospective module of both datasets surveys the individual's personal history.

The NEPS SC6 first surveys individuals who have, apart from adult education, completed their education. In contrast to data from official statistics or panel studies, the SC6 offers detailed retrospective data on the respondents' full educational biographies – including their pre-tertiary educational and occupational background – which enables it to distinguish between permanent dropout and non-completion that is followed by a later course in higher education. Furthermore, in contrast to former data, the NEPS SC6 allows the analysis of real dropout. Most data on higher-education dropouts merely asks about respondents' plans and expectations to drop out in the future (e.g. Bargel, Ramm and Multrus 2008; Blüthmann, Thiel and Wolfgramm 2011; Fellenberg and Hannover 2006). The NEPS SC6 also surveys transitions into the labour market of individuals with different educational outcomes. While most data focusing on higher-education students do not include information on their labour market careers, the NEPS SC6 dataset facilitates the analysis of the first labour market outcomes of higher-education graduates and dropouts. Furthermore, in contrast to most data – which usually comprise persons who have been enrolled in higher education only – the NEPS SC6 dataset also includes the occupational biographies of other educational leavers, which permits analysis of the impact of different educational credentials on labour market returns.

The NEPS SC5 surveys first-year students and contains detailed information on educational decisions during college including costs, returns and subjective probabilities of success as well as aspirations and attitudes towards specific educational options. Furthermore, it measures the academic and social integration concept of Tinto (1975). Thus the reasons for higher-education non-completion as well as the different impacts of pre-tertiary and in-college factors on higher-education non-completion can be analysed. Finally, in contrast to most data that focus on a specific higher-education system

(Pohlenz and Tinsner 2004; Pohlenz, Tinsner and Seyfried 2007; Schiefele, Streblow and Brinkmann 2007; Thiel, Blüthmann and Richter 2010), the NEPS SC5 provides a broader picture of non-completion in Germany by using representative nationwide data.

Chapter 5 Pathways in and out of Higher Education: Effects of Prior Educational and Vocational Experiences on Higher-Education Non-completion in Germany

As mentioned before, in Germany higher-education non-completion is not only the result of decision-making processes within the higher-education system; it also takes place in different institutional contexts within and outside higher education. The German pre-tertiary education system, for example, provides many pathways to obtain a higher-education entrance qualification. These pathways equip students with different knowledge, skills and qualifications that are assumed to directly affect their decisions about whether to remain in higher education. First, pre-tertiary experiences and qualifications might increase students' chances of success in higher education. Second, these experiences and qualifications influence the opportunities in the labour market, which might encourage students to drop out in order to take a job. This chapter is the first empirical chapter of Part I of my dissertation. It examines the impact of pre-tertiary education pathways on the non-completion risk of higher-education students in Germany, including experiences in pre-tertiary vocational training and the labour market.

5.1. Introduction

The "standard" pathway into higher education in Germany is entering a *Gymnasium* (academic track in secondary education) after primary school, graduating with an *Abitur* (full entry qualification for all types of higher education) and directly entering higher education. There are also a number of alternative pathways into higher education, and a considerable proportion of students enters university after periods of vocational training, labour force participation or via second-cycle qualifications (Heine, Krawietz and Sommer 2008; Jacob 2004; Jacob and Weiss 2008; Schindler and Reimer 2011). More than 25 per cent of all first-year students have obtained a vocation training qualification before entering higher education (Willich et al. 2011), and a growing proportion of students obtains their entry qualification (*Abitur*) via detours or alternative routes. This has the advantage that access to higher education still is possible in later stages of an

individual's educational career, for example after a period of vocational training or labour market participation.

There is, however, some evidence that non-standard pathways into higher education result in a higher propensity to drop out. American research has found that "delayed entry" students – those who enter higher education after periods of labour market participation or inactivity – are particularly prone to leaving higher education without a degree (Attewell, Heil and Reisel 2012; Bozick and DeLuca 2005; Goldrick-Rab and Han 2011; Hearn 1992; Milesi 2010; Roksa and Velez 2012). In the German educational system, delays are more likely to be caused by prior vocational training or alternative routes to an upper-secondary diploma, but the effects of prior vocational training on degree completion are inconclusive. Heublein et al. (2010) report that students with prior vocational training are more likely to leave higher education before graduating, while Lewin et al. (1995) propose that entering vocational training after graduation from upper-secondary school is an insurance strategy: these students often deliberately plan to enter higher education later, but acquire vocational skills in case of failure. Meulemann (1991), however, finds no evidence that prior vocational training is detrimental to success in higher education. Unlike Heublein et al. (2010), he applies multivariate event history models to distinguish students who have obtained their entry qualification for higher education outside the standard secondary pathway[14] from those who obtained an upper-secondary certificate and chose to enter vocational training instead of higher education first.

Müller and Schneider (2013) also classify different pathways to higher education and show that deviations from the standard pathway (direct entry after upper-secondary education) lead to higher dropout rates among university students in Germany. Many researchers equate the non-completion of higher education to dropping out altogether (Attewell, Heil and Reisel 2011; Griesbach et al. 1998; Lewin 1995; Lewin et al. 1995; Milesi 2010; Müller and Schneider 2013; Reisel and Brekke 2010; Roksa 2012; Roksa and Velez 2012), but many students who do not complete a particular degree course remain in higher education but change the type of institution or choose another subject (Brint and Karabel 1989; Dougherty and Kienzl 2006; Goldrick-Rab and Pfeffer 2009;

[14] Meulemann refers to "zweiter Bildungsweg", indicating that entry qualification was either obtained as part of the vocational training course or during employment (i.e., in evening classes).

Kalogrides and Grodsky 2011). Heublein (2012), for example, shows that up to 13 per cent of a year group's students in Germany do not graduate from the initially chosen subject but remain in higher education after changing the subject or type of institution.

I therefore propose extending the notion of non-graduation to distinguish between dropping out and non-completion that is followed by an alternative course in higher education. This chapter investigates whether non-standard pathways in Germany result in a higher propensity to drop out. To do so, I separate the effects of prior vocational training and different routes to entry qualifications. As these pathways usually coincide with other factors that may prevent successful graduation, I take parental background, life-course transitions and age into account. For a detailed description of pre-tertiary educational pathways, see Section 2.2.2. in Chapter 2.

5.2. Theory and hypotheses

Theoretical approaches to higher-education non-completion are mainly grounded in the theoretical perspective developed by Tinto (1975, 1982, 1993). His models try to explain dropout based on the relationship between individual attributes and the campus environment. He points out that social and academic integration in college are the main driving forces behind persistence in higher education. Bean and Metzner (1985) criticise that Tinto's model applies to most traditional students, but not to those who follow non-traditional pathways into academic education. They develop a model suitable for researching non-traditional students (older, part-time and those who do not live on campus) by emphasising non-institutional variables and their interaction with academic performance. This model acknowledges that non-academic responsibilities or commitments, such as family obligations, can compete for resources that otherwise could be invested in studying. Roksa and Velez (2010) argue that particular life-course transitions are responsible for higher rates of non-completion among American students who entered higher education after a delay.

More psychological perspectives (Schneider and Stevenson, 1999; Arnett, 2004) instead argue that a delay can help students focus on their future plans and academic goals. Following this line of reasoning, I expect that mature students are more successful

in higher education and drop out less often, which, at least in US studies, is empirically unproven. In Germany, however, delayed entry is often associated with training and labour market experiences that may produce skills and high incentives to graduate. In addition, tuition fees for higher education in Germany are low or even zero, and legislation is geared towards high levels of public support for students in higher education; therefore I assume low financial barriers in Germany. There are few studies on non-graduation in German higher education, however, and most do not take into account the influence of pre-tertiary pathways and life-course-related restrictions simultaneously. I argue that different pathways into higher education result in specific resources and restrictions that influence students' persistence. For this reason I briefly outline how these may affect non-completion.

5.2.1. Vocational training

Particularly in an educational system with a strong vocational training sector like in Germany, students who have acquired vocational skills prior to higher education have a different opportunity structure in terms of alternatives to graduation than traditional students. Many upper-secondary graduates choose to enter vocational training first despite their eligibility for higher education. This may be an "insurance strategy", as the skills obtained in vocational training can be used as a fallback option in case of failure in higher education (Lewin et al. 1995; Mayer 2003). Vocational skills can be used in the labour market, and therefore students who have obtained vocational training prior to higher education have more attractive alternatives outside higher education. Students with vocational training may therefore be more likely to drop out (*H1a*). However, students who have successfully completed vocational training may profit from their skills and knowledge in higher education. They might be more efficient and structured, which might compensate for a possible lack of experiences and qualifications obtained in upper-secondary education. Moreover, these students are more familiar with the returns from education in the labour market, and may have decided to enter higher education in order to improve their prospects, which in turn, generates a high motivation to succeed.

I therefore propose a competing hypothesis: that students with prior vocational training are less likely to drop out (*Hypothesis 1b*). Regarding persistence in the chosen

field of study, I assume that students with prior vocational training have chosen their subject particularly carefully. According to theories of occupational choices (Super, 1957; Holland 1959, 1973), a student needs a clear self-concept and knowledge of occupational fields. Vocational training experience supports the development of these characteristics, and probably leads to a more stable idea about future employment goals. In many cases the subject is related to the previous vocational training, and the higher-education course is likely to be part of a deliberate and considered educational strategy. I therefore assume that students who enter higher education after vocational training have a low inclination to change their subject (*Hypothesis 1c*).

5.2.2. Track mobility

Students who did not enter the *Gymnasium* after primary school can enter upper-secondary education after graduating from lower-secondary school. This type of track mobility implies that the student – despite qualifying for entering higher education – did not systematically pursue the academic track (Köller et al. 2004; Müller and Schneider 2013). Besides, students who have graduated from lower-secondary education often enter upper-secondary education in order to improve their chances of being admitted to an attractive vocational training course, so their primary goal in many cases is not higher education but the vocational training market. These students possibly have a weaker academic aptitude or use higher education as a "parking lot" if they did not succeed in entering vocational training right after graduation from upper-secondary education. Students who obtained their upper-secondary certificate by track mobility thus have a higher dropout propensity than those who took the direct pathway to *Abitur* (*Hypothesis 2a*). These students, however, are not likely to differ significantly from traditional students in their motivation or dedication to the chosen subject, and therefore I expect that they are equally likely to change their subject (*Hypothesis 2c*).

5.2.3. Alternative pathways

Students who have obtained their entry certificate outside general upper-secondary education differ from traditional students. They have obtained vocational education and usually gained some work experience afterwards. These students have also attended

evening school and passed a final exam there, or have delivered a proof of proficiency in their chosen subject to gain access to higher education. Like the students who have obtained their upper-secondary certificate via track mobility, they are likely to suffer from a lack of general academic skills and therefore should have comparable problems in higher education. I therefore expect these students to be more likely to drop out (*Hypothesis 3a*). I nevertheless may assume that this group is particularly positively selected in terms of dedication and motivation to study, as they have usually pursued evening education, with the accompanying sacrifices in spare time, for several years. I therefore expect these students to be more persistent than those who obtained entry qualifications in general upper-secondary education, and thus to be more likely to graduate (*Hypothesis 3b*). Like the students who have obtained a vocational qualification, they should have made a very considered decision to study and carefully chosen their subject. Hence, I propose that they are less likely to change their subject (*Hypothesis 3c*).

5.3. Data and analytical approach

5.3.1. Data

The analysis is based on data from the National Educational Panel Study (NEPS): Starting Cohort 6 (SC6) – Adults (Adult Education and Lifelong Learning) (Blossfeld, Roßbach and von Maurice 2011).[15] The final sample is restricted to students who were enrolled in a university at least once in their life. Students from universities of applied sciences (*Fachhochschule*), universities of cooperative education (*Berufsakademie*), business academies (*Wirtschaftsakademien*) and academies of public administration (*Verwaltungsakademien*) are excluded from the sample because their reasons for non-completion are assumed to differ strongly between the different higher-education institutions. Since there are not enough cases from the different educational systems to treat them separately, they were removed from the sample. To ensure comparability of individual educational careers, I excluded all students who studied abroad or have a university degree from the German Democratic Republic (former East Germany), assuming that differences in educational systems and labour market situations have

[15] More information on the NEPS SC6 can be found in Chapter 4.

different effects on dropout behaviour. Students who are older than 27 are also excluded, as students over this age are not eligible to receive attractive fiscal benefits and other sources of government support. Besides, mature students often enter higher education for personal interest and intellectual enrichment without serious intentions of graduating. Preliminary analyses have revealed that these students often remain enrolled for far more than 10 years without graduating. As this is likely to cause a severe bias, I removed this age group from the data. The final dataset contains 1,712 cases.

5.3.2. Analytical approach

A course in higher education can either be successfully completed or not. This would call for a binary outcome variable and the application of logistic regression analyses, as often used for education-related topics. Non-completion, however, does not necessarily result in dropout. In the US literature several researchers discuss the distinction between "drop out" and "stop out" and the appropriate methodological treatment. Stratton, O'Toole and Wetzel (2008) propose a multinomial logistic regression to integrate interruptions and re-enrolment as outcomes into the estimation. They argue that drop out and stop out typically occur in the first year, and therefore focus on the higher-education outcome of the first year. As graduation is not possible after one year, a student can end up in three stages: "stop out" (identified by later re-enrolment), "drop out" (no later re-enrolment) or "continuous enrolment". They discuss the event history methods proposed by DesJardins (2003) and point out that the focus of their interest is not the *timing* of the dropout, but rather *if* it occurs, and therefore refrain from applying event history models.

However, they mention three reasons why it may be necessary to take the longitudinal structure of a higher education course into account. First, censoring may occur in the data, which is likely to cause bias if it is not treated adequately. Especially in Germany, where higher-education courses can last far longer than four years, this is a serious issue to be solved. Second, covariates may change values during the course of higher education. For example, family transitions like births or pregnancy directly influence the risk of graduating or dropping out. Third, the risk set changes due to selective drop out, causing bias through unobserved heterogeneity. I have a number of censored (i.e., not graduated before the end of the observation period) cases in my data,

and have to deal with time-varying covariates. Therefore, I follow DesJardins (2003) and apply event history models. However, one difference between the German and American higher-education systems requires a modification of the DesJardins model. Stop out during higher education in Germany is less of an issue because tuition fees are low in Germany, and enrolment results in diverse fiscal advantages for students and their parents. Students who interrupt their course in Germany typically remain enrolled but postpone the completion of their seminars. For this reason it is not possible to identify stopout in German student data. Some students, however, quit their course before graduation and enter a course in another field or type of institution. German universities record this as *Exmatrikulation*; in process-generated data, these students are recorded as dropouts. Coding these students as dropouts, however, is problematic because this ignores the fact that a successful graduation is still possible and likely. Another strategy for classifying these students is possible when individual retrospective life-course data are available. Using knowledge about later re-enrolment in another course and subsequent graduation, it is possible to identify and distinguish between successful students and dropouts. I argue that it is also problematic to code the changers as graduates, based on later graduation, as it ignores the fact that the first course did not result in graduation.

To account for these different kinds of non-completion, I run a competing risk model (Allison 1982). Competing risk models are suitable to treat multinomial outcomes as dependent variables; it also allows me to include 64 right-censored[16] cases in the analyses that would otherwise have to be excluded from the models. As I have fine-grained retrospective data with the exact dates of enrolment and course termination, I arrange the data in a person-month format, so that each month is assigned one of the four outcomes: “still enrolled”, “graduate”, “change” or “dropout”. This results in 100,370 spells from 1,712 cases. The month-wise coding has the advantage that I can take into account that graduation and exmatriculation can occur at any time in Germany, even during a term; therefore I do not have the problem of large numbers of tied observations, as discussed by Taniguchi and Kaufman (2005). All episodes (months) that did not result in graduation, dropout or change are coded 0 (still enrolled) on the outcome variable, meaning that this person is still at risk of non-completion or graduation. I dropped seven

[16] These 64 respondents were still enrolled at the time of interview.

cases because they had a course duration of more than 13 years. In the competing risk models I choose "still enrolled" as the base category. This allows me to measure the risk of all alternative outcomes relative to the base category *still enrolled*. One problem that may occur in competing risk models is a violation of the "proportional subhazards assumption", meaning that covariates vary over time (Fine and Gray 1999). I apply the proportional subhazards test proposed by Cleves et al. (2010), which confirms that the assumption of proportional subhazards is not violated in my models. For a descriptive overview, the stacked cumulative incidence function is used. This function gives the proportion of students at time *t* who have experienced a specific educational outcome, which accounts for the fact that students can experience other competing educational outcomes.

5.3.3. Dependent variable

For the reasons described above, I use the following definition for my dependent variable:

1. *graduate*: The respondent graduated from the first higher-education course entered
2. *dropout:* The respondent did not graduate from the first course, and left higher education
3. *change:* The respondent did not graduate from the first course entered, but remained enrolled in higher education and changed the subject or the type of institution.
4. *still enrolled*: The respondent is still enrolled in his or her initial course

5.3.4. Independent variables

I define three pathways to entry qualification: *Abitur*, which serves as reference category, *track mobility* and *alternative pathway*. These are mutually exclusive and coded as dummies. Track mobility indicates that the entry qualification was obtained in upper-secondary education, but after initially graduating from lower-secondary education. Alternative pathways are defined as those that result in entry qualifications for higher education that were not obtained in upper-secondary school. As described above, these qualifications most typically are obtained in second-cycle education, by graduating from

vocational training or in evening education. Vocational training denotes the successful completion of a two- or three-year training course either in the dual system or in a vocational school. Vocational training can co-occur with any of the three pathways to entry qualification.

5.3.5. Control variables

Vocational training is very likely to co-occur with some labour market experience. Participation in the labour market, however, is likely to result in skills that can also be beneficial in higher education. In order to isolate the effects of actual training from those of practical experience in the labour market, I control for years of work experience. Since a student's family of origin has an influence on the pathway chosen and may affect their graduation patterns, I therefore control for the parents' level of education. The dummy variable is coded 1 when at least one parent has obtained a higher-education degree. I also control for sex (male = 1). As different fields of study have specific graduation patterns, especially regarding non-completion, I control for field of study as categorical variable (education, STEM/agrarian/transportation, health and care, economic and administrative, law and public administration, social and behavioural sciences). Since family obligations are the most likely to influence the risk of non-completion, I therefore control for whether students had children under the age of six before enrolment and whether the respondent expected a child during the course (or the partner, if the respondent is male). Using available information about the date of childbirth, I coded a spell-wise pregnancy dummy, assuming that the respondent learns about the pregnancy approximately nine months before birth. Respondents who have entered higher education via a non-standard pathway are obviously somewhat older than traditional students. In order to avoid spurious effects that are merely caused by this difference in age, I introduce a metric variable for age at enrolment. In Germany, educational expansion has also led to increasing participation in higher education. Therefore I assume that institutions are less selective in later cohorts, which may lead to higher rates of non-completion. I therefore include 5-year period dummies for the time of enrolment. Table 3 shows an overview of the distributions.

Table 3: Cross tabulations (first part)

	Still enrolled		Drop out		Graduate		Change		Total	
	N	% row	N	% row	N	% row	N	% row	N	% row
Track mobility										
no	55	3.93	151	10.78	966	68.95	229	16.35	1,401	81.83
yes	9	2.89	60	19.29	196	63.02	46	14.79	311	18.16
Second cycle education										
no	64	3.83	207	12.40	1,127	67.49	272	16.29	1,676	97.90
yes	0	0.00	4	9.52	35	83.33	3	7.14	42	2.45
Vocational training										
no	61	4.17	163	11.13	987	67.42	253	17.28	1,464	85.51
yes	3	1.21	48	19.35	175	70.56	22	8.87	248	14.49
At least one parent with higher-education degree										
no	19	2.54	111	14.25	532	67.81	121	15.39	783	45.74
yes	45	4.83	100	10.73	630	67.81	154	16.63	929	54.26
Sex										
female	29	3.60	115	14.29	535	66.46	126	15.65	805	47.02
male	35	3.86	96	10.58	627	69.13	149	16.43	907	52.99
Children before enrolment										
no	64	3.79	206	12.21	1,144	67.81	273	16.18	1,687	98.54
yes	0	0.00	5	20.00	18	72.00	2	8.00	25	1.46
Pregnancy (self or partner)										
no	64	3.75	209	12.25	1,159	67.94	274	16.06	1,706	99.65
yes	0	0.00	2	33.33	3	50.00	1	16.67	6	0.35
Field of study										
Education	16	4.32	36	9.73	280	75.68	38	10.27	370	21.61
STEM/agrarian/transp.	21	4.20	49	9.80	325	65.00	105	21.00	500	29.20
Health/care	4	2.44	15	9.15	130	79.27	15	9.15	164	9.58
Economics/administration	3	1.63	33	17.93	113	61.41	35	19.02	184	10.75
Law/public administration	2	1.71	21	17.95	76	64.96	18	15.38	117	6.83
Social/behav. sciences	18	4.77	57	15.12	238	63.13	64	16.89	377	22.02

Note: Second part of the table see next page

Table 3: Cross tabulations (second part)

	Still enrolled		Drop out		Graduate		Change		Total	
	N	% row	N	% row	N	% row	N	% row	N	% row
Year of first enrolment										
1963-1969	0	0.00	3	2.16	118	84.89	18	12.95	139	8.12
1970-1979	0	0.00	16	9.30	133	77.33	23	13.37	172	10.05
1976-1980	0	0.00	36	15.86	163	71.81	28	12.33	227	13.32
1981-1985	0	0.00	52	18.57	187	66.79	41	14.64	280	16.36
1986-1990	0	0.00	38	15.02	178	70.36	37	14.62	253	14.78
1990-1995	0	0.00	27	12.92	144	68.90	38	18.18	209	12.21
1996-2000	2	1.27	19	12.03	106	67.09	31	19.62	158	9.29
2001-2005	62	22.36	20	7.30	133	48.54	59	21.53	274	16.00
Total	64	3.7	211	12.3	1,162	67.9	275	16.0	1,712	100

5.3.5.1. Controlling for grades

It is common practice to control for grades in dropout research, as grades are the main predictor of academic success. As I have retrospective life course data from adults, our data do not contain GPA or other variables that indicate the performance in higher education. Information about the score of the highest secondary school exam is available, but I have several objections to using these as a control. First, due to design considerations, the score has been recorded for only 950 of the 1,718 respondents, so using only cases with available information on the score would result in severe problems of statistical power and possibly sampling bias. Regarding the large proportion of missing data[17], multiple imputation obviously is not recommended. Second, final exam grades are assigned in different types of secondary education, and grading is not standardised in order to reflect a student's actual aptitude. The German grading philosophy instead aims towards a normal distribution with a mean of approximately 2.5 within institutions, which makes using final exam grades as a measure for aptitude is rather arbitrary.

I am aware that these results may be biased, and that I may over- or underestimate the effects of pathways when I do not take different aptitude levels into account. For this reason I ran a linear regression of the score of the highest secondary school exam on

[17] Students with a vocational training qualification only do not have a score of the highest secondary school exam.

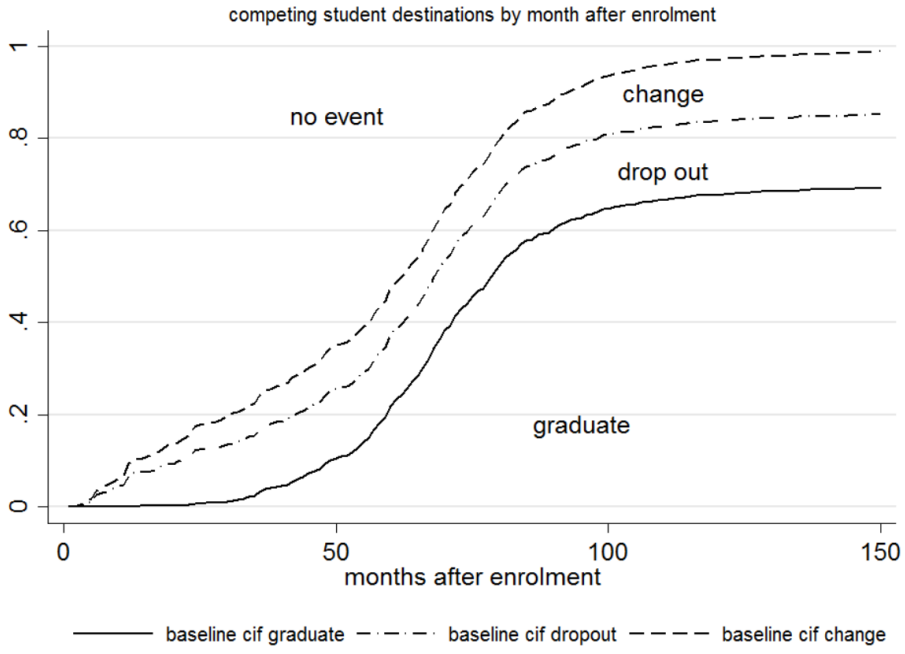
pathways with the available sample, controlling for the type of secondary school diploma and birth cohort in order to determine if students who follow non-standard pathways have a lower score. I did not find significant effects except for track mobility: on average, these students have a slightly higher score (2.41 versus 2.49 on a 1-6 range, 1 = the highest grade). From this I conclude that not controlling for the score of the highest secondary school exam is unlikely to lead to overestimating the effect of track mobility. Work experience, alternative pathways and vocational training are not associated with a lower score, so I can safely assume that excluding the score of the highest secondary school exam control will not lead to an omitted variable bias.

5.4. Results

5.4.1. Descriptive overview

Figure 5 shows the stacked cumulative incidence function of all outcomes over time for the baseline model. The graph shows that the "risk" of graduation is zero in the first two years after enrolment, but that the two types of non-completion are more likely to occur in the early phase of a higher-education course. After two years, however, the cumulative non-completion incidence remains more or less stable, whereas a growing proportion of the students has graduated. By the end of the observation period, 68 per cent of all students have graduated, 12 per cent have dropped out altogether, 16 per cent have changed their subject or type of institution, and 4 per cent are still enrolled in their initial course.

Figure 5: Stacked cumulative incidence function (baseline)



5.4.2. Competing risk models

Table 4 shows the results of the competing risk models. I report the subhazard ratios for each of the outcomes relative to being still enrolled. Subhazard ratios below 1 indicate negative effects, while those above 1 indicate positive effects. In order to facilitate the interpretation of the subhazard ratios, Figure 6 shows the cumulative incidence function of all explanatory variables on the three outcomes. I find that track mobility has a significant effect on dropout, which corresponds to a lower graduation rate, but hardly affects the likelihood of changing courses. A diploma in vocational training results in a higher graduation rate, which does not correspond to lower dropout rates, but to a lower change rate. This indicates that students with vocational education are more likely to graduate from their initially chosen course not because they are less likely to drop out altogether, but because they are less likely to change subjects. For the alternative pathway, I do not find significant effects on any of the outcomes, but I observe

comparatively large effects, which indicates low statistical power in this category due to a small subgroup (N = 42).

A cautious interpretation of the effects suggests that students from alternative entry pathways are less likely to drop out, but at the same time are more likely to graduate or change subjects than traditional students. Work experience produces higher persistence in the chosen subject: students with work experience are more likely to graduate because they are less likely to change and less likely to drop out altogether.

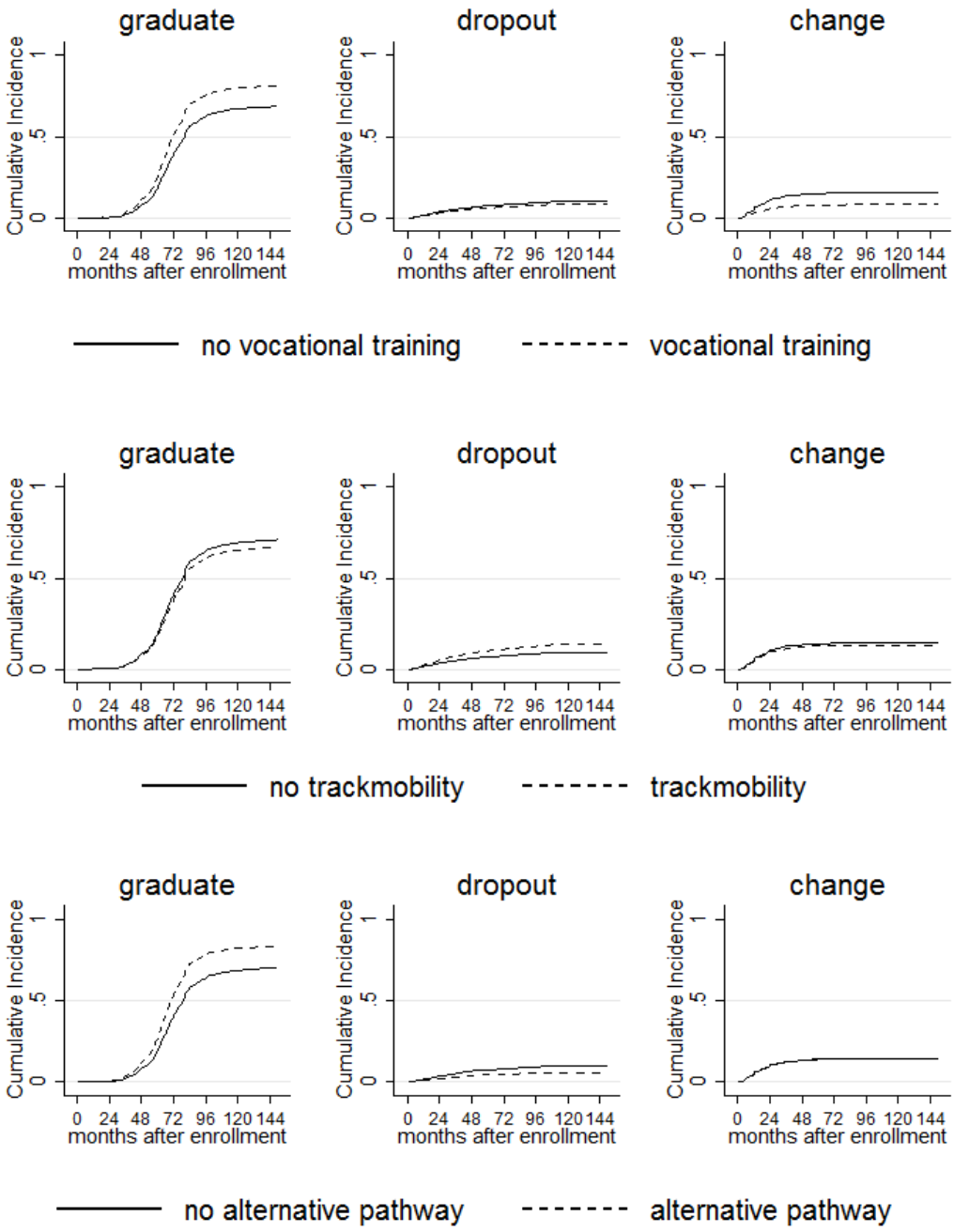
The parents' level of education does not have a significant effect on non-completion or graduation, but men drop out of university less often than women. Having children under the age of six does lead to a somewhat increased risk of dropout, but also increases the subhazard ratio of graduating. However, none of the effects is significant, whereas a current pregnancy has a clearer effect on higher-education outcome: a pregnancy of the respondent (or his partner) increases the subhazard ratio of dropping out, but also of graduating. This is surprising, but may indicate that a pregnancy in some cases impedes course progress, while in other cases it may be deliberately planned shortly before graduation or accelerates graduation. The effects of the field of study reflect the perception that some fields are "easier" than others, a particularly high subhazard ratio for dropout is observed in law and public administration, whereas in STEM/agrarian/ transportation-related fields the change rate is remarkably high, but not the dropout rate. A higher age at enrolment is associated with higher subhazard ratios for dropout and lower subhazard ratios for graduating. The effects for year of first enrolment indicate that persistence in higher education is consistently lower for later cohorts, which may be a consequence of either decreasing selectivity in terms of aptitude or an increasing inclination for students to use the first enrolment as a "parking lot" when the desired education is not available at the time of graduation from secondary education. For example, there may be increasing pressure in the vocational training market in cohorts with large proportions of upper-secondary graduates or competition for an attractive field of study with entry restrictions, such as *numerus clausus*. Students are then more likely to enrol in a suboptimal course initially, and change to vocational training or the desired course as soon as it is available.

Table 4: Results of competing risks regressions, subhazard ratios

	Model 1: Drop out vs. still enrolled	Model 2: Graduate vs. still enrolled	Model 3: Change vs. still enrolled
Pathway to entry qualification			
Abitur (ref.)			
Track mobility	1.51 *	0.90	0.91
Alternative pathway/second cycle	0.57	1.15	1.01
Vocational training	0.82	1.43 ***	0.51 **
Control variables			
Work experience (years)	0.97	1.05 **	0.81 *
At least one parent with higher-education degree	0.79	1.02	0.98
Sex (male = 1)	0.62 ***	1.07	0.92
Children before enrolment (yes = 1)	1.03	1.14	0.66
Self or partner pregnant (yes = 1, time varying)	3.53 ***	1.65 **	0.32
Field of study			
Education (ref.)			
STEM/agrarian/transportation	1.04	0.61 ***	2.25 ***
Health/care	0.88	0.88	0.91
Economics/administration	1.63 *	0.57 ***	2.30 ***
Law/public administration	2.02 **	0.64 **	1.52
Social/behavioural sciences	1.49 *	0.55 ***	1.74 **
Age at first enrolment	1.25 ***	0.92 **	1.00
Year first enrolment			
1963-1970 (ref.)			
1971-1975	3.84 **	0.69 *	1.07
1976-1980	7.21 ***	0.55 ***	0.88
1981-1985	7.92 ***	0.44 ***	1.03
1986-1990	5.98 **	0.48 ***	1.10
1991-1995	5.27 **	0.51 ***	1.45
1995-2000	4.91 **	0.49 ***	1.35
2001-2005	3.23	0.41 ***	1.56
N observations (person-months)	100,370	100,370	100,370
N subjects	1,712	1,712	1,712
N failed	211	1,162	275
N competing	1,437	486	1,373
N censored	64	64	64
Log pseudolikelihood	-1490.3984	-7971.6508	-1994.2901

Notes: Subhazard ratios; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 6: Cumulative incidence functions based on coefficients in Table 4



My results show that prior educational pathways have an effect on non-completion of university studies. Regarding the effect of prior vocational training, I formulated two contradicting hypotheses, as vocational skills are resources that can be equally beneficial

in the labour market and in higher education. The findings indicate that vocational training has no effect at all on dropout rates, which may be because the positive and negative effects of the acquired skills counteract each other, so I can confirm neither Hypothesis 1a nor 1b. I did, however, assume that students with prior vocational training had made a more considered decision regarding their subject and therefore are less likely to change their course. I confirmed this hypothesis (*Hypothesis 1c*). In sum, students with prior vocational training are more likely than traditional students to graduate from their initially chosen course.

I also examine the effects of different pathways to entry qualifications. In addition to the traditional route to an upper-secondary diploma, students can obtain eligibility via track mobility or alternative pathways. Track mobility appears to be disadvantageous for success in higher education, as I observe that these students drop out more often. This corroborates Hypothesis 2a. Those who have obtained their entry qualification outside general upper-secondary education, on the contrary, have no disadvantages in terms of study success. I suggest that this group is positively selected in terms of motivation and persistence as they have previously "survived the tough route" to their entry qualification. The effects, however, are large but insignificant, due to the small number of cases.

5.5. Conclusion

This chapter examined the relationship between pre-tertiary education pathways and the non-completion of higher-education. I argue that most previous research treats non-completion of higher education as dropping out without taking into account that non-completion in many cases does not involve dropping out of higher education altogether; students may re-enter alternative courses in different subjects or institutions. For this reason I suggest using competing risk models that take changes of courses within higher education into account. Furthermore, I examine the effect of non-traditional pathways into higher education. These routes gain importance in the German educational system, and a considerable proportion of students enters higher education with vocational or labour market experience. The skills obtained in vocational training or the labour market can be used in higher education, and students may profit from such knowledge and skills.

However, these skills can also work as a pull factor, as they open up labour market opportunities.

From these analyses I can conclude that non-traditional pre-tertiary pathways influence different types of non-completion in different ways. Formal skills obtained in vocational training do not seem to have an effect on dropping out altogether, but appear to have positive effects regarding persistence in the chosen subject. It is not clear, however, if these positive effects come about through the actual skills that may be beneficial in higher education or if students who enter higher education after a period of vocational training and labour market participation are selected in terms of other characteristics like motivation and goal orientation. Career choice theories (Holland 1973) suggest that mature students have more accurate self-knowledge and may be better able to choose a course that matches their interests.

Track mobility seems to lead to a higher risk of non-completion of higher education. I suggest that students who obtained their upper-secondary diploma via track mobility in general have lower academic ability than those who took the direct pathway. It would thus be worthwhile to control for ability, but the available data contain final exam grades only, which are not comparable across schools and federal states in Germany, and are not available for students who did not take the *Abitur*. Another reason for the higher rate of non-completion of these students might be that track mobility is often used as a strategy to improve one's chances on the vocational training market. I may therefore speculate that some students use higher education as a parking lot when they did not succeed in securing an apprenticeship immediately after graduation. These students keep searching and drop out as soon as they find an apprenticeship. In contrast to the common idea of dropout as "failure", this approach may indicate a success outside higher education.

Although our subsample was too small to deliver statistically firm results, I found some indications that students who enter higher education via alternative pathways have a considerably smaller risk of non-completion than traditional students. In international research the group of "non-traditional" students appears to be highly problematic, but in the German educational system this seems not to be the case. This may be due to the fact that alternative pathways in Germany usually comprise formal learning and examinations, and therefore the group is pre-selected in terms of aptitude. Besides, the alternative

pathways in most cases involve evening schools and adult education, which have a high dropout rate as well. I therefore assume that those who have "survived" these pathways have proven they have a particularly strong goal orientation, persistence and motivation to succeed.

In summary, pathways to higher education are important predictors of success in higher education. Prior research has shown that deviating pathways are problematic as they predict a high risk of non-completion. My analyses revealed that these pathways are not necessarily problematic in themselves, but that they come with confounders that are the real impediments to success in higher education. I also argue that double qualifications, such as vocational training followed by higher education, are not an inefficient educational strategy (Büchel and Helberger 1995) but that vocational training and alternative pathways are important channels of second-chance education in Germany, which give educational opportunities to late bloomers. Because of the more detailed analyses of different types of non-completion, I am also able to show the positive effect of vocational and occupational skills on persistence in higher education. Students with such skills show a lower tendency to change their subject, and tend to graduate quicker than traditional students. In other words, non-traditional pathways do not always result in a higher dropout propensity, as shown by previous research; students can profit from vocational and occupational skills and from a more considered choice of subject.

Chapter 6 Higher-Education Non-Completion in Germany – Gender Differences in STEM Fields

Despite many educational policies designed to address gender imbalances in education, highly educated women are still under-represented in technical occupational fields in Germany. One reason for this might be the higher risk of non-completion for female students in higher-education fields such as science, technology, engineering and mathematics (STEM). In this chapter I examine the higher non-completion risk of women in post-secondary STEM education. In line with the previous chapter, the importance of pre-tertiary educational pathways will be examined. Furthermore, using the NEPS SC5 I am able to include possible intervening in-college factors, such as academic and social integration, in the analyses. Thus, in contrast to the previous chapter I will assess the impact of both pre-tertiary and in-college experiences on the higher non-completion rate of women in post-secondary STEM education in Germany.

6.1. Introduction

The number of female students in higher education has steadily increased in all Western countries in recent decades. Currently, 54 per cent of all tertiary students in the European Union are women (Eurostat 2013); in the United States, they account for 56 per cent of students (NCES 2014). This female advantage, however, does not apply to all academic fields. The rate at which women obtain degrees in science, technology, engineering and mathematics (STEM) remains below that of men (Charles and Bradley 2002; Charles and Bradley 2006; Charles and Bradley 2009; Xie, Fang and Shauman 2015). While the disadvantage of female students in STEM degree attainment was in the past explained as the result of women's lower aptitude for STEM subjects, recent research shows that there is little support for this claim (Hyde et al. 2008; Spelke 2005; Xie, Shauman and Shauman 2003). From kindergarten through high school, girls get better grades in all major subjects, including maths and science (e.g., Buchmann, DiPrete and McDaniel 2008; Helbig 2012). However, even when looking at students with identical abilities, women are still less likely than men to complete a post-secondary degree in a STEM subject (Griffith 2010; Tyson et al. 2007). Moreover, women tend to be just as well

prepared for post-secondary STEM education as men: the number of maths courses completed at the upper-secondary school level is almost the same for both (Lange et al. 2014; Watt, Eccles and Durik 2006).

Due to the apparent lack of gender differences in pre-tertiary education, some researchers have shifted their focus to higher education as the decisive period in which to explain the gender gap in higher-education STEM degrees. Both research areas, however, show large differences in their results concerning the factors that influence the degree completion of women and men in post-secondary STEM education. Some still find evidence of the influence of pre-tertiary factors, such as maths achievement and participation in high school maths courses (e.g., Legewie and DiPrete 2014; Maltese and Tai 2011; Zhao, Carini and Kuh 2005), while others point out that social and cultural experiences during college are decisive factors for non-completion in STEM (e.g.Gayles and Ampaw 2014; Kamphorst et al. 2015). Amelink and Meszaros (2011) even find that there are no differences between the influencing factors for women and men concerning pre-tertiary and in-college experiences. There are two possible reasons for these differing results. First, most literature focuses on either pre-tertiary experiences or in-college experiences. In contrast, I argue that one has to consider both types of experiences in order to assess their importance for the gender gap in post-secondary STEM education completion. Second, previous research widely ignores the fact that in addition to general performance, such as maths achievement and participation, field-specific skills and knowledge are important pre-tertiary variables that influence the gender gap in higher-education STEM degrees. The question of whether deficits in field-specific skills and knowledge cause women to drop out of post-secondary STEM education has not yet been investigated.

This chapter aims to fill these gaps by examining the reasons for the high non-completion rate of female students in post-secondary STEM education. To do so, I consider both students' pre-tertiary and in-college experiences in my analyses. Furthermore, I consider two types of pre-tertiary experiences: general college preparation and pre-tertiary field-specific experiences.

The next section examines previous research on gender differences in STEM education, and presents the theoretical considerations regarding why pre-tertiary and in-college experiences are expected to influence female students to leave post-secondary

STEM education. After that I provide information on the measurements I used to operationalise pre-tertiary and in-college experiences, followed by a description of the analytical approaches. The chapter ends with a discussion of the empirical results and concluding remarks.

6.2. Previous research

A large body of research aims to explain gender differences in STEM. This research shows that women in general have a lower level of interest and participation in STEM subjects, but not consistently lower levels of performance (e.g.Charles and Bradley 2006; Eccles 2005; Hyde et al. 2008; Nagy et al. 2010; Riegle-Crumb, Moore and Ramos-Wada 2011; Sikora 2015; Spelke 2005; Watt, Eccles and Durik 2006). Although women show an equal or even better preparation for science careers than men (Buchmann and DiPrete 2006; Buchmann, DiPrete and McDaniel 2008; Helbig 2012), there are still persistent gender gaps in higher-education degree attainment in STEM. Furthermore, women leave STEM majors at significantly higher rates than men (Chen 2013; Leszczensky et al. 2013; Mau 2003).

The body of research on gender differences in the academic outcomes of STEM majors can be divided into two distinct strands of literature. The first strand, which can be defined as the "deficit perspective", attributes gender gaps in post-secondary STEM education participation and degree completion mainly to gender differences in pre-tertiary maths and science achievement and participation (e.g. Legewie and DiPrete 2014; Morgan, Gelbgiser and Weeden 2013; Xie and Killewald 2012; Zhao, Carini and Kuh 2005). These studies find that the high school years are the decisive period for the emergence of the gender gap in post-secondary STEM educational attainment. The second strand focuses on social and cultural experiences during college (e.g. Gayles and Ampaw 2014; Kamphorst et al. 2015). This research starts from the premise that women who enter STEM fields have the same (or better) background characteristics as male STEM students. They find that, for example, integration into the STEM environment has a significant influence on degree attainment for women in post-secondary STEM education. In sum, however, it is not clear whether background characteristics or

integration problems are the reason for the gender difference in academic outcomes of STEM fields.

I argue that it is important to consider both students' pre-tertiary and in-college experiences in order to identify the main mechanisms responsible for the gender gap; otherwise, research on the reasons behind the higher non-completion rate of female students may be plagued by confounding or spurious relationships. Furthermore, I argue that it is important to distinguish between general academic preparation and pre-tertiary field-specific experiences. Up to now, most research has concentrated only on upper-secondary maths achievement and participation in high school maths courses (Gayles and Ampaw 2014; Kamphorst et al. 2015; Legewie and DiPrete 2014; Watt 2006). Education systems now require more maths courses than previously. In most European countries, maths is compulsory for everyone up until the end of upper-secondary graduation. Thus, the opportunity for girls to drop out of maths in upper-secondary education has been greatly reduced. Education systems, especially those with a strong link to the labour market, also provide ample opportunities to deepen STEM-specific skills and knowledge prior to college. Research on gender differences in upper-secondary STEM education participation shows that women are less likely to attend vocational training or upper-secondary education courses in physics, engineering and technology (Lörz, Schindler and Walter 2011; Sikora 2015; Solga and Pfahl 2009). The impact of gender differences in pre-tertiary field-specific experiences on higher-education STEM attainment has not yet been investigated. I contribute to this line of research by examining the importance of both pre-tertiary and in-college experiences for the gender differences in post-secondary STEM educational attainment. I also include pre-tertiary field-specific experiences in my analyses.

6.3. Theory

Most approaches to explaining student attrition in higher education are based on the concept of student integration: they assume that students' integration into the social and academic systems of higher-education institutions has an important affect on their decisions about whether to continue their education (e.g. Pascarella and Terenzini 1979;

Spady 1970; Tinto 1975; Tinto 1993). American integration theorists such as Tinto (1975, 1993) or Pascarella and Terenzini (1979) emphasise that in-college experiences are more important than what has happened before, or what takes place outside of, higher education. Other research, however, shows that pre-tertiary experiences are also conducive to explaining non-completion in higher education (e.g. Conley 2008; Maltese and Tai 2011; Mau 2003). In the following, I explain why pre-tertiary experiences might also be responsible for the gender gap in post-secondary STEM education non-completion. Subsequently, I outline the relationship between in-college experiences and the high non-completion rate of female STEM students.

6.3.1. Pre-tertiary experiences

The literature divides the pre-tertiary experiences, traits and personal aptitudes that are (potentially) related to persistence in higher education into two main categories: general academic preparation (e.g., pre-tertiary achievement and college readiness) and field-specific academic preparation (professional skills and knowledge).

Several studies have examined the degree to which general high school academic preparation impacts persistence in post-secondary education. Common predictors of higher-education success are high pre-tertiary academic performance and high levels of college readiness. *Pre-tertiary academic performance*, especially grades and test scores in mathematics and reading, serves as an objective indicator of a young person's realistic prospects in higher education. Today, girls outperform boys in their educational achievement: from kindergarten through high school, girls get better grades in all major subjects, including maths and science (e.g. Buchmann, DiPrete and McDaniel 2008; Helbig 2012). Against this background, it is unlikely that disparities in prior academic grades and test scores can help explain the disadvantage of female students in post-secondary STEM education. *College readiness* can be defined as the level of preparation a student needs in order to enrol and succeed in post-secondary education: students with high levels of college readiness are more likely to graduate from higher education, since they can think critically and cope with the content of knowledge that is presented in post-secondary education (Conley 2008; Roderick, Nagaoka and Coca 2009; Venezia and Jaeger 2013). Furthermore, students with the level of preparation have knowledge about

post-secondary education, the meaning and understanding of the culture, and the structure of the higher-education system (Conley 2008; Holland and Farmer-Hinton 2009; Tinto 2012). Women often enter higher education with high levels of general college preparation, and thus a high level of college readiness, obtained by a generally higher-education entrance qualification (Brändle and Lengfeld 2016; Helbig 2012; Schindler 2013). In conclusion, women are positively selected in terms of pre-tertiary academic performance and college readiness. Therefore, I assume that general academic preparation does not help to explain gender differences in higher-education success in STEM majors (*Hypothesis 1*).

In some cases, students can obtain field-specific experience before entering higher education. In Germany, for example, with its strong vocationally orientated education system, students can attend vocational training as well as specific upper-secondary education courses prior to college. Both teach technical knowledge and practical skills that have a positive impact on higher-education success, especially if the content of the training or courses matches that of future studies (Hartung and Krais 1990). Furthermore, field-specific experience helps to create a clear self-concept and knowledge about their future occupational field (Holland 1959; Holland 1973; Super 1957), which develops students' confidence in their ability to perform their professional role (Cech et al. 2011). If students have a clear occupational self-concept and high professional role confidence that is in line with their chosen college major, they are more likely to persist and pursue a career in this profession (Cech et al. 2011; Holland 1959; Holland 1973; Super 1957). Due to gender role socialisation processes (e.g. Correll 2001; Eccles, Barber and Jozefowicz 1999; Seymour and Hewitt 1997), girls and women are less likely to attend male-typical vocational training or upper-secondary courses, such as STEM courses or vocational training in STEM. Therefore female students tend to have fewer field-specific experiences in STEM prior to higher education. A lack of pre-tertiary field-specific experience is likely to contribute to the higher non-completion rate of women in post-secondary STEM education (*Hypothesis 2*).

6.3.2. In-college experiences

In prior research, in-college experiences have almost always been defined as two types of integration – academic integration and social (Dahm and Lauterbach 2016; Tinto 1975; Tinto 1993) – and are structured by study conditions (Litzler and Young 2012; Seymour and Hewitt 1997).

Academic integration describes the match between a student's intellectual orientation and that of the institution (Tinto 1993). In contrast to grade performance, intellectual development measures the individual's identification with the norms and values of the academic system (Tinto 1975, p.104).

Research shows that female high school graduates are equally prepared as or better prepared than their male counterparts for science careers (Buchmann and DiPrete 2006; Buchmann, DiPrete and McDaniel 2008; Helbig 2012). For example, girls and boys perform equally well in upper-secondary maths courses (Hyde et al. 2008; Lange et al. 2014). These good pre-tertiary performances represent perfect preconditions for degree completion in STEM for men and women. It is, however, likely that the actual academic performance does not match the perceived academic performance. Women are said to develop a distorted picture of their competences in maths and science. They attach less value to maths and science than men (Eccles (Parsons), Adler and Meece 1984; Eccles, Barber and Jozefowicz 1999; Eccles and Harold 1992) and have a low self-assessment of their maths and science abilities (Correll 2001; Correll 2004). As a result, despite having equal abilities, women evaluate their abilities more pessimistically than men (Correll 2001; Correll 2004; Eccles, Barber and Jozefowicz 1999). This negative perception of academic performance is likely to push women out of STEM.

There is also evidence that students are less likely to complete their degree if they cannot identify themselves with the academic environment (Tinto 1975; Tinto 1993). Pre-tertiary field-specific experiences are likely to ease the transition into a profession's environment for three reasons. First, field-specific technical knowledge and practical competencies help increase an individual's confidence within a specific major. Second, the identification with (and commitment to) a major's sentiments, values and collectively supported norms eases the integration into the major's culture (Cech et al. 2011). Third, a clear occupational self-concept and knowledge of the field supports fruitful discussions

and engaged dialogues with faculty and peers (Holland 1959; Holland 1973; Super 1957). Since women are less likely to have pre-tertiary field-specific experiences in STEM, I expect female students to have more problems identifying with the STEM environment than male students.

In summary, female STEM students are assumed to perceive their academic performance more negatively than male students. Furthermore, women seem to find it harder to identify with the STEM environment because of their lack of pre-tertiary field-specific experiences. Therefore, it is likely that the extent of a student's academic integration (or lack thereof) helps to explain the higher non-completion rate of female STEM students (*Hypothesis 3*).

Integration also takes place at the social level, mainly through interactions with peers and faculty in the form of social communication, friendship support, faculty support and collective affiliation (Tinto 1975, p.107). Thus, social integration is dependent on the social environment in which a student is embedded. It is generally accepted that the more students are socially integrated, the more likely they are to remain in the higher-education system. Women are a minority in the male-dominated environment of a STEM major. According to Kanter's (1977) theory of tokenism, being a minority in a gender-atypical field is assumed to create problems. Kanter asserts that women in predominately male settings report that they are not taken seriously by the dominant male group. Furthermore, they run the risk of being isolated from the dominant group, or being reduced to the stereotypical role of a woman being incompetent at mathematics and natural sciences (Kanter 1977; Steele 1997). While women have become more integrated over time, inequalities and the underrepresentation of women in male-dominated fields persist. Female STEM students are therefore likely to be discouraged by their social environment (peers and faculty), which prevents integration and therefore increases their chances of not completing post-secondary STEM education. Therefore, I expect social integration to be an important factor in explaining the gender difference in post-secondary STEM education completion (*Hypothesis 4*).

6.4. Data and analytical approach

6.4.1. Data

To analyse the reasons for gender differences in post-secondary STEM education completion, I use the starting cohort first-year students of the German National Education Panel Study (NEPS)[18] (Blossfeld, Roßbach and von Maurice 2011).[19] The data provide detailed information of 17,910 first-year bachelor students who started their first higher-education course in the year 2010/11. This data is particularly suitable for analysing my research question, as it contains information about the students' pre-tertiary and in-college experiences.

In the following analyses I focus on students from universities of applied sciences (Fachhochschule) and universities (public and private). As the focus of the chapter is the gender difference in the non-completion of upper-secondary STEM education, I exclude non-STEM students from the analyses. I also exclude students on teacher training courses and those who completed vocational education and entered higher education without a general university qualification, also called "non-traditional students".[20] Both groups are assumed to have different preconditions and reasons for non-completion than STEM students, and should therefore be examined separately.[21] Finally, I only include respondents up to age 35, assuming that older students have other influences over their higher education than younger students. To maintain the largest possible sample size, I handle missing data with multiple imputations by chained equations (MICE, m = 100). This technique uses a separate conditional distribution for each imputed variable and was applied because of the nature of the variables I had to impute: binary and count variables are only allowed to take on specific values, which is not possible using the multivariate

[18] doi:10.5157/NEPS:SC5:6.0.0.
[19] For a detailed description of the data, see Chapter 4.
[20] Since 2009, German higher-education systems have been open to occupational-qualified individuals without an upper-secondary school qualification. To be admitted to the higher-education system, they have to pass an entrance examination in Germany.
[21] For further details on the non-completion rates of non-traditional students, see Brändle and Lengfeld (2016), Dahm and Kerst (2013)

normal distribution technique.[22] Hence, the final sample comprises 2,848 male and 1,324 female STEM students (4,172 total).[23]

6.4.2. Variables

6.4.2.1. Dependent variable

The dependent variable defines whether students are completers or non-completers of STEM in their first Bachelor. Those who did not complete are defined as students who either changed to another field or dropped out of higher education altogether.[24] In my dataset, 475 students (11.4 per cent) did not complete post-secondary STEM education. Since students have not graduated their Bachelor yet, I contrast non-completion (=1) with still being enrolled (=0). Students who are still enrolled have not changed their course of study and can therefore still be considered on track to graduate in a STEM major.

This rather broad definition of non-completion can be explained by my intention to find reasons why female students leave a higher-education STEM career. Therefore I am not interested in explaining why they dropped out of higher education altogether.

6.4.2.2. Independent variables

The main independent variable is gender. I observe a significant gender difference in the probability of completing a post-secondary STEM degree: women are significantly more likely than men to drop out of a STEM degree programme (13 per cent vs. 10 per cent).

In order to explain this gender difference, I control for several pre-tertiary and in-college variables that have been proven to influence post-secondary STEM education non-completion. To operationalise pre-tertiary experiences, I include several variables. First, I control for pre-academic achievement, using the score of the upper-secondary

[22] For the proportion of missing observations for each imputed variable, see Appendix Table A 1.
[23] The strong reduction of the sample size is due to the fact that within the randomly drawn sample of the NEPS, SC5 students at state-approved private higher-education institutions and teacher training students are oversampled. Neither sample is considered in the final data set of this chapter.
[24] Since I work with prospective panel data, the dependent variable is right-censored, which means that students might still drop out before graduation or that students who have left the university might finish their studies later. Therefore in this chapter I can only make statements regarding the third academic year before the regular study time has ended.

education exam in German. This variable is measured continuously and ranges from 1 (lowest possible achievement) to 15 (highest possible achievement). Second, I include the type of higher-education entrance qualification (1 = general entrance qualification (*allgemeine Hochschulreife*), 0 = restricted entrance qualification (*Fachhochschulreife*)) as an indicator of college preparation. These two variables are used to define the level of general academic preparation. To control for field-specific preparation, I include the score of the upper-secondary education exam in maths (again ranging from 1 to 15). I also control for whether an individual has a vocational training qualification in STEM (1 = yes, 0 = no).[25] I further include a variable indicating whether a student attended upper-secondary education courses in STEM (1 = yes, 0 = no). In Germany, pupils can decide which key subjects they want to be examined in; however, in most federal states maths is mandatory, which leads to a distribution skewed heavily towards STEM fields. Therefore, I exclude maths as a determining factor and focus on all other STEM fields (such as physics or chemistry).

The influence of in-college experiences is operationalised through variables measuring academic and social integration. The student cohort of the NEPS is the first dataset in Germany that offers an instrument to directly measure the various dimensions of students' social and academic integration in higher education (Dahm and Lauterbach 2016). To determine the impact of *academic integration* on the non-completion of post-secondary STEM education, I created indices for *perceived academic performance* and *identification with the academic environment*. Both variables are based on a constituted index. The first is measured with the following three items (all ranging from 1 = "not true at all" to 4 = "absolutely true"): "My academic achievements/grades are better than I had originally expected", "I am satisfied with my performance in the degree program", "I have fully met my own expectations for my performance and grades in this degree program". Cronbach's alpha (a = 0.8) shows that these three items measure the same construct; therefore it is a good index. The second additive index is measured by three items (ranging from 1 to 5): "I can completely identify with my studies", "I enjoy my

[25] The occupations in which the vocational training degree was obtained are coded according to the German Classification of Occupations 2010 (KldB 2010). The KldB 2010 consists of five hierarchical coding levels, in which occupational expertise comprises the horizontal dimension and requirement level the vertical dimension of occupations.

field of studies very much", "To be honest, my studies don't thrill me". Again, Cronbach's alpha (a = 0.9) indicates a good index.

Social integration comprises the indices *interactions with fellow students* and *interactions with faculty*. The first index (a = 0.8) is comprised of the items (ranging from 1 to 4): "I have been successful in building contacts with other students during my studies", "I know a lot of classmates with whom I can exchange ideas about questions in my field of study" and "I have many contacts with students in my cohort". The second index (a = 0.8) is measured by four items (ranging from 1 to 4): "I get along well with the instructors in my degree program", "Most of the instructors treat me fairly", "I feel accepted by the instructors" and "The instructors are interested in what I have to say".

Finally, I also control for additional variables. First, to make sure that my results are not driven by institutional characteristics such as the demands and environments of higher-education institutions, I differentiate between universities and universities of applied sciences (Fachhochschule). Second, I assume that the mechanisms of gender-specific non-completion might differ between the STEM majors and therefore control for the field of study. Third, I take into account the possibility that the student's family might have an influence on the highest educational degree they attain. Previous research has shown that students who come from academic families demonstrate better starting conditions due to the cultural and financial resources provided by their parents than those whose parents never attended higher education. Therefore I control for whether at least one parent has obtained a higher-education degree. To avoid spurious effects caused by older students, I introduce a metric variable for the student's age at the time of starting higher education. Last of all, to control for possible interdependencies between the risk of non-completion and time spent in higher education, I include a time variable in my models.

6.4.3. Analytical approach

In a first step, I give a descriptive overview of the differences between male and female students in terms of the factors I expect to have an impact on the non-completion of upper-secondary STEM education. I first calculate the average values of the explanatory variables for female and male STEM students. I then show the relationship between each

independent variable with the dependent variable *non-completion of postI -secondary STEM education*. As the research question involves analysing a binary variable (the decision whether to stay in or leave post-secondary STEM education), I use bivariate logistic regressions. The variables that show significant differences between males and females in their average values as well as a significant effect on the dependent variable are assumed to help explain the gender gap in upper-secondary STEM education.

In a second step, I run multivariate analyses in order to determine the extent to which these factors are responsible for the higher non-completion rate of female STEM students. I therefore analyse the probability of a non-completion of upper-secondary STEM education by re-running the logistic regressions. In doing so, I stepwise introduce the different assumed explanatory components into the regression model, under the control of the above-mentioned variables. I display average marginal effects (AMEs) so that the results are comparable across models (Mood 2010). In contrast to linear regression coefficients, logistic regression coefficients are confounded by unobserved heterogeneity even when the independent variables in the model are not correlated with the error term (Best and Wolf 2012). Thus since the unobserved heterogeneity affects the size of the logistic regression coefficients, comparing these coefficients between models biases the substantive effects. To solve the scaling problem and produce interpretable coefficients which can also be compared between models, I use AMEs. The AMEs are relatively robust to scaling (e.g.Wooldridge 2002, p. 470) and can be easily and intuitively interpreted: the probability of leaving post-secondary STEM education ($y = 1$), on average, changes by AME points when the independent variable increases by one unit.

Furthermore, I apply a decomposition technique to quantify the extent to which these factors influence the observed pattern of gender differences. To disentangle how much of the gender gap is mediated by pre-tertiary and in-college experiences, I use the decomposition method developed by Karlson, Holm and Breen (KHB) (Karlson and Holm 2011; Karlson, Holm and Breen 2010).[26] Similar to the usage of AMEs, the KHB method can be applied to calculate coefficients that can be compared across nested models by holding the variance of both models constant. The KHB method can also decompose the effects of both discrete and continuous variables in the model. Thus using

[26] I use the user-written Stata program 'khb', which uses the KHB decomposition method (Karlson and Holm, 2011, Karlson, et al., 2010)

this method, I am able to quantify the percentage share explained by all explanatory variables in a respective model step (D_{total}), under control of the control variables. I can also define the percentage share that each variable set ($D_{variableset}$) contributes to explain the gender difference in upper-secondary STEM education non-completion.

6.5. Results

6.5.1. Descriptive overview

In order to examine which variables might help explain the gender difference in STEM higher-education non-completion, I calculate the mean values of the explanatory variables for both sexes. In addition, I present the average advantage for female students on the explanatory variables in Table 5, Column 3. To establish the relationship between the explanatory variables and the dependent variable *Non-completion*, I run a set of bivariate analyses. The logit coefficients are presented in Column 4 of Table 5.

The first mean values for the variable set *General Academic Preparation* in Table 5 show that women obtain significantly higher scores in German than their male counterparts. Furthermore, they considerably more often enter higher education with a general entry qualification than men. Column 5 shows that having good scores in German and entering higher education with a general entry qualification reduces the risk of non-completion in general. The logit coefficients are negative and significant for the score in German, which supports my assumption that female STEM students are positively selected in terms of their general academic preparation. Hence, it appears that general academic preparation should not be responsible for the disadvantage of female students in post-secondary STEM education, which is in line with Hypothesis 1.

Table 5: Description of the explanatory variables and bivariate results for STEM students only

	STEM students		Gender difference	Relationship with dep. variable	Description of the variables
	Mean values		Average advantage female	Logit coeff.	
	Male	Female			
Dependent variable					
Non-completion of STEM	0.10	0.13	+0.03***		0 = no; 1 = yes
Independent variables					
Pre-tertiary experiences					
General academic preparation					
Score German	9.24	10.41	+1.17***	-0.05***	0 to 15 = excellent
Entrance qualification	0.75	0.88	+0.13***	-0.18	1 = general; 0 = restricted
Field-specific preparation					
Score maths	10.65	10.68	+0.03	-0.12***	0 to 15 = excellent
STEM courses	0.83	0.76	-0.07***	-0.58***	0 = no; 1 = yes
Vocational training in STEM	0.15	0.04	-0.11***	-0.17	0 = no; 1 = yes
In-college experiences					
Academic integration					
Perceived academic performance	2.42	2.41	-0.01	-1.50***	1 to 4 = high
Identification with environment	3.54	3.58	+0.04	-0.82***	1 to 5 = high
Social integration					
Interactions with students	3.02	3.13	+0.11***	-0.37***	1 to 4 = high
Interactions with faculty	2.97	2.96	-0.01	-0.59***	1 to 4 = high
N	2,848	1,324			

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results for pre-tertiary field-specific experiences show that there is no significant gender difference in maths scores. Female STEM students, however, complete upper-secondary education courses and vocational training in STEM less often than male STEM students. The bivariate relationship between the score in maths and STEM non-completion is negative. In other words, the higher the score in maths, the lower the risk of non-completion of post-secondary STEM education. The latter two variables are also negatively related to non-completion, whereas only the variable *Upper-secondary Education Courses in STEM* shows a significant effect. In conclusion, I find that female STEM students have shortcomings in their pre-tertiary field-specific experiences, with the exception of their score in maths. In accordance with Hypothesis 2, the bivariate

results indicate that pre-tertiary field-specific experiences, except for maths scores, seem to be good predictors of the higher non-completion rate of female STEM students.

Concerning in-college experiences, I find that female STEM students show the same degree of academic integration as male STEM students, in both variables. Contrary to my expectation, women do not perceive their academic performance more pessimistically than men. Furthermore, they do not have more problems identifying with the STEM environment than male students. Consequently, despite the high negative significant relationship between the explanatory variables and the dependent variable, the variable set *Academic Integration* does not seem to be a relevant mediator of the gender difference in higher-education non-completion in STEM subjects. This indicates that I have to reject Hypothesis 3.

Finally, the bivariate results also show that female STEM students have no problems with social integration. First, they attach significantly greater weight to interactions with peers than male STEM students. Second, there are no differences concerning interactions with faculty. Both variables have a negative impact on the dependent variable. Thus, the more they are socially integrated, the less likely they are to complete their STEM education. Again, contrary to Hypothesis 4, these results indicate that female STEM students do not struggle with social integration.

6.5.2. Logistic regressions

In the next section I discuss the results of stepwise logistic regressions for having not completed STEM in post-secondary education. In addition, I explain the observed pattern of the gender gap through a non-linear decomposition. In the last row of Table 6 I display the cumulative percentage of the gender difference explained by all independent variables (under the control of the above-mentioned variables). The percentage share that each variable contributes to explaining the gender difference in the full model is shown in the last column.

Model 1, Table 6 displays the AMEs for female STEM students. Without controlling for further variables, female STEM students are significantly more likely to have not completed STEM than male students (see the positive coefficient $b_{AME} = 0.028$

in Model 1). The gender effect slightly decreases but remains significant after including the control variables (see the positive coefficient b_{AME} = 0.024 in Model 2).

When I introduce the *General Academic Preparation* factors in a third step, the effect for gender slightly increases in size (b_{AME} = 0.026 in Model 3). Although I still have a significantly higher non-completion probability for female STEM students, the effect is only significant at the 5 per cent level. The *Score in German* has a significant negative impact on the non-completion rate in STEM. Students with high scores in German are less likely to drop out of their STEM education. Contrary to the theoretical assumption, Model 3 shows a positive but not significant effect for the variable *Entrance Qualification*, meaning that students with a general entrance qualification seem to be less likely to complete STEM than those with a restricted entry qualification. The entire model explains a total of -12 per cent of the gender effect. This result indicates that, despite higher levels of general academic preparation, women are less likely to complete STEM education than men, holding all other variables constant. One possible explanation for this effect might be the fact that students with a restricted entrance qualification often attended vocational training before entering higher education. If this vocational training was obtained in STEM, non-completion is less likely due to the advantage of the field-specific skills and knowledge gained. However, this is an unverified assumption.

Model 4 contains the variable set *Pre-tertiary Field-Specific Experiences*. Adding these variables has the consequence that there is no longer a significant relationship between gender and the dependent variable. Furthermore, the AME for gender in Model 4 is the lowest out of all the models (b_{AME} = 0.020 in Model 4). In line with my theoretical assumptions, all three variables significantly lower the risk of non-completion. In particular, experiences obtained in STEM-related courses and vocational training strongly prevent non-completion (b_{AME} for pre-tertiary courses in STEM = -0.034 and b_{AME} for vocational training in STEM = -0.050 in Model 4). I also observe a sharp increase in the cumulative percentage of the gender difference explained by the model. The proportion rises from -12 per cent in Model 3 to 17 per cent in Model 4, which is an increase of almost 30 percentage points. To sum up, the results of Model 4 strongly support Hypothesis 2: that women have higher non-completion rates than men because of their shortcomings in pre-tertiary field-specific experiences.

In Model 5 I include the first variable set of in-college experiences: *Academic Integration*. As a result, the gender effect size increases and becomes significant again. The AME for gender in Model 5 ($b_{AME} = 0.030$) is even higher than in the bivariate model ($b_{AME} = 0.028$ in Model 1). I find a strong negative impact of the "academic integration" variables on the dependent variable. A comparison of the fourth and the fifth models also shows that the effect of pre-tertiary field-specific experiences is partially mediated by the academic integration variables. In particular, pre-tertiary achievement in maths no longer has a significant effect after controlling for in-college achievement and identification. Furthermore, the significance and effect size decrease for completed upper-secondary education courses and vocational training. This indicates that, in addition to pre-tertiary field-specific experiences, the process of academic integration is a strong predictor of non-completion of post-secondary STEM education, independent of gender. The proportion of the gender gap explained by the model, however, shows that the *Academic Integration* variable set does not help explain the gender gap. The proportion of the gender difference explained by all independent variables in the model decreases from 17 per cent in Model 4 to 4 per cent in Model 5, which is consistent with the increase of the gender effect. Thus Hypothesis 3 has to be rejected.

In a last step, I introduce the variable set *Social Integration* into the model. The gender effect in Model 6 does not change. Furthermore, the cumulative percentage of the gender gap explained by the variables in Model 6 again decreases from Model 5 to Model 6. Finally, the variables in the full model (Model 6) explain 7.36 per cent of the gender gap in STEM non-completion. While interactions with peers have no effect on the non-completion of STEM education, interactions with faculty encourage non-completion. This might be due to the fact that only weak students tend to contact faculty members to ask for help. Good students need less help, and therefore rate social contact with faculty lower than others.

The percentage share that the *Social Integration* variable set contributes to explaining the gender gap in the full model is displayed in the last column of Table 6. Concerning pre-tertiary experiences, I observe that the variable set *General Academic Preparation* has almost no explanatory value (last column: $D_{variableset} = -3$), which is in line with Hypothesis 1. In contrast, the variable set *Pre-college Field-Specific Experiences* appears to be an important factor in explaining the gender gap in upper-

secondary STEM education, which confirms Hypothesis 2. All three variables together explain 14 per cent of the gender gap in upper-secondary STEM education. Contrary to Hypotheses 3 and 4, these findings demonstrate that in-college experiences do not help explain the gender gap in STEM non-completion for two reasons. First, my results indicate that women in STEM do not have problems with academic integration (last column: $D_{variableset}$ = -9). Second, the variable set *Social Integration* has no explanatory value (last column: $D_{variableset}$ = 0). The low explanatory values of the models indicate that there seem to be other important factors explaining the gender gap in STEM non-completion. I discuss these in the next section.

Table 6: Leaving post-secondary STEM education: results of the logistic regression and decomposition (KHB)

	Model 1 AME	Model 2 AME	Model 3 AME	Model 4 AME	Model 5 AME	Model 6 AME	$D_{variableset}$ for Model 6
Gender (female = 1)	0.028**	0.024**	0.026*	0.020	0.030**	0.030**	
	(2.74)	(2.74)	(2.49)	(1.85)	(2.63)	(2.60)	
Pre-tertiary experiences							
General academic preparation							
Score German			-0.004*	-0.002	-0.002	-0.002	-3
			(-2.06)	(-1.01)	(-0.82)	(-1.01)	
Entrance qualification (general = 1)			0.018	0.013	0.022	0.018	
			(1.33)	(0.97)	(1.64)	(1.37)	
Field-specific academic preparation							
Score maths				-0.006***	-0.002	-0.002	14
				(-3.54)	(-1.48)	(-1.45)	
STEM courses (yes = 1)				-0.034**	-0.025*	-0.027*	
				(-3.15)	(-2.34)	(-2.49)	
Vocational training in STEM (yes = 1)				-0.050**	-0.044**	-0.043*	
				(-2.99)	(-2.63)	(-2.57)	
In-college experiences							
Academic integration							
Perceived academic performance					-0.077***	-0.082***	-9
					(-6.26)	(-6.75)	
Identification with environment					-0.031***	-0.040***	
					(-3.61)	(-4.53)	
Social integration							
Interactions with peers						0.005	0
						(0.45)	
Interactions with faculty						0.046**	
						(2.83)	
Control variables	no	yes	yes	yes	yes	yes	
N	4,172	4,172	4,172	4,172	4,172	4,172	
D_{total} (in contrast to Model 1)			-12	17	4	2	2

Notes: AME; z statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; Control variables: Education of the parents, type of higher-education system, age at entering higher education, time spent in higher education, field of study. Coefficients reported in the Appendix Table A 2.

6.6. Conclusion

In this chapter, I examined the reasons for the higher non-completion rate of female students in post-secondary STEM education. In contrast to the majority of prior research, I included both pre- and in-college experiences in the analyses in order to assess their importance for the gender gap in post-secondary STEM education completion. Furthermore, I am the first to have analysed two types of pre-tertiary experiences: general college preparation and pre-tertiary field-specific experiences. In Germany, a considerable share of higher-education entrants obtains field-specific experiences prior to higher education. Since there is evidence that women and men choose different fields in which to gain such experience, I wanted to find out whether these specific pre-tertiary experiences are important factors in explaining the higher non-completion rate of women in upper-secondary STEM education.

Based on data from the NEPS starting cohort first-year students, the analyses show large variations in the explanatory value of pre-tertiary and in-college experiences for the observed gender gap. The models demonstrate that neither general academic preparation nor in-college experiences explains the higher non-completion rate of female STEM students. The results reveal that pre-tertiary field-specific experiences appear to be the main driving factors behind this gender gap. My data point out that, despite German education policies that aim to make STEM careers more attractive to women, and which start early in children's education, female STEM students still have deficits in pre-tertiary field-specific skills and knowledge. To put it differently, women are unspecialised when it comes to STEM. These deficits seem to ultimately cause women to drop out of post-secondary STEM education at a higher rate than men. Furthermore, my results downplay the role of in-college experiences. At first sight, is seems that female STEM students do not have problems with academic and social integration during higher education. The question why female students leave post-secondary STEM education despite being at least as satisfied (or more satisfied) with in-college STEM experiences than male STEM students requires more investigation in future research.

I speculate that there are at least two other factors causing women to drop out of post-secondary STEM education that I cannot capture with my data. It is known, for example, that women favour family-flexible careers, which is not typical of STEM careers (Frome et al. 2006; Lörz, Schindler and Walter 2011; Reskin 1993). Therefore female STEM students might give up their study plans altogether for this reason (Armstrong and Price 1982), even if they rate their in-college situation positively. However, finding out whether this is the case would require a control of long-term career plans and life goals, which is not possible with the data used in this study. Another possible reason that more female students drop out of STEM programmes is the fact that they tend to have broader interests (and thus a wider opportunity structure than male students), including in non-STEM subjects. Due to their high levels of pre-tertiary achievement in all subjects, female students have access to all higher-education majors. This is in line with research on vocational interests, which has shown that girls show broader interest profiles than boys, who are more restricted to realistic and investigative interests (which are distinctly related to STEM) at an earlier age (Nagy, Trautwein and Lüdtke 2010). Therefore, it can be assumed that female STEM students more often change their major due to the low opportunity costs of doing so. The interaction effects between gender and pre-tertiary achievement variables, however, show that female and male STEM students do not differ in their non-completion rates. These tests can be interpreted as a first rejection of this "opportunity structure" assumption.

Some readers may also question the validity and reliability of self-reported data from students regarding their performance in higher education. While this is a legitimate concern, an individual's performance has low informative value. To maintain someone's performance, one needs comparison values. One possibility is to measure students' relative performance (i.e., individual performance compared to that of fellow students). Another option is to compare individual performance with the fulfilment of self-set standards of achievement, which is also not possible with the data. Thus, perceived performance seems to be an adequate indicator of academic integration. Finally, it would be desirable to know more about the gender composition of peer groups and faculties. One of my basic theoretical assumptions is that being a minority in a gender-atypical field creates problems. Although I am not able to directly control for the gender composition due to my descriptive results, it is plausible to assume that women are a minority in post-

secondary STEM education – the analysis shows that only 23 per cent of all female students choose a STEM major (in contrast to 55 per cent of all male students).

To conclude, although I am aware that other factors than those considered here may explain the higher non-completion rate of female STEM students, the findings of this chapter provide an important new interpretation of the significance of the pre-tertiary phase for educational success in post-secondary STEM education. The question of whether the gender gap in post-secondary STEM education attainment can be closed by early encouragement and intervention in field-specific training of women, however, requires further investigation.

Chapter 7 Labour Market Outcomes of Higher-Education Dropouts in Germany: How Formal Vocational Qualifications Shape Transitions and Occupational Status

The previous two chapters have shown that the pathways to higher education play a crucial role in higher-education students' decisions about whether to complete their degree. The German education and training system provides ample opportunities to enter higher education. These pathways equip students with different kinds of knowledge, skills, qualifications and certificates, which in turn affect their decisions about whether to stay in or leave the higher-education system to enter the labour market.

Thus the opportunities available in the labour market play a crucial role in students' decisions about whether to complete their degree. Germany's vocational training system provides skills and knowledge that are directly transferable to particular occupations and industries, and most vocational students receive formal schooling alongside on-the-job training in the form of in-company apprenticeships. There is thus a direct link to the labour market. Research has shown that students with pre-tertiary vocational qualifications are more likely to drop out of higher education. As a consequence, a considerable proportion of dropouts in Germany enter the labour market with vocational experience. In this chapter I will analyse the impact of vocational qualifications on the labour market outcomes of higher-education dropouts.

This chapter is co-authored by N. Tieben.

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7.1. Introduction

Worldwide, a considerable proportion of students leaves higher education without a degree and has to enter the labour market with no formal vocational qualifications. Previous research shows that higher-education dropouts have a higher risk of being unemployed, working part time or on fixed-term contracts, and on average earn lower wages than higher-education graduates (e.g. Becker, Grebe and Bleikertz 2010; Davies and Elias 2003; Griesbach, Lewin and Schacher 1977; Johnes and Taylor 1991; Lewin et al. 1995; Reisel 2013). In Germany, however, approximately a quarter of all first-year students enters higher education after obtaining a formal vocational training degree (Autorengruppe Bildungsberichterstattung 2014). This "double qualification" usually enhances students' labour market opportunities or bridges waiting periods (e.g., when entrance restrictions prevent an immediate transition onto the desired course), and serves as a risk-mitigating strategy for students who may not be confident of succeeding in higher education (Büchel and Helberger 1995; Pilz 2009). However, research on double qualifiers has shown that an additional vocational degree does not produce additional labour market benefits for higher-education graduates (Büchel and Helberger 1995; Hammen 2011).

The question of whether a vocational qualification serves as a safety net in case of higher-education non-completion, however, has not yet been examined. This chapter aims to fill this gap by examining the labour market transitions of higher-education dropouts. Since many dropouts in Germany obtain non-tertiary vocational qualifications on top of their higher-education courses, I investigate whether these formal vocational qualifications mitigate the risk of protracted labour market transitions and low occupational status when a degree has not been obtained. I distinguish between two labour market outcomes: (1) the transition into a stable first job, which indicates whether higher-education dropouts have more difficulties finding a job and (2) the occupational status of the first job, which indicates if higher-education dropouts without pre-tertiary vocational training are more likely to enter low-status jobs than dropouts with formal vocational qualifications.

7.2. Previous research

Although a large body of research examines the returns from education, these generally focus on formal vocational qualifications, such as (upper/vocational) secondary and tertiary certificates. A number of researchers acknowledge that entering higher education (but not graduating) may deliver returns in the labour market, but the empirical results are inconclusive (Bailey, Kienzl and Marcotte 2004; Davies and Elias 2003; Flores-Lagunes and Light 2007; Grubb 2002; Johnes and Taylor 1991; Kane and Rouse 1995; Matković and Kogan 2012; Reisel 2013; Schnepf 2014; Schnepf 2015; Stegmann and Kraft 1988).

Reisel (2013), for example, shows that attending college without graduating in the United States results in higher incomes compared to high school graduates who never entered college (see also Bailey, Kienzl and Marcotte 2004; Flores-Lagunes and Light 2007; Grubb 2002 for similar results in U.S. studies). The same study, however, also reveals that Norwegian college dropouts achieve lower incomes than upper-secondary education graduates. A longitudinal study of Serbia and Croatia (Matković and Kogan 2012) shows that in Serbia, time spent in higher education before dropping out results in a slightly shorter job search and higher occupational status compared to early dropouts and job seekers with an upper-secondary diploma who never entered higher education. For Croatia they report no advantages associated with time spent in higher education. Schnepf (2014, 2015) shows that university dropouts are more likely to hold professional and managerial positions than upper-secondary education graduates who never entered higher education in Belgium, the Czech Republic, Denmark, the Netherlands, Poland and Slovakia, but not in France, Germany, Italy, Norway, Spain or the UK. For Germany, Stegmann and Kraft (1988) find that higher-education dropouts do not have a higher risk of being unemployed, but achieve a lower occupational status and a lower income than higher-education graduates. The same study also reveals that dropouts in Germany achieve a slightly higher income but no higher occupational status than upper-secondary education graduates with a formal vocational training certificate.

In previous studies there are some inconsistencies and open questions regarding the labour market transitions of dropouts compared to reference groups that never entered higher education. In general, job seekers who dropped out of higher education seem to have a small advantage over those who never entered higher education. I nevertheless

suggest some aspects that deserve further scrutiny. In the U.S. context, labour market opportunities seem to depend on college enrolment or the length of time spent in higher education (Reisel 2013), and Matkovic and Kogan (2012) report similar findings for Serbia. Yet in Germany, the additional returns from entering higher education without graduating are low compared to those who never entered higher education (Stegmann and Kraft 1988).

The existing literature, however, does not take into account the possibility that higher-education dropouts may enter the labour market with separate, formal vocational qualifications. The German educational system provides ample vocational training opportunities that a large proportion of general upper-secondary education graduates perceives to be an attractive alternative pathway. In the following sections I therefore briefly overview the German post-secondary educational system and examine the implications for the labour market transitions of higher-education dropouts in this context. For a more detailed overview of the German education and labour market system, see Section 2.2. in Chapter 2 and Section 3.2. in Chapter 3.

7.3. The German post-secondary educational system

Access to higher education in Germany is restricted to graduates of upper-secondary education. Eligibility is typically obtained by graduating from general upper-secondary education (*Abitur* or *Fachabitur*), but students can enter higher education via several other pathways, including vocational upper-secondary education[27] (Schindler 2014). The most-attended vocational track is the so-called dual or apprenticeship system, which combines formal schooling with on-the-job training in the form of in-firm apprenticeships (Müller, Steinmann and Ell 1998; Walden and Troltsch 2011). The second-most frequent type of training is purely school-based vocational training. The German vocational training system is characterised by a relatively high degree of standardisation and occupational specificity, which ensures a high level of comparability of vocational

[27] Students can higher education via this route when a vocational training course with additional lessons from the general upper-secondary curriculum has been successfully completed.

qualifications.[28] There is also a strong link between vocational training and the labour market in Germany: there is a strict channelling of education leavers into specific occupations and a direct match between educational qualifications and labour market positions (Bol and Weeden 2014; Kerckhoff 2000; Shavit and Müller 1998). Therefore graduating from vocational training in Germany is attractive as it usually results in good employment opportunities and high chances of a direct entry into a stable position within the training company (Soskice 1994; Wolbers 2007).

For this reason, an increasing proportion of general upper-secondary education graduates who meet the entry requirements for higher education instead choose vocational training (Jacob, 2004; Büchel and Helberger, 1995, Pilz, 2009). A growing number of young adults obtain a double qualification (i.e., both a higher-education degree and a vocational qualification). In many cases, this means that a vocational education graduate enters higher education (Hillmert and Jacob 2004; Jacob 2004). Currently, one-fifth of all higher-education students graduate from vocational training before entering higher education (Autorengruppe Bildungsberichterstattung 2014). Büchel and Helberger (1995) note that general upper secondary education graduates in particular pursue a double qualification strategy because they expect better job opportunities with a higher-education degree, but perceive the vocational qualification as a safety net in case of failure in higher education. Tieben (2016) shows that students with pre-tertiary vocational qualifications have a slightly higher risk of leaving higher education without a degree: 40 per cent of all dropouts have a formal (non-tertiary) vocational qualification at the time of leaving higher education. Another 25 per cent of all dropouts enters vocational training after de-registration from higher education and obtains a formal vocational certificate within 5 years after dropping out. This may explain why Stegmann and Kraft (1988) do not find large differences in the labour market returns of dropouts compared to general upper-secondary education graduates who did not enter higher education in their German sample, while these differences are more marked in other countries (Kane and Rouse 1995; Matković and Kogan 2012; Reisel 2013; Schnepf 2014; Schnepf 2015). I therefore suggest that additional vocational qualifications should be taken into account when examining the labour market transitions of dropouts.

[28] A more detailed description of the vocational training system is available in Section 2.2.1 of Chapter 2 and Section 3.2.1. in Chapter 3.

7.4. Theories on education-to-work transitions

The relationship between education and labour market returns has been examined from different theoretical perspectives (see Bills 2003 for a comprehensive overview). Human capital approaches (Becker 1964; Bowman 1966; Mincer 1958; Mincer 1989; Schultz 1962) assume that educational investments produce skills that increase productivity, and that applicants with higher educational attainment thus achieve higher returns in the labour market than those with lower educational attainment. Especially in the economics literature, the human capital assumption is tested by simultaneously modelling the effects of time spent in education and degree completion on returns to education (e.g. Antelius 2000; Arkes 1999; Bauer, Dross and Haisken-DeNew 2005; Bol and van de Werfhorst 2011; Flores-Lagunes and Light 2010; Groot and Oosterbeek 1994; Layard and Psacharopoulos 1974). Other researchers model the time spent in higher education to capture the accumulation of human capital in incomplete higher-education studies (Matković and Kogan 2012; Matković and Kogan 2014). The disadvantage of this approach, however, is that a longer persistence in higher education, i.e. when people take longer than the normal time to complete a degree, captures delays that can be caused by poor performance, part-time enrolment or family obligations. The assumption that time spent in higher education before dropout results in human capital that can be transferred to the labour market also remains doubtful, because it does not convey clear information about the student's course commitment and learning progress (Groot and Oosterbeek 1994).

The human capital approaches more generally have been criticised for assuming that employers draw conclusions about job applicants' productivity based on the time they spent in the educational system (Rosenbaum 1986). Later approaches instead assume that the recruitment process takes place in a context of uncertainty: since employers cannot determine job candidates' actual productivity levels, they screen potential employees on the basis of observable characteristics ('signals' (Spence 1973)) such as educational attainment, gender, age, work experience, unemployment duration or other personal characteristics. It is, however, rarely discussed whether employers perceive higher-education non-completion as a signal in the recruiting process, and if it is a positive or negative signal. Higher-education dropout could be interpreted as a failure and

thus signal a lack of ability, perseverance and goal commitment (Heckman and Rubinstein 2001). Future employers might therefore perceive hiring dropouts as a risky investment as they might be likely to display these characteristics in the job as well. Arrow (1973), on the contrary, argues that enrolment in higher education can serve as a positive signal for employers even if the applicant did not obtain a higher-education degree.[29] According to Thurow's (1975) notion of "queuing", employers rank applicants according to their observable characteristics and prefer those who rank highest. Since higher-education dropouts are likely to apply for jobs in the skilled labour market, they probably compete with higher-education graduates and applicants who never entered higher education. In this ranking, the higher-education graduates should have a large competitive edge. However, dropouts may rank higher than applicants who never entered higher education.

As described above, the vocational training system plays an important role in Germany and has been highly debated in the social sciences since it may divert students from aspiring to higher education and achieving higher returns in the labour market (Hillmert and Jacob 2003; Vanfossen, Jones and Spade 1987). Shavit and Müller (2000), however, conclude that especially in countries with high occupational specificity, vocational training is a very attractive 'safety net' that guarantees smooth transitions into the labour market and stable occupational careers. Yet previous research has largely neglected the fact that vocational training and higher education are not mutually exclusive, and that vocational training graduates can choose to enter higher education later in life (Büchel and Helberger 1995; Hammen 2011; Jacob 2004; Tieben and Rohrbach-Schmidt 2014). Büchel and Helberger (1995) assume that these double qualifiers pursue an 'insurance strategy' in the German educational system, as they hope to benefit from their vocational skills during higher education and in the labour market. The vocational training certificates may also serve as a fallback option in case of higher-education dropout.

A number of studies (Büchel and Helberger 1995, Hammen 2011) find that a vocational training certificate does not result in additional labour market returns for successful graduates, but the assumption that vocational training serves as 'insurance' in

[29] For more information see Section 3.1.2. in Chapter 3.

case of higher-education non-completion has not yet been empirically tested. As outlined above, a large proportion (40 per cent) of German dropouts obtained formal vocational qualifications before entering higher education (Tieben 2016), which raises the question of whether dropouts with vocational credentials can profit from these qualifications and have advantages in the labour market transition over dropouts without formal vocational qualifications. The signalling value of formal vocational qualifications in the recruitment process depends on the link between the structure of the educational system and the labour market (Allmendinger 1989b; Gangl 2003b; Shavit and Müller 2000; van de Werfhorst 2011; Wolbers 2003). As discussed above, the German labour market can be regarded as highly credentialist due to its strong linkage between vocational education and the labour market.[30] Because of the high specificity of the German vocational training system, the signals sent by job seekers' formal vocational qualifications to prospective employers are particularly informative. Thus I expect that higher-education dropouts profit from vocational qualifications in their labour market transition. They should have fewer difficulties finding a job than higher-education dropouts without a vocational training degree (*Hypothesis 1*). Furthermore, because a vocational training degree opens the door to skilled employment (Soskice 1994; Wolbers 2007), higher-education dropouts with a vocational degree are expected to obtain higher occupational status positions than dropouts without a vocational certificate (*Hypothesis 2*).

7.5. Data and analytical approach

7.5.1. Data

For the empirical analyses I rely on the starting Cohort 6 'Adult Education and Lifelong learning' (SC6) from Germany's NEPS (Blossfeld, Roßbach and von Maurice 2011; Leopold, Raab and Skopek 2013; Skopek 2013). For more information on the data see Section 4.2. in Chapter 4. In the following I give details on the sample I use in this chapter. In order to ensure the maximum comparability of individuals in the analytic

[30] In addition, high occupational positions – for example in the civil service or in traditional professions such as teachers, medical doctors, lawyers and the clergy – can only be accessed via a specific higher-education diploma.

sample, I select respondents who have obtained a general upper-secondary leaving certificate either by graduating from general upper-secondary education (*Abitur* or *Fachabitur*) or via alternative routes like vocational upper-secondary education or evening schools. Students from universities of cooperative education (*Berufsakademie*), business academies (*Wirtschaftsakademien*) and academies of public administration (*Verwaltungsakademien*) are excluded because students in these institutions usually pursue training that combines employment and training simultaneously. As these groups cannot be clearly assigned to either vocational training or higher education and the case numbers are not sufficient to treat them separately, they were removed from the sample. As the focus of the chapter is the education-to-work transition of higher-education dropouts, I also remove persons who enter parental leave or other types of inactivity, e.g., performing military service, from the sample because these respondents are presumably not actively searching for a job or are unavailable for the labour market. Thus, including them would result in biased estimators of the average job-search duration. Furthermore, I exclude respondents who were older than 36 when they dropped out in order to capture only those who are searching for their first stable job. To ensure that the results are not biased by specific educational and labour market context effects of former East Germany, I also exclude respondents who were born in or graduated from higher education in former East Germany before 1989. Furthermore, I exclude individuals who obtained their higher-education entrance qualification outside Germany or who studied abroad. To maintain the largest possible sample size, I handle missing data with multiple imputation techniques, which take full advantage of the available data and avoid some of the bias in standard errors and test statistics that can accompany listwise deletion. For respondents who had at least one non-missing value on any of the variables in the analysis, missing data was imputed using chained equations (White, Royston and Wood 2011). Dependent variables were not imputed. The final sample comprises 4,748 cases.

7.5.2. Variables

7.5.2.1. Dependent variables

The education-to-work transition of post-secondary education leavers is measured in two ways. The first is a binary variable that indicates if a respondent enters his or her first stable job. The labour market entry process is reconstructed based on the monthly activity information stored in the retrospective life-history data of the NEPS SC6. Because the NEPS allows for parallel activity status, a status hierarchy was defined with education as the highest priority, followed by employment as the second priority, and not in education, employment or training.

I follow common definitions (e.g. Noelke, Gebel and Kogan 2012) and define the "first stable job" as occupations that last at least six months and include a minimum of 20 hours of work per week. The advantage of using the first stable job instead of any first job is that I omit short employment episodes like trainee positions and internships as well as periods of early career instability. This approach makes it more likely that I will capture the first meaningful employment relationship.

The second dependent variable is a metric variable measuring the occupational status of the first stable job, which is the same occupation used to define the search duration in the first education-to-work transition. For this I use the International Socio-economic Index of Occupational Status (ISEI) (Ganzeboom 2010; Ganzeboom, de Graaf and Treiman 1992). This scale has the advantage of a parsimonious measurement and therefore maintains the maximum statistical power. Furthermore, in contrast to income, the item non-response rate for the variable *ISEI* is relatively low for this variable, which assures low losses of cases in the final analyses. In the present sample the scale of the status scores ranges from 12 to 89.

I distinguish the probability of entering a first stable job from the occupational status of the first stable job because I assume that analysing the former only partly describes the process of labour market integration. Post-secondary education leavers, for example, might have a smooth labour market transition but enter a lower-status job if they do not find a job that matches their actual skills in order to avoid unemployment

(Scherer 2005; Wolbers 2007). To rule out this possibility, I also have a closer look at the occupational status of the first stable employment in a second step.

7.5.2.2. Independent variables

The main independent variable is educational attainment. As the focus of this chapter is the difference between dropouts with and without pre-tertiary vocational training, I considered restricting the sample to dropouts and comparing only these groups. Using this strategy, however, it would be difficult to assess the actual magnitude of the coefficients in the models. I therefore included higher-education graduates and vocational training graduates without higher-education experience to facilitate a meaningful evaluation of the results. I hence distinguish four groups: (1) students who graduated from vocational training, but never entered higher education, (2) students who graduated from vocational training, but then dropped out of higher education, (3) students who dropped out of higher education, but did not graduate from vocational training before entering higher education and (4) students who graduated from higher education. Individuals are counted as labour market entrants only if they have, at least preliminarily, completed their initial educational career. Thus, in this chapter dropouts are defined as individuals who drop out permanently.

Control variables include socio-demographic characteristics such as the highest educational level of the parents, sex and age at education-to-work transitions. First, an individual's family of origin might have an influence on the highest educational degree attained and on education-to-work transitions. From previous research I know that social resources increase the efficiency of a job search in terms of search duration and occupational position (Kogan 2011). However, greater financial resources allow job applicants to extend the length of their search until they receive a satisfactory job offer. While this prolongs the education-to-work transition, it optimises the job match. Therefore I control for whether at least one parent has a higher-educational degree.[31] To avoid spurious effects caused by higher ages at education-to-work transitions, I introduce a metric variable for age at de-registration. Furthermore, I control for the score of the

[31] Education of the parents is defined by the International Standard Classification of Education scale.

general upper-secondary education exam to take differences in competence levels into account. This metric variable ranges from 1 ‘very good’ to 6 ‘insufficient’. Differences between female and male education leavers are considered by including a dummy variable for sex (female = 0). I also control for work experience, as this is likely to ease labour market transitions. This dichotomous variable accounts for occupational experiences acquired between obtaining a higher-education entrance qualification and entering the first significant job. It does not include work experience gained during vocational training. To control for structural changes in the labour market and the educational system, I include four education-leaving cohort dummies in the models. These dummy variables vary in length: the oldest cohort spans more than 10 years in order to obtain a sufficient number of cases. For further definitions of the independent variable and basic descriptive information, see Table 7.

Table 7: Description and basic descriptive statistics of variables

Variable	N	%	Description
Educational attainment			
Vocational training qualification (VTQ)	1,345	28.33	Graduated from vocational training but never entered higher education
Higher-education dropout without pre-tertiary VTQ	378	7.96	Dropped out of higher education, never graduated from vocational training
Higher-education dropout with pre-tertiary VTQ	119	2.51	Dropped out of higher education but graduated from vocational training before entering higher education
Higher-education degree	2,906	61.20	Graduated from higher education, double qualification included
At least one parent higher education			Education of the parents
No	2,308	48.61	
Yes (=1)	2,440	51.39	
Age at de-registration	4,748	25.66 (mean)	Age when students leave post-secondary education (metric variable)
Sex	2,370	49.92	Female
	2,378	50.08	Male (=1)
Upper-secondary final score	4,748	2.48 (mean)	score of the highest secondary school exam (*Abitur*) (metric variable, from 1 'very good' to 6 'insufficient')
Work experience			Employed at least 20 hours per week (occasional jobs and work experience gained during vocational training excluded)
No	3,779	79.59	
Yes	969	20.41	
Education-leaving cohort			Year of leaving post-secondary education
1964–1984	1,154	24.30	
1985–1994	1,431	30.14	
1995–2004	1,193	25.13	
2005–2014	970	20.43	
Stable employment			Number of respondents who find a stable job within the observation period
No	808	17.02	
Yes	3,949	82.98	
N	4,748	100.00	

7.5.3. Analytical approach

In a first step, I describe the transition from education to first stable job depending on the level of educational attainment using an event history approach. This method has two decisive advantages. First, with event history models, all relevant changes of the condition during a given time period, as well as the timing of events, can be considered. One could instead use a binary dependent variable regression model like a logit or probit model. Individuals who had transitioned into the labour market would be coded '1' for the dependent variable, while students who did not find a job by the time of the interview would be coded '0'. However, this strategy is problematic, as it does not take into account when a person enters his or her first job. Defining pre-specified time intervals

(e.g., 36 months since de-registration of post-secondary education) would result in the loss of a large amount of information, particularly about when someone left (Jenkins 2005, p.10).

In summary, using binary dependent variable regression models does not consider the dynamic perspective of the transition into the first stable job. This dynamic, however, is particularly important for analysing career paths, since both the quality of the matching process as well as the time it takes to obtain a suitable job matter. Therefore, event history models are used that help describe how smooth the transition from education to work is for students with different post-secondary education outcomes.

The second advantage of event history models is that they make it possible to estimate unbiased models, including right-censored cases (Blossfeld 2010, p.999). Censoring occurs when the exact duration of an event is not known. Event history models permit the calculation of both the likelihood that individuals will experience an event while at risk and of those who are right censored. Those who do not enter the labour market until the date of the last interview are right censored. Furthermore, I decided to right censor individuals who entered vocational training after leaving higher education, as this would make them unavailable to the labour market for at least two years.[32] Education leavers who remain without a stable job longer than 48 months are right censored as well, assuming that they are no longer searching for a job.

For a descriptive overview, I estimate failure functions using the Kaplan-Meier product-limit method. This is a rather straightforward representation of the time it takes to enter the labour market after leaving the education system. The survivor function is the inverse of the failure function. The survivor function indicates the share of individuals that have not yet started their first stable job at a given point in time (Allison 1984; Blossfeld and Rohwer 2002; Jenkins 2005). Consequently, the failure function refers to the share of persons that already have made a particular transition (or failure) at any point in time.

In the multivariate analyses of the transition from education to a first stable job I apply Cox proportional hazards regression models (Cox 1972). I chose the Cox model because I have no theoretical concerns about time dependency, which is introduced in this

[32] 50 per cent of all dropouts enter vocational training after leaving higher education.

model as an unspecified baseline hazard rate (Blossfeld, Golsch and Rohwer 2007). Furthermore, as the main interest is the direction and strength of the covariate effects on the event occurrence (not the search duration), this model is appropriate. Its basic assumption is that the hazard rate does not differ by subgroups of the population during the observation period (Blossfeld, Golsch and Rohwer, 2007). Statistical tests, for example based on the Schoenfeld residuals, show that the proportional assumption of the Cox model is violated for the central independent variable, 'educational attainment'. Therefore, additional models are calculated.[33] Since the results of interest remain unchanged across the different ways of modelling, I keep to the Cox proportional hazards regression model. The theory-driven reasoning behind this modelling strategy is that the actual search duration does not deliver additional insights, as this is caused by properties of the different transition patterns of graduates from vocational training and higher education, as further elaborated in the results and conclusions sections of this chapter.

In a second step I select respondents who successfully entered the labour market and conduct ordinary least squares (OLS) models to analyse the occupational status of the first stable job. This method is applicable since occupational status is measured on a metric scale ranging from 10 (lowest status) to 90 (highest status) (Ganzeboom 2010). Positive (negative) coefficients in the models indicate higher (lower) occupational status.

7.6. Results

7.6.1. Entering a first stable job

7.6.1.1. Descriptive overview

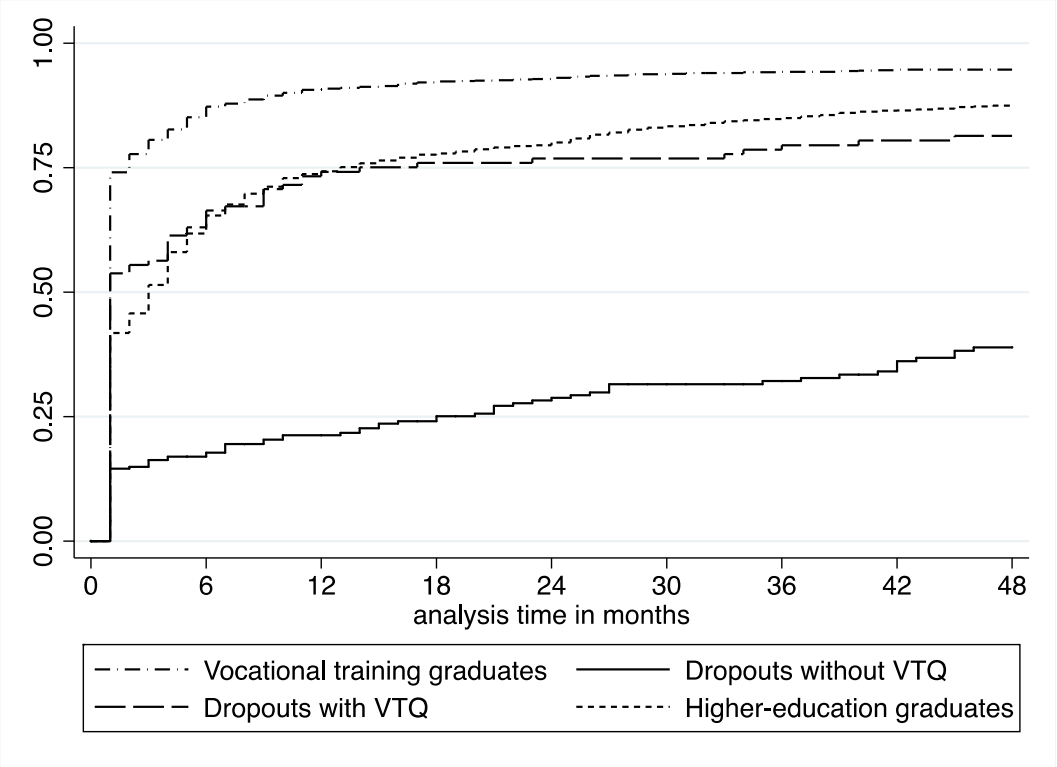
To understand how the patterns of transition into a first stable job differ by post-secondary educational attainment, I estimated failure functions using the Kaplan-Meier method. The failure functions in Figure 7 show the cumulative proportion of individuals that had entered a stable job at time *t* after leaving education, separated by educational attainment. Individuals who did not enter the labour market by the time of the interview

[33] I calculated stratified Cox models, which shows that the overall effect of the other variables remains the same. As a robustness check I also run piecewise constant hazard models. They show the same results as the Cox models. The results are shown in Table B1 and B2 in the Appendix.

or within four years after leaving education are treated as right censored. In such cases, the duration of the job search is defined as the period of time between leaving the educational system and the date of interview (a duration of 48 months without an event).

Figure 7 shows how important it is to take dropouts' additional formal vocational qualifications into account. I split the dropouts into those with and without additional vocational qualifications, and observe that dropouts who did not graduate from vocational training have a high risk of remaining without a stable job (less than 50 per cent enter a stable job within 48 months). Dropouts with vocational qualifications have considerably better chances of entering a stable job. Approximately 50 per cent of the higher-education dropouts with a vocational training degree enter a stable job immediately after leaving the educational system, and three out of four make a transition within the first year. Their transition rates are thus comparable to those of higher-education graduates. This indicates that higher-education dropouts can use additional vocational qualifications as a safety net to protect them from the risk of remaining unemployed or in precarious job situations. Among higher-education graduates I observe a similar transition pattern, although an immediate transition occurs somewhat less frequently. This is probably due to the fact that this group is more likely to enter a transition or orientation period after de-registration. It is also likely that higher-education graduates deliberately postpone entering their first job and that they "take some time off" or pursue an internship before entering the working world. By contrast, many higher-education dropouts probably postpone their de-registration until they find a job, which may explain why they are more likely than graduates to enter a stable job during the first 6 months after they leave higher education. The labour market transition of vocational training graduates is particularly smooth, as the majority enters a stable job within the first 6 months and the risk of not finding a job within 48 months is below 5 per cent. This is not surprising in the German context, because vocational training usually takes place as an in-firm apprenticeship and employers have an interest in retaining their apprentices after graduation.

Figure 7: Transition to first stable job – Kaplan-Meier failure curves over 48 months after leaving the educational system.



7.6.1.2. Cox regressions

In order to rule out the possibility that the group differences in the labour market transitions are driven by individual characteristics (such as sex, age, social background, cognitive competences and work experiences) or by specific context conditions at the time of the transition, I run multivariate Cox regressions with corresponding controls. Table 8 shows the results of these models. The coefficients are displayed as hazard ratios, i.e., coefficients greater than 1 indicate a positive association with the transition rate and coefficients smaller than 1 indicate a negative association. I run two versions of the models, varying only the reference category to contrast the groups with (1) higher-education dropouts who have no additional vocational qualifications and (2) vocational training graduates who never entered higher education. Doing so, I can identify the returns for higher-education graduates and for dropouts with and without vocational

qualifications, compared to respondents who never entered higher education (Model 1a). In Model 1b I identify returns for higher-education graduates and for dropouts with additional vocational training, compared to dropouts with no formal vocational qualifications.

The results of Model 1a largely confirm the findings of the descriptive Kaplan-Meier failure curves. They reveal that vocational training graduates have the smoothest transitions into the labour market, even when control variables are taken into account. All other groups have significantly lower transition rates. The results also indicate that dropouts without additional vocational training have by far the lowest transition rate. In Model 1b I observe that dropouts without formal vocational qualifications have a significant disadvantage compared to dropouts with a vocational degree. As expected in Hypothesis 1a, I can conclude that a formal vocational qualification seems to counter the disadvantages of being a dropout by easing the transition from education to the labour market. It seems that the vocational training qualifications serves as a stronger signal than higher-education experiences.

Although the control variables do not explain much of the group differences presented from the Kaplan-Meier failure functions, upper-secondary scores does not seem to affect the transition to a stable job. Women are less likely to enter a stable job within the observation period; this may be related to family obligations, which are not captured in the models. The negative effects of work experience and social background are somewhat surprising, but I only can speculate about the reasons for this finding. The negative effects might be due to the higher status expectations of the respondents and their parents. Respondents with work experience or highly educated parents might not take the very first job offered to them, but instead take the time to find an occupation that meets their own (and their parents') expectations. Furthermore, I also find that in younger cohorts, the transition rate is lower than in older cohorts.[34] This is in line with research showing that labour market transitions in recent cohorts comprise longer periods of

[34] Due to the small subsamples, it is not productive to test for cohort "effects". Running the analyses separately for each group of cohorts, however, shows relatively stable estimators across cohorts. Therefore I can exclude the possibility of significant interactions between cohort and the central independent variables. The same also holds for the subsequent analyses.

orientation and unstable labour market perspectives (Buchholz and Kurz 2008; Gebel 2009; Scherer 2005).

Table 8: Results of the Cox proportional hazards regression model for the transition into first stable job

	Model 1a Cox		Model 1b Cox	
	Hazard ratios	z	Hazard ratios	z
Educational attainment				
Vocational education qualification (only VEQ)	*Ref.*		6.64***	(17.80)
Higher-education dropout + VEQ	0.65***	(-3.97)	4.30***	(10.22)
Higher-education dropout	0.15***	(-17.80)	*Ref.*	
Higher-education degree	0.67***	(-9.03)	4.48***	(14.83)
At least one parent higher-education degree (yes = 1)	0.90**	(-3.14)	0.90**	(-3.14)
Age at de-registration	0.99	(-1.14)	0.99	(-1.14)
Sex (male = 1)	1.20***	(5.45)	1.20***	(5.45)
Upper-secondary final score	0.97	(-0.92)	0.97	(-0.92)
Work experience	0.61***	(-11.40)	0.61***	(-11.40)
Education-leaving cohort				
1964–1984	1.10	(1.86)	1.10	(1.86)
1985–1994	1.27***	(4.99)	1.27***	(4.99)
1995–2004	1.23***	(4.18)	1.23***	(4.18)
2005–2014	*Ref.*		*Ref.*	
N	4,748		4,748	

Notes: Hazard ratios*; z* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

7.6.2. Occupational status: OLS regressions

The results from the Cox models show the transition rates of higher-education dropouts and provide an overview of how successfully the different occupational groups enter their first stable job. The transition rates, however, do not allow me to draw conclusions about how "attractive" a job applicant is to employers or about their human capital. This is because an applicant who does not succeed in obtaining his or her first-choice job is likely to enter a less attractive position instead of extending their search until the desired job is offered. Therefore I run linear regression models comparing the occupational status (ISEI) of first job entrants with different educational outcomes.[35] As shown in Table 9, I observe that higher-education graduates obtain by far the highest returns from education in terms of occupational status, which is in line with the established theories and

[35] This includes only those respondents in the model who entered the labour market, which explains the lower number of respondents in Models 2a and 2b.

empirical findings. There seems to be a constrained access to specific occupations that require higher-education diplomas. Contrary to Hypothesis 2, however, the results of Model 2a show no significant difference in the occupational status of the first stable job between vocational training graduates and higher-education dropouts with and without vocational training qualifications. The results in Model 2b even indicate that dropouts without formal vocational qualifications obtain slightly higher occupational positions than those with a vocational training degree. Nonetheless, an additional formal vocational qualification does not improve the occupational status of the first stable job, and attending (but not graduating from) a higher-education institution does not lower the occupational status of the first job.

Next I summarise the most important results for the control variables. Parental education has a marginally significant positive effect on the occupational status of the first stable employment. Older respondents obtain slightly higher-status positions than younger respondents. Work experience has no significant explanatory value. The gender effect is in line with prior research that shows that women enter slightly higher job positions than men, when comparing women and men with similar qualifications in full-time jobs (Schimpl-Neimanns 2004). Low scores in the upper-secondary final exam result in lower job positions, and respondents from the oldest cohort obtain higher occupational positions than those from the youngest cohort. In recent decades, educational requirements for the workforce have evolved in keeping with the rapid technological and organisational changes: the qualifications of the workforce have increased due to the higher-educational attainment of employees in the service sector compared to those in agriculture or manufacturing. As a consequence, the likelihood of obtaining high occupational positions decreases for the education-leaving cohort as the competition on the labour market increases with educational expansion and the change of the labour market structure (Jacob, Kleinert and Kühhirt 2013; Müller, Steinmann and Ell 1998).

Table 9: Results of the ordinary least square model for the occupational status of the first stable job

	Model 2a OLS – ISEI		Model 2b OLS – ISEI	
	Coef.	t	Coef.	t
Educational attainment				
Vocational education qualification (only VEQ)	*Ref.*		-2.50	(-1.55)
Higher-education dropout + VEQ	-2.16	(-1.32)	-4.66*	(-2.15)
Higher-education dropout	2.50	(1.55)	*Ref.*	
Higher-education degree	21.52***	(32.68)	19.02***	(12.23)
At least one parent higher-education degree (yes = 1)	0.98*	(1.97)	0.98*	(1.97)
Age at de-registration	0.44***	(4.57)	0.44***	(4.57)
Sex (male = 1)	-1.16*	(-2.32)	-1.16*	(-2.32)
Upper secondary final score	-2.54***	(-4.96)	-2.54***	(-4.96)
Work experience	-0.96	(-5.18)	-0.96	(-5.18)
Education-leaving cohort				
1964–1984	2.77***	(3.56)	2.77***	(3.56)
1985–1994	0.87	(1.19)	0.87	(1.19)
1995–2004	0.41	(0.55)	0.41	(0.55)
2005–2014	*Ref.*		*Ref.*	
Constant	42.87***	(17.02)	42.87***	(17.02)
N	3,813		3,813	

Notes: t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; ISEI = Standard International Socio-Economic Index of Occupational Status

7.7. Conclusions

In this chapter I examine the labour market returns of higher-education dropouts relative to graduates of higher education and vocational training. Since in Germany a considerable share of dropouts obtains additional formal vocational qualifications, I particularly wanted to find out whether vocational qualifications serve as a safety net in case of higher-education non-completion. In contrast to prior research, I not only compare the labour market outcomes of higher-education dropouts and graduates, but also enlarge my comparison group to vocational training graduates without higher-education experiences and distinguish between higher-education dropouts with and without vocational qualifications.

In line with common labour market theories, I assume that the process of matching job applicants to open positions takes place in a context of uncertainty, and that employers evaluate the "signals" of job applicants (Spence 1973). I discussed whether higher-education dropout signals a lack of ability and non-cognitive skills to prospective employers, as proposed by Heckman and Rubenstein (2001), or if instead enrolment in

higher education (even without graduation) is assessed as positive signal (Arrow 1973). As Germany is known for its highly credentialist labour market, I expected dropouts to have significant disadvantages in their labour market transitions compared to job seekers with formal vocational qualifications. As suggested by Büchel and Helberger (1995), dropouts can profit from formal vocational qualifications as a safety net. I therefore proposed that dropouts with formal vocational qualifications should have better chances of entering stable employment (Hypothesis 1) and securing a higher-status first stable job (Hypothesis 2). I confirm Hypothesis 1, but surprisingly, the dropouts without formal vocational qualifications achieve status scores that are comparable to those with vocational training.

The conclusions are therefore as follows. Entering the German labour market without formal vocational qualifications is risky. Employers indeed seem to rely on these signals when they screen potential candidates for a vacancy. In this sense, vocational training is indeed a safety net for those who drop out of higher education. However, I also observe that among successful candidates, only a completed higher-education degree results in higher status scores: I do not find large differences between dropouts with and without vocational qualifications and candidates who never entered higher education. At first sight, it therefore does not seem to matter which route into stable employment was taken, because detours and vocational qualifications do not affect the occupational status of the first job. Still, the reasons for the non-existent labour market disadvantages of dropouts should still be examined.

Perhaps dropouts who do succeed, i.e. securing a high-status first stable job, have certain characteristics that are helpful in the labour market. I know, for example, that dropout rates in STEM subjects are particularly high, and that STEM dropouts are sought after in the labour market (see Becker et al. 2010 for a qualitative study examining this issue). I therefore suspect that the high occupational status of dropouts without formal vocational qualifications is to a large extent driven by this group. Single-case analyses indeed show that many higher-education dropouts with high occupational positions are those who ultimately work as engineers or managers of medium-sized companies. I therefore suggest that these students were lured away from higher education by attractive exit options in the labour market. This possibility suggests the need to control for the field of study, which I did not do, for two reasons. First, I compare respondents with and

without higher-education experiences, so I cannot control the field of study for respondents who did not enter higher education. Second, respondents who have entered higher education often transfer to another subject, resulting in multiple higher-education episodes. Field of study is therefore not necessarily constant across the entire higher-education episode before dropout.[36]

It would also be desirable to know more about the reasons for dropping out of higher education. Obviously, the group of dropouts is not homogenous. Some apparently leave higher education because of low performance and/or a lack of motivation, whereas others leave due to (perceived) better options elsewhere. It is, for example, very likely that dropouts with poor labour market opportunities decide to enter vocational training after leaving higher education (or leave higher education because they want to pursue vocational training instead). It is therefore likely that I do not observe differences between the groups of dropouts with and without vocational training because only the more "promising" candidates in both groups are actually searching for a job. I must also consider gender differences, as female dropouts who plan to start a family may postpone labour market entry or alternative educational activities. Due to data limitations I was not able to disentangle these mechanisms. I therefore have to keep these points in mind when interpreting the results.

[36] One could argue that the type of higher-educational system might also serve as an important signal. However, just like the field of study, I cannot control for the type of higher-educational system, as it might vary between the higher-education episodes.

Chapter 8 The Impact of Macro-level Labour Market Conditions on the First Jobs of German Higher-Education Dropouts

Labour market outcomes are not only dependent on individual-level processes, such as the behaviour of employers and employees. They are also influenced by macro-level conditions such as cyclical fluctuations, which directly affect the supply and demand of labour. If labour is scarce, an employer will hire applicants without optimal qualifications. When jobs are scarce, applicants without formal qualifications are pushed into less attractive jobs. How macro labour market conditions affect the types of first jobs that higher-education dropouts are able to get has not been examined yet. In this chapter I will analyse the impact of aggregate unemployment rates on the first transition rates and occupational status of the first job of higher-education dropouts compared to higher-education graduates. Below I describe the reasons for focusing on first employment and differentiating between transition rate and occupational position.

8.1. Introduction

Despite the expansion of education and the resulting increase in higher-education entrants, higher-education dropout is a major problem for all Organisation for Economic Co-operation and Development (OECD) countries. Between 10 and 25 per cent of higher-education students in OECD countries fail to complete their degree (OECD 2010). Dropouts who enter the labour market suffer distinctive disadvantages in employment outcomes compared to graduates (Davies and Elias 2003; Heublein, Spangenberg and Sommer 2003; Johnes and Taylor 1991; Matković and Kogan 2012). It takes dropouts longer to find a job, and they tend to enter low-quality jobs more often than higher-education graduates. There is evidence that an unsuccessful first labour market entry has long-lasting negative effects on future career success (Cutler et al. 2015, Kahn 2010, Oreopoulos et al. 2012, Scherer 2004, Scherer 2005, Lange et al. 2014). In Germany, for example, entering low-qualified jobs is associated with less prosperous careers and higher unemployment risks later in life (Scherer 2004, 2005). Thus first labour market outcomes

are highly significant for the quality of long-term careers, and therefore deserve special attention.

This chapter examines the first labour market outcomes of higher-education dropouts and graduates in times of favourable and poor labour market conditions (i.e., low and high unemployment rates, respectively). It explores whether higher-education dropouts are affected more strongly by high or low unemployment rates than higher-education graduates in terms of both how long it takes them to get their first job and the occupational status of that job. Chapter 7 showed that in Germany, higher-education dropouts have lower first labour market outcomes than higher-education graduates, but that dropouts achieve status scores comparable to those of vocational training graduates. These results indicate that dropouts have different starting conditions than individuals who never attended higher education, however they both still lack a higher-education degree. Comparing the labour market transitions of higher-education dropouts with those of higher-education graduates helps to clarify the importance of a higher-education degree during an economic downturn. Prior research has been conducted on the impact of labour market conditions on the employment outcomes of lower-educated, vocationally educated and higher-educated individuals (e.g. Gesthuizen and Wolbers 2010; Klein 2015; Pollmann-Schult 2005). Vuolo et al. (2016) extend the research to also include higher-education dropouts in their analyses by focusing on the impact of educational degrees on the employment outcomes of workers in their thirties. However, it appears that no work has been done on the impact of macro-level labour market conditions on the first jobs of higher-education graduates vs. dropouts in Germany.

8.2. Previous research

A growing body of literature looks at the effects of labour market conditions on the labour market outcomes of individuals with different levels of education (e.g. Gesthuizen and Wolbers 2010; Klein 2015; Pollmann-Schult 2005; Teulings and Koopmanschap 1989; van Ours and Ridder 1995). This research examines the reasons for the high unemployment rates of lower-educated individuals by analysing the direct effect of macro-level conditions on the displacement in the labour market of lower-educated

individuals, including those with no completed degree or a qualification from lower-secondary school, by higher-educated workers. In addition to structural shifts, changes in the business cycle are found to be an important factor in explaining the poor labour market outcomes of unskilled workers, especially in Germany. While no evidence of this has been found in the Netherlands (Gesthuizen and Wolbers 2010), Klein (2015) shows that in Germany, in comparison to higher- and vocationally educated workers, the risk of unemployment for less-educated individuals increases more during economic downturns. Pollmann-Schult (2005) find that this is also the case for unskilled workers. Cutler et al. (2015), Kahn (2010) and Oreopoulos et al. (2012) find major negative and persistent long-term labour market consequences for higher-education graduates who finished university during recessions in Europe, the USA and Canada, especially among students at the bottom of the ability distribution. While all higher-education graduates enter lower-level occupations in times of poor labour market conditions, students with high innate ability are able to improve their position later in their career.

Taken together, these studies demonstrate that poor labour market conditions, defined by high unemployment rates, have a negative impact on employment outcomes in the short and long run, especially for the less-educated reference group. Yet these studies have not examined the impact of macro-level labour market conditions on the first jobs attained by higher-education dropouts. This group of education leavers, however, is quite an interesting group, especially in Germany, where the link between educational qualifications and employment is relatively close: the majority of those who hold formal certificates have a distinct advantage in the labour market over the majority of those who do not (Hillmert 2009). Furthermore, research on the direct impact of macro-level conditions mainly focuses on the risk of being (or becoming) unemployed. Research on individuals' first jobs, however, shows that occupational positions are also strongly dependent on individuals' educational levels, especially in Germany (Müller and Gangl 2003; Müller and Shavit 1998). Furthermore, early occupational positions are significant predictors of future career prospects (e.g. Scherer 2004; Scherer 2005). Vuolo et al. (2016) attempt to close the first gap by examining the changes in employment outcomes by educational attainment during the Great Recession in North America, including higher-education dropouts. Comparing labour market outcomes in the years 2005, 2007, 2009 and 2011, they find that the recession affected all educational groups. Individuals

who started, but did not finish, post-secondary educational programmes had lower occupational outcomes than those with post-secondary degrees. Furthermore, the recession exacerbated these differences. Yet it is unknown whether this also applies to first employment. Vuolo et al. (2016) focus on the impact of educational degrees on employment outcomes among workers in their thirties. Their analyses also refer to a very short (and recent) time span: before, during and after the 2008–09 recession. However, economic fluctuations also took place in earlier times.

In conclusion, this paper improves upon earlier research in at least three ways. First, it is the first to compare the effects of macro-level labour market conditions on the first education-to-work transitions of higher-education graduates vs. dropouts in Germany. This is an important issue, since the higher-education dropout group accounts for a marked proportion of all labour market entrants (OECD 2010): almost one-quarter of all first-year students quit higher education before graduating (Heublein et al. 2010). Second, I extend the existing research by examining the consequences of favourable and unfavourable labour market conditions on two important first labour market outcomes – how long it takes to find a first stable job and the occupational status of that job. Third, based on the NEPS data, the education-to-work transitions of higher-education dropouts and graduates can be defined simultaneously over a long time period (1960 to 2013).

8.3. Theory and hypotheses

In order to explain why business cycles affect the first labour market outcomes of higher-education dropouts, at least two important issues have to be taken into account. First, theorizing on the macro-level relationship between unemployment and the first labour market outcomes of education leavers must take into account employers' and employees' behaviour at the micro level. In other words, it has to be theoretically explained why higher-education dropouts are generally expected to have lower labour market outcomes than higher-education graduates. Second, the influence of macro-level conditions on the micro-level behaviour of both employers and employees will be examined from a theoretical perspective, followed by a description of the assumed effects of the aggregate

unemployment rate on the labour market outcomes of higher-education dropouts vs. graduates.

Regarding the first point above, the education-to-work transition can be described as a matching process between two performers – the job seeker and the employer. The outcome of the two-sided allocation decision is a result of the interplay among opportunity structures and the preferences of the negotiating partners, whereby both employers and employees try to maximize their outcomes (Granovetter 1981; Mortensen 1986; Sørensen 1977; Sørensen and Kalleberg 1981; Thurow 1975). In other words, the employer attempts to find the worker with the highest productivity and the lowest training costs for the specific requirements of the open position. Meanwhile, employees search for the occupational position that promises the highest rewards. According to the job competition theory (Thurow 1979; Thurow 1975) there are two queues that have to be matched to each other. In a first step, applicants rank job vacancies according to their perceived attractiveness and rewards. This job queue is matched to a second queue – the labour queue – in which employers rank the supply of job seekers according to their trainability. Since employers cannot evaluate the real productivity or trainability of education leavers, they screen job seekers on the basis of observable characteristics such as educational attainment (Arrow 1973; Riley 2001; Spence 1973). Those with the strongest signals obtain the highest positions in the labour queue. As educational attainment is crucial for determining individuals' relative position in the labour queue (Thurow 1975), higher-education graduates rank higher in the labour queue than dropouts. Therefore it can be expected that in general, higher-education dropouts have lower occupational outcomes than higher-education graduates.

However, the association between education and occupation is assumed to change with an adjustment in macro-economic conditions such as the unemployment rate. Thus macro-level conditions are expected to influence the balance of both queues. In other words, labour market outcomes are assumed to vary according to the unemployment rate. In the following, this issue will be addressed by discussing the extent to which the first occupational outcomes of higher-education dropouts and graduates will be influenced by good labour market conditions (low unemployment rate) vs. bad labour market conditions (high unemployment rate). Two elements of occupational outcomes will be considered:

(1) the transition into the first stable job and (2) the occupational position of that job. Table 10 provides an overview of the expected effects.

During good economic times, when unemployment decreases, it can be assumed that educational qualifications are less important since there are many positions available. According to Reeder (1955), employers react to the business cycle by lowering their hiring standards when there are more open positions than applicants. Thus job competition for open positions is relatively low, meaning that both higher-education graduates and dropouts can easily find an adequate job. For dropouts, the probability of getting a good first job should increase when the aggregate unemployment rate decreases: employers choose less-educated applicants to fill the remaining high-status positions after exhausting the supply of higher-educated applicants. Since higher-education graduates will continue to be preferred for the best jobs, they will remain at the top of the queue. Thus a decrease in the unemployment rate does not change their occupational position.

If unemployment increases, two processes are decisive for the labour market outcomes of higher-education dropouts: (1) employers' changing hiring decisions and (2) variation in the behaviour of other job seekers in the labour queue. Both are expected to lower the educational outcomes of higher-education dropouts. Employers have two possibilities to react to recessions. To save costs, they can reduce the wages of their employees. This is difficult, however, in labour markets with low wage flexibility. Therefore the more likely strategy is to raise their hiring standards and recruit higher-skilled workers without increasing wages (Okun 1981; Reder 1955). This strategy will increase productivity without raising wage costs. In other words, when aggregate unemployment increases and causes the job queue to lengthen, the job queue no longer balances the labour queue. As a result, lower-skilled jobs will be filled by higher-educated workers, since higher-skilled workers tend to be more productive even in lower-skilled jobs than lower-skilled workers. However, under poor labour market conditions, job seekers are expected to lower their expectations concerning their first job and apply for lower-level positions in order to reduce the costs associated with searching for a matching job (Devine and Kiefer 1991; McCall 1970).

Thus, even if employers do not increase their hiring standards during worse economic times, low-skilled jobs will be filled with high-skilled workers. As a result, increasing hiring standards and lowering expectations both cause higher-educated

workers to fall downward on the economic ladder by entering jobs that were previously filled by less-educated workers. These workers, in turn, take the jobs previously filled by less-educated workers (Thurow 1975). Concerning the first labour market outcomes of higher-education dropouts, we can expect the following. First, the transition rate will decrease with increasing unemployment rates, as higher-education graduates are preferred over higher-education dropouts. The transition rate of graduates will not be affected by increasing unemployment rates, as they will enter lower occupational positions rather than search for a job that matches their qualifications. Furthermore, in times of increasing unemployment rates, employers' increasing hiring standards and job searchers' decreasing demands will lead to lower occupational positions for both higher- and lower-skilled job searchers.

In conclusion, the following two scenarios can be expected. First, the difference in the transitions rates into the first stable job for both higher-education dropouts and graduates will be smaller in times of low unemployment rates and larger in times of high unemployment rates (*Hypothesis 1*). Second, the difference in the occupational position of the first stable job in times of low unemployment rates is smaller than in times of high unemployment rates (*Hypothesis 2*).

Table 10: Overview of the expected effects of changes in the unemployment rate

	Transition rate		Occupational position	
	Dropout	Graduate	Dropout	Graduate
Decreasing unemployment rate	Increase	Increase	Increase	No effect
Increasing unemployment rate	Decrease	No effect	Decrease	Decrease

8.4. Data and analytical approach

8.4.1. Data

As in the previous chapter, the following analyses are based on the Starting Cohort 6 'Adult Education and Lifelong learning' from the German NEPS (Blossfeld, Roßbach

and von Maurice 2011; Leopold, Raab and Skopek 2013; Skopek 2013). In addition to the sample restrictions I made in Chapter 7, the following analyses focus on higher-education dropouts and graduates only for two main reasons. First, previous studies have demonstrated the importance of vocational training qualifications, already. Second, and more importantly, this chapter analyses the first labour market outcomes of higher-education dropouts vs. graduates under favourable vs. unfavourable labour market conditions. Comparing the occupational outcomes of dropouts (without further post-secondary education qualifications) and graduates helps to clarify the importance of a higher-education degree during economic downturns. Excluding individuals who never entered higher education and higher-education dropouts who obtained a vocational training qualification before entering higher education results in a final sample of 3,271.

8.4.2. Variables

8.4.2.1. Dependent variables

The impact of macro labour market conditions on occupational outcomes is analysed in two separate steps. In the first step, I use a binary variable to analyse whether the respondent enters his or her first stable job. In the second step, the dependent variable is a metric variable that measures the occupational status (International Socio-economic Index of Occupational Status, ISEI) of the first stable job. I make this distinction because research on the impact of macro-level conditions on first labour market outcomes has mainly focused on the risk of being unemployed. Research on the long-lasting consequences of macro-level conditions, however, has shown that low-ability students who enter low-status occupations in times of poor labour market conditions are not able to improve their positions later in their careers (e.g. Cutler, Huang and Lleras-Muney 2015; Kahn 2010; Oreopoulos, von Wachter and Heisz 2012). Thus, examining first labour market transitions does not fully capture the impact of macro labour market conditions on the first occupational outcomes of education leavers. Therefore I also examine the occupational status of the educational leavers' first job. For detailed information on the operationalization of both dependent variables, see Section 7.5.2. in Chapter 7.

8.4.2.2. Independent variables

The two main independent variables are educational outcome and aggregate unemployment rate (per cent). Concerning the first, two higher-educational outcomes are differentiated: (1) students who dropped out of higher education and did not obtain a higher-education degree before or after dropping out and (2) students who graduated from higher education. Individuals who entered vocational training after leaving the higher-education system are censored from the time their vocational training starts. Just as in Chapter 7, they are not allowed to enter the risk set after obtaining a vocational training degree.

The monthly aggregate general unemployment rates[37] were obtained from the Federal Employment Agency (Bundesagentur für Arbeit) and are used to describe the labour market situation during the education-to-work transition. Using unemployment rates instead of indicators such as GDP or the annual vacancy ratio makes it possible to directly measure business cycle variation on a monthly basis over a very long time span (monthly data from the year 1950 to 2015 are available). Furthermore, the national instead of federal rates are used because higher-education graduates are not as sensitive to local labour markets as to the national market.

Further control variables comprise demographic characteristics such as the highest educational level of the parents, sex and age at education-to-work transition. Furthermore, variables control for the score of the upper-secondary education exam and whether a higher-education graduate also obtained a vocational training qualification. To control for structural changes in the labour market as well as in the education system, education-leaving cohorts are included in the models as a control variable.[38] The analyses also consider whether higher-education leavers have a direct labour market transition in order to control for the possibility that students found their first job before finishing their studies, which might affect the occupational status of the job. For further definitions of the independent variable and basic descriptive information, see Table 11.

[37] Unemploymentrate of the dependent civilian labour force, West Germany

[38] There is evidence that structural changes are less important for education-to-work transitions in Germany (Pollmann-Schult 2005, Klein 2015). Therefore, entry cohorts are only included as control variables.

Table 11: Description and basic descriptive statistics of variables in Tables 12 and 13

		Level of education		Level of education	
		Dropouts		Graduates	
Variable	Description	N	%	N	%
Aggregate unemployment rate	Monthly aggregate unemployment rates	365	8.78 (mean)	2,906	8.71 (mean)
Direct transition into labour market					
No		243	66.58	655	49.89
Yes		122	33.42	658	50.11
At least one parent received higher-education degree	Educational level of the parents				
No		171	46.85	1,246	42.88
Yes		194	53.15	1,660	57.12
Age at de-registration	Age when students de-register from post-secondary education (metric variable)	365	26.31 (mean)	2,906	26.81 (mean)
Vocational training qualification	Pre-tertiary vocational training qualification				
No		365	100.00	2,209	76.02
Yes		0	0.00	697	23.98
Sex (male = 1)	Female student	174	47.67	1,306	44.94
	Male student	191	52.33	1,600	55.06
Upper secondary final score	score of the highest secondary school exam (*Abitur*) (metric variable, from 1 'very good' to 6)	365	2.56 (mean)	2,906	2.44 (mean)
Work experience					
No		354	96.99	2,202	75.77
Yes		11	3.01	704	24.23
Education-leaving cohort	Year of leaving higher education				
1964–1984		84	23.01	719	24.74
1985–1994		112	30.68	792	27.25
1995–2004		86	23.56	741	25.50
2005–2014		83	22.74	654	22.51
First stable job					
No		262	71.78	432	14.87
Yes		103	28.22	2,474	85.13
ISEI[39]		96	51.33 (mean)	2,375	70.90 (mean)
N		365		2,906	

[39] Proportion of missing observations (item non-response): 6.8 per cent for dropouts, 4 per cent for graduates.

8.4.3. Analytical approach

This chapter seeks to answer two questions: (1) whether a respondent finds a job or not and (2) which occupational status higher-education leavers enter. I use a discrete-time event history model to analyse the first question (Allison 1984; Singer and Willett 2003) for two reasons. First, binary dependent variable regression models such as logit or probit models cannot account for the dynamics of the transition process. Second, event history analyses can estimate unbiased models, including censored cases (Blossfeld 2010, p.999). Censoring occurs when the duration of an event is not exactly known. I use a discrete time logistic model due to the presence of the central explanatory variable – 'the monthly changing aggregate unemployment rate'. The advantage of a discrete-time logistic model is that time-varying variables can be easily included. Furthermore, this model does not require a hazard-related proportionality assumption, as described in Chapter 5 (Jenkins 2005).

In the following I first define the basic concepts of event history analyses – the risk set and the hazard rate. Then I specify how the hazard rate depends on explanatory variables, which will clarify the usage of the model for time-varying explanatory variables.

The first central concept in event history analyses is the risk set, which is the set of individuals who are at risk of event occurrence at each point in time (Allison 1984). In the following, higher-education leavers are at risk of entering employment until the date of their last interview. Those who do not enter the labour market during this period are right censored. Furthermore, I right censor those who enter vocational training after leaving higher education, as these individuals will not be looking for their first job for at least two years. Education leavers who remain without a stable job longer than 48 months are right censored as well, under the assumption that they are no longer searching for a job. In the present sample, 21 per cent of education leavers are right censored, with higher-education dropouts' spells being censored more often (71 per cent) than those of graduates (15 per cent). There is a high percentage of censored cases within the group of dropouts because 50 per cent of all dropouts enter vocational training after leaving higher

education. The focus on inflow samples of education leavers and first job entrants avoids the problem of left censoring in the following analyses.

The second key concept is the hazard rate, which is defined as the conditional probability that an individual will enter the labour market at time *t*, given that a transition has not taken place yet. The monthly transition rate of the complete sample equals the number of respondents who find a job in a given month, divided by the number of respondents who are still looking for a job. Analysing event history data requires some model assumptions on how hazard rates vary over time. Assuming that the transition rate is relatively high in the first month after leaving higher education and decreases progressively every 6 months, duration dependency is modelled by including eight dummy variables for the current duration of the job search.[40] Thus the hazard rates are allowed to vary between the different time periods.

To specify how the hazard rate depends on explanatory variables, I use a logistic regression model that contains the dichotomous dependent variable 'finding a first job', and every month spent searching for employment is treated as a unique observation in the model. Thus the data are organised as follows: for each person, there are as many data rows as there are time intervals at risk of the event occurring for each person. For each person-month, the dependent variable is coded 1 if a person enters the labour market in that month; otherwise it is coded 0. For censored cases the dependent variable is always 0. Furthermore, for each person the aggregate unemployment rate can easily be included in the data, as each month at risk is treated as a distinct observation now. In a final step I estimate the logit models using the maximum likelihood. As in logistic regression, the interpretation of raw parameter estimates is rather rare. Thus in the final models the estimated coefficients are displayed as odds ratios – the ratio of the odds of event occurrence. Odd ratios are symmetric about 1. In the case of a dichotomous variable, the odds of event occurrence in the two groups of the variable are equal, with an odds ratio of 1. If the odds ratio is greater than 1, the event is more likely to occur in the second group; if it is less than 1, it is less likely (Singer and Willett 2003).

To determine the occupational status of the first jobs of higher-education dropouts vs. graduates, I use a standard ordinary least squares (OLS) regression. This method is

[40] Models allowing the hazard rate to be different in each month showed same results, see Table C 1 in the Appendix.

applicable since occupational status is measured on a metric scale ranging from 10 for occupations with the lowest status to 90 for occupations with the highest status (Ganzeboom 2010). Positive coefficients mean higher occupational status, while negative coefficients indicate lower occupational status.

In both the discrete-time logistic models and standard OLS models, I include interaction effects between both central independent variables – 'educational outcome' and 'aggregate unemployment rate' – based on the theoretical assumption that aggregate unemployment rates have different effects on the labour market outcomes of higher-education dropouts and graduates. While in linear regression models, interaction effects make effects conditional upon other variables, this is not the case in logistic regression (Bauer 2015). Therefore it is difficult to determine how the interaction effect modifies the slope by considering only the coefficients. Consequently I will show conditional effect plots to visualise the estimated correlation, using average marginal effects.[41] For occupational status I will also show a conditional profile plot.

8.5. Results

This section presents the results of the discrete-time event history models. The models in Table 12 show the effects of different covariates on the rate of transition into the labour market. The estimated parameters measure the change in the odds of the conditional likelihood of entering first employment caused by a one-unit increase in the associated covariate. In the case of small hazard rates, the covariate effects are analogously interpretable as the effects in a proportional hazard model. This means that coefficients greater (smaller) than 1 indicate positive (negative) effects on the job transition rate.

[41] For a detailed description of average marginal effects, see Section 6.4.3 in Chapter 6.

Table 12: Coefficients of discrete-time event history models of entry into first employment from higher education

	Model 1		Model 2		Model 3		Model 4	
	Odds ratios	z	Odds ratios	z	Odds ratios	z	Odds ratios	z
Higher-educational outcome								
dropout	0.21***	(-14.90)	0.19***	(-15.43)	0.35***	(-3.32)	0.35***	(-3.35)
graduate	*Ref*		*Ref*		*Ref*		*Ref*	
Unemployment rate[42]	1.01	(1.17)	1.00	(0.34)	1.01	(1.50)	1.01	(0.63)
Interaction effects								
dropout * unemployment rate					0.94*	(-1.71)	0.93*	(-1.89)
graduate * unemployment rate					*Ref*		*Ref*	
At least one parent with higher-education degree (yes = 1)			0.86***	(-3.22)			0.86***	(-3.33)
Age at leaving education system			0.97***	(-3.15)			0.97***	(-3.16)
Vocational training qualification (yes=1)			1.71***	(8.92)			1.71***	(8.87)
Sex (male = 1)			1.41***	(7.35)			1.42***	(7.40)
Upper secondary final score			0.93	(-1.58)			0.93	(-1.59)
Work experience			0.49***	(-12.43)			0.49***	(-12.44)
Education-leaving cohort								
1964-1984			*Ref*				*Ref*	
1985-1994			1.16*	(1.95)			1.16*	(1.94)
1995-2004			1.13	(1.20)			1.12	(1.16)
2005-2014			0.89	(-1.34)			0.89	(-1.31)
T1	*Ref*		*Ref*		*Ref*		*Ref*	
T6	0.15***	(-35.47)	0.15***	(-34.26)	0.15***	(-35.46)	0.15***	(-34.25)
T12	0.07***	(-35.79)	0.08***	(-34.21)	0.07***	(-35.79)	0.08***	(-34.21)
T18	0.04***	(-31.47)	0.04***	(-30.15)	0.04***	(-31.47)	0.04***	(-30.15)
T24	0.03***	(-28.15)	0.03***	(-27.00)	0.03***	(-28.15)	0.03***	(-27.00)
T30	0.04***	(-27.80)	0.05***	(-26.23)	0.04***	(-27.81)	0.05***	(-26.23)
T36	0.02***	(-23.43)	0.03***	(-22.27)	0.02***	(-23.43)	0.03***	(-22.27)
T42	0.03***	(-22.65)	0.03***	(-21.42)	0.03***	(-22.65)	0.03***	(-21.42)
T48	0.02***	(-19.84)	0.02***	(-18.85)	0.02***	(-19.84)	0.02***	(-18.85)
N(Person-Months)	37,896		37,896		37,896		37,896	
N(Persons)	3,271		3,271		3,271		3,271	

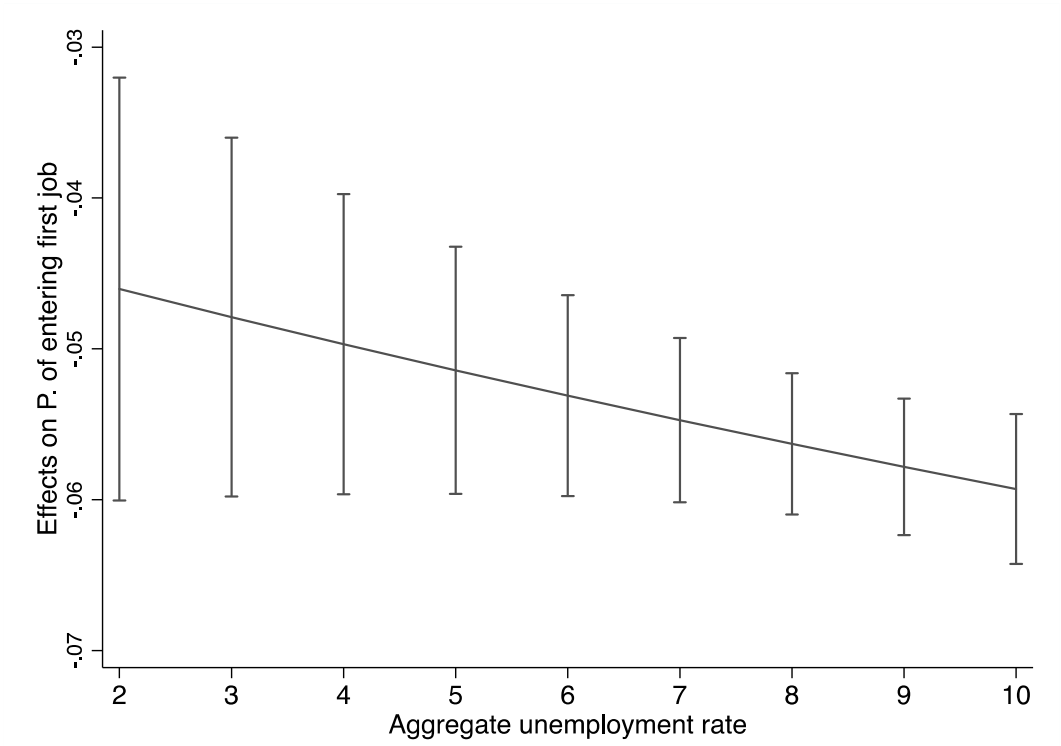
Notes: Odds ratios; *z* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[42] Monthly aggregate unemployment rate (percentage).

To provide a first impression of how higher-education dropouts and graduates differ in their transition rates, and how the unemployment rate affects the transition rate in general, Models 1 and 2 contain only the main factors, which means that there are no interaction effects. In line with the results in Chapter 7, Models 1 and 2 show that higher-education dropouts have significantly lower transition rates than higher-education graduates. In Model 1 the transition rate of dropouts is 79 per cent lower than that of higher-education graduates. This difference increases to 81 per cent after controlling for further variables in Model 2. In other words, higher-education dropouts suffer more from unemployment after leaving the higher-education system than higher-education graduates. The aggregate unemployment rate, however, has no significant effect on the transition rate in general in either Model 1 or Model 2. As the purpose of this chapter is to clarify whether the transition rates into the first stable job of higher-education dropouts will be more negatively affected by increasing unemployment rates than those of graduates, Models 3 and 4 contain interaction effects. In line with Hypothesis 1, Models 3 and 4 show that increasing unemployment rates significantly lower the transition rate of higher-education dropouts. The graphical illustration of the interaction effect also confirms this assumption (and Hypothesis 1). Figure 8 shows the difference in the transition rates into employment of higher-education dropouts vs. graduates for different unemployment rates. The results provide support for an increasing difference with an increasing unemployment rate. As shown in Figure 8, the transition rate to employment is about 4.6 per cent lower for dropouts than for graduates at an unemployment rate of 2 per cent. This negative effect becomes even stronger at higher unemployment rates: if the unemployment rate is 10 per cent, dropouts have an almost 6 per cent lower transition rate to employment than graduates.

In summary, the results of the transition rate into an individual's first stable job show that higher-education dropouts face more problems in entering the labour market than higher-education graduates in general. Furthermore, this disadvantage increases with higher unemployment rates. It seems that a missing higher-education degree leads to labour market exclusion in times of worse economic conditions, as higher-education dropouts show longer periods of unemployment after leaving the educational system than higher-education graduates. This might indicate that employers favour higher-skilled over lower-skilled applicants when unemployment rates are high.

Figure 8: Conditional effect plot – transition rate into first job by unemployment rate and higher educational outcome



Next I examine whether higher-education dropouts are also disadvantaged in terms of the occupational status of their first job. According to theoretical assumptions, if the unemployment rate is high, higher-education graduates can be expected to enter lower-status jobs to prevent periods of long unemployment. As these are often jobs that are taken by less-educated individuals such as higher-education dropouts, the occupational status obtained by dropouts should decrease even more when unemployment is high. Table 13 presents the results of the linear model: the ISEI obtained by educational leavers. The models without interaction effects, Models 1 and 2, clearly show that higher-education dropouts enter significantly lower-status jobs than higher-education graduates. In the first model, the ISEI for dropouts is almost 20 occupational status points lower than that of graduates. After controlling for further covariates, the difference remains highly significant (see Model 2). Furthermore, both models suggest that rising unemployment rates have a highly significant negative effect on the occupational status of the first job: the higher the unemployment rate, the lower the ISEI of the first job.

Table 13: Coefficients of linear regression model: Job status (ISEI) of the first job for educational leavers

	Model 1		Model 2		Model 3		Model 4	
	Coeff.	t	Coeff.	t	Coeff.	t	Coeff.	t
Higher-educational outcome								
dropout	-19.75***	(-12.08)	-20.67***	(-12.71)	-25.06***	(-5.21)	-25.08***	(-5.30)
graduate	*Ref*		*Ref*		*Ref*		*Ref*	
Unemployment rate[43]	-0.47***	(-4.42)	-0.82***	(-4.69)	-0.49***	(-4.56)	-0.85***	(-4.78)
Interaction effects								
dropout * unemployment rate					0.64	(1.17)	0.53	(0.99)
graduate * unemployment rate					*Ref*		*Ref*	
Direct transition into labour market (yes = 1)			-3.67***	(-5.79)			-3.66***	(-5.77)
At least one parent with higher-education degree (yes = 1)			0.77	(1.20)			0.80	(1.24)
Age at leaving education system			0.26**	(2.00)			0.25**	(1.99)
Vocational training qualification			-3.78***	(-4.59)			-3.76***	(-4.56)
Sex (male = 1)			2.70***	(4.15)			2.70***	(4.15)
Upper secondary final score			-1.07	(-1.64)			-1.07	(-1.64)
Work experience			-1.11	(-1.29)			-1.09	(-1.26)
Education-leaving cohort								
1964-1984			*Ref*				*Ref*	
1985-1994			1.83*	(1.69)			1.82*	(1.68)
1995-2004			3.16**	(2.19)			3.16**	(2.19)
2005-2014			1.55	(1.24)			1.54	(1.24)
Constant	74.99***	(76.51)	73.21***	(20.43)	75.21***	(75.35)	73.43***	(20.44)
N[44]	2,471		2,471		2,471		2,471	

Notes: Coefficients; *t* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[43] Monthly aggregate unemployment rate (percentage) at time of entering the labour market.
[44] Only education leavers with a first job.

Once again, an interaction effect between higher-educational outcome and unemployment rate was added. In contrast to the results of the discrete-time event history model, the interaction effect is non-significant and positive in Models 3 and 4. The positive coefficient of the interaction effect (see Table 13) seems unexpected at first, as it indicates that the job status of higher-education dropouts increases with rising unemployment rates. The coefficient of the educational outcomes in Models 3 and 4 clearly decreases, whereas the coefficient of the unemployment rate remains stable.

Figure 9 shows that the occupational position of higher-education dropouts is 24 points lower than that of higher-education graduates when the unemployment rate is 2 per cent. In contrast to Hypothesis 2, this difference decreases with increasing unemployment rates. When the unemployment rate is 10 per cent, the occupational positions of dropouts and graduates differ by only 20 ISEI points. This result supports the assumption that the disadvantage of higher-education dropouts decreases with higher unemployment rates. However, the total increase in the occupational position is only four ISEI points, which is very small. Furthermore, interpreting the confidence intervals, the effect might also go in the other – i.e., the expected – direction.

Displaying the occupational positions of higher-education dropouts and graduates under different unemployment rates in Figure 10, however, shows that higher-education graduates suffer more from higher unemployment rates than dropouts. While the occupational status of dropouts remains almost constant over different unemployment rates, the ISEI of graduates significantly decreases with increasing unemployment rates. This explains the initially unexpected positive interaction effect for higher-education dropouts in Models 3 and 4, which indicates no rise in dropouts' job status, but a decrease in the occupational status of higher-education graduates when the unemployment rate increases. Thus, in an economic downturn, higher-education graduates fall down the economic ladder by entering lower occupational positions, but it seems that they do not enter jobs that were previously filled by dropouts. Dropouts have the same jobs as in favourable economic conditions. Accordingly, higher-education dropouts do not profit from good labour market conditions by entering higher positions in times of low unemployment rates than when unemployment rates are high.

Figure 9: Conditional effect plot – occupational status of first job by unemployment rate and higher educational outcome

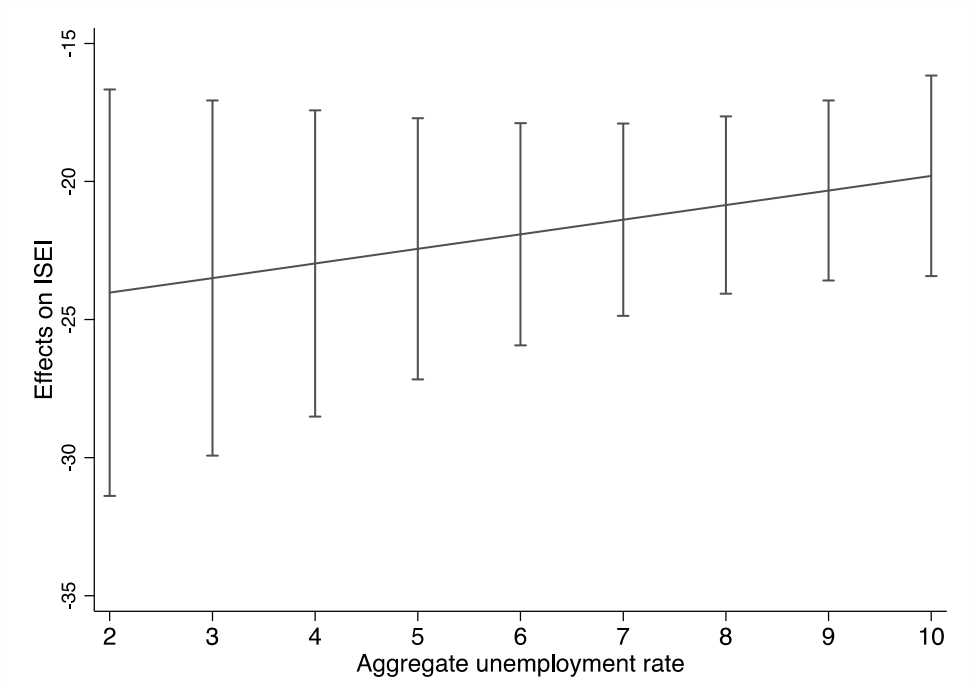
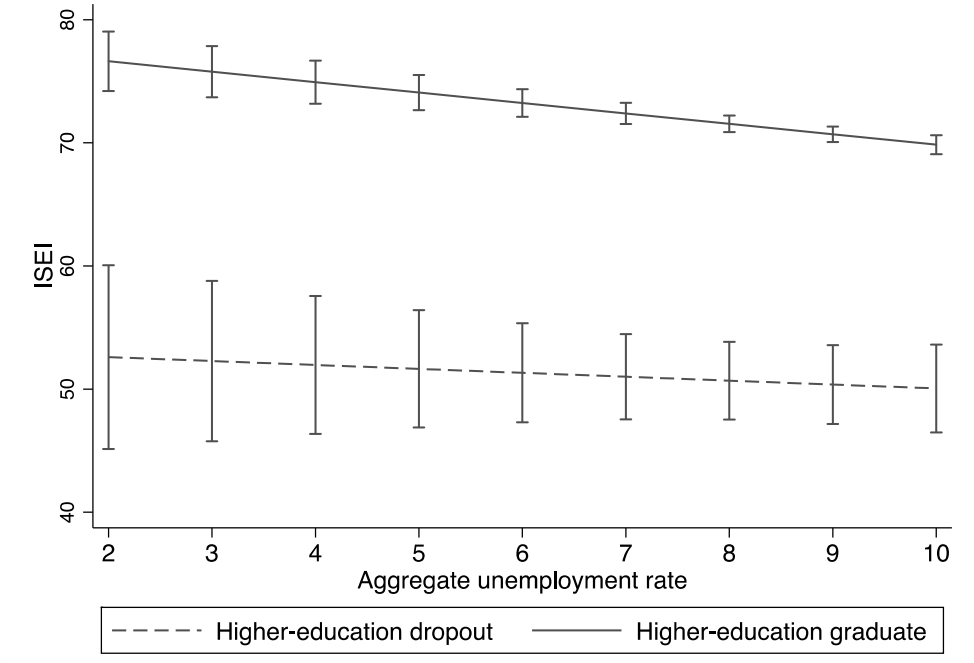


Figure 10: Conditional profile plot – occupational status of first job by unemployment rate and higher educational outcome



In conclusion, it is clear that the job status of higher-education dropouts is not affected by increasing unemployment rates. Contrary to Hypothesis 2 (that higher-education dropouts will be more affected by worsening labour market conditions than higher-education graduates), the results indicate that higher-education graduates are at more of a disadvantage than dropouts.

8.6. Conclusion

This chapter analysed how German higher-education dropouts' first jobs are affected by macro-level labour market conditions in comparison to higher-education graduates. The focus on first labour market outcomes is important, as previous research shows that unsuccessful labour market entry has long-lasting effects on future labour market outcomes, especially for less-educated individuals (e.g. Oreopoulos et al. 2012, Scherer 2004, Scherer 2005, Lange et al. 2014). Since higher-education dropouts generally have lower occupational outcomes than higher-education graduates, a decrease in returns during bad economic times would strengthen the disadvantage of higher-education dropouts in comparison to higher-education graduates. Examining the impact of low and high aggregate unemployment rates on the labour market outcomes of higher-education dropouts helps to assess the importance of higher-education qualifications under different economic conditions. According to the theoretical assumption, it was expected that the disadvantage of dropouts in comparison to graduates should increase with rising unemployment rates. This effect was expected for both the transition rates into first employment (Hypothesis 1) and the status of the first occupational position (Hypothesis 2).

In line with Hypothesis 1, the results of this chapter highlight the fact that dropouts have more trouble finding a job than graduates when unemployment rates are high. The results regarding the status of the first job, however, indicate that the decreasing transition rates of higher-education dropouts are not the result of crowding out. Although higher-education graduates enter lower-status occupational positions when unemployment is high, dropouts' occupational status does not change when unemployment rates shift. In other words, it is not the case that graduates enter jobs that

were previously filled by dropouts, which in turn results in longer job search durations for dropouts. One explanation might be that higher-education dropouts opt to pursue vocational training instead of trying to get a job. Tieben (2016), for example, shows that a significant proportion of dropouts who did not obtain a vocational training degree prior to higher education enter vocational training within 60 months after leaving the higher-education system. As these dropouts are right censored in the present dataset, it is plausible to assume that the lower transition rates of higher-education dropouts in times of high unemployment rates are due to the fact that dropouts are more likely to enter vocational training when unemployment rates are high.

Overall, contrary to the assumption that dropouts' labour market outcomes are more sensitive to changing labour market conditions than those of graduates, this chapter shows that dropouts are very resistant to changes in labour market conditions in Germany. The position of dropouts varies little in times of weakening labour market conditions, while higher-education graduates are clearly disadvantaged in their first occupational positions when unemployment is high. In line with the theory, higher-education graduates enter lower-status positions when labour market conditions worsen, but – unexpectedly – they do not push dropouts out of the labour market. Higher-education dropouts are able to find jobs irrespective of the labour market conditions. Furthermore, their occupational positions do not vary with a shortcoming of vacancies, but remain at a comparatively low level.

To conclude, the results strongly indicate that higher-education dropouts and graduates do not compete for the same positions in the German labour market. This can be explained by the nature of this market, which ensures a structured education-to-work transition: there is a strict educational channelling of education leavers into job positions and a direct close match between educational qualifications and labour market positions (Bol and Weeden 2014; Shavit and Müller 1998). Thus, an individual's educational qualification defines which occupational sector they will work in, which means that only those who have the right credentials are allowed to perform the job tasks of occupations governed by credentials. This constrained entrance to specific occupations through licensing or certification refers to the system's so-called social or credential closure (Bills 2003; Weeden 2002). This occupational closure prevents higher-education dropouts from entering occupations reserved for higher-education graduates. The present chapter shows

that occupational closure still holds under different economic conditions: regardless of the unemployment rate, higher-education dropouts and graduates do not enter the same occupational positions. Consequently, graduates do not push dropouts out of the labour market even during economic downturns. The dropouts remain in the same low-status jobs, which once again highlights their disadvantaged position in the German labour market.

Unfortunately, some questions remain open. Due to data restrictions, it was not possible to determine why students dropped out, even though these reasons might have an impact on the education-to-work transition. Furthermore, there is no information on employers' actual hiring preferences and practices in the data. Therefore the results provide rather indirect evidence of employers' reactions to changing labour market conditions. These two points have to be kept in mind when interpreting the results. Besides, it is clear that the demand for (and supply of) employees is not only influenced by the unemployment rate, but can also be shaped by structural changes in the labour market. As there is no appropriate way to measure the demanding specific industries available for the period of observation, a rather rough measure of cohort entry was used, based on the month of leaving higher education. In further research it would be worth examining the impact of structural changes on the labour market outcomes of higher-education dropouts and graduates. Furthermore, in times of deteriorating labour market conditions, rather unsuccessful students might decide to remain in higher education until the economy improves, which means that there might be a preceding selection effect concerning the group of higher-education dropouts. Models controlling for selection effects, however, show that this is not the case (see Table C 4 in Appendix).

Chapter 9 Conclusion and Discussion

9.1. Introduction

In this dissertation I examined higher-education non-completion in Germany at the individual level, focusing on the following two guiding research questions:

1. How do pre-tertiary educational pathways affect higher-education non-completion in Germany?
2. Are higher-education dropouts worse off in terms of their first labour market outcomes compared to upper-secondary education leavers with additional formal qualifications, such as higher-education or vocational training credentials?

According to Heublein (2014), higher-education non-completion is not only a result of decision processes taking place during higher education, but should also be explained by taking pre-tertiary education experiences and labour market opportunities into account. Therefore, this dissertation paid special attention to the impact of prior pathways to higher education, including vocational training and labour market experiences, on higher-education dropout. Furthermore, it compared the importance of formal qualifications and macro-level labour market conditions on the first labour market outcomes of higher-education dropouts vs. other education leavers. For the analyses I used datasets from the National Education Panel Study (NEPS). Using these datasets, this dissertation contributes to the existing debate on higher-education non-completion by adding pre-tertiary educational pathways and labour market outcomes to the analysis of non-completion in Germany. In the following section, I will summarise the scope and findings of each chapter. I will then draw an overarching conclusion on the impact of pre-tertiary educational pathways on higher-education non-completion and the labour market prospects of higher-education dropouts. Subsequently, theoretical and methodological contributions will be discussed and remaining research problems will be addressed. Finally, the chapter highlights areas for further research.

9.2. Summary of the main results

Chapter 1 gives an overview of the current political and theoretical debate on higher-education non-completion in Germany. Subsequently, I define the objectives and research questions of the dissertation and give an overview of each chapter. A review of previous research shows that a number of studies examine the reasons for (and consequences of) higher-education non-completion in Germany. However, the importance of pre-tertiary experiences, such as pre-tertiary educational pathways and vocational qualifications, have not been fully examined. Furthermore, the results on the labour market prospects of higher-education dropouts in Germany are inconclusive, especially concerning the first job attained by dropouts vs. other education leavers and the impact of macro-level labour market conditions. Thus, there is need for higher-education research that includes path dependency and selection mechanisms both before and after dropout.

Chapter 2 and 3 start with a comprehensive overview of theoretical approaches, followed by a description of the German education and labour market system. Both chapters conclude with the guiding research question of each part of the dissertation. Chapter 2, i.e. Part 1, starts with a review of the main theories and conceptual frameworks on non-completion of higher education that have been developed in sociology, psychology and economics. It shows that non-completion is a complex process that is influenced by various factors and mechanisms, which can be categorised as pre-tertiary, in-college and background factors. The possible pathways to higher education are then outlined; the German education system is shown to provide ample opportunities to enter higher education via alternative pathways. Further characteristics of the German education system include a high degree of stratification, standardisation and occupational specificity. Assumptions from theory and the structural conditions of the education system emphasise the importance of pre-tertiary educational pathways for higher-education non-completion in Germany.

Chapter 3, i.e. Part 2, provides an overview of theories on labour market returns, such as human capital theory, signalling and screening theory, matching and job competition theory, and credentialism theory, and highlights the importance of educational attainment – particularly the meaning of educational credentials. The German labour market system can be described as an occupational labour market with a strong

link to the education system. It also features strong employment protection legislation for permanent employment, and is therefore characterised by high job stability and low turnover rates. Concerning structural changes in the education and labour market system, it appears that educational expansion in Germany has been rather modest in comparison to other countries; occupational upgrading has more or less paralleled the expansion of higher education. Assumptions from theory and the structural conditions of the labour market system lead to the question of the real consequences of higher-education non-completion for first labour market outcomes.

Chapter 4 describes the dataset used and its advantages compared with other available data in Germany. I used the data from the NEPS Starting Cohort 6 (SC6) 'Adult Education and Lifelong learning' and Starting Cohort 5 (SC5) 'First-Year Students' (Blossfeld et al. 2011). The SC6 data provide detailed retrospective life history data with comprehensive information on the education and employment biography of each respondent as well as important cross-sectional data on several subjects, such as competence development in adulthood, employment situation, family constellation, as well as educational choices and participation in further training. The SC5 dataset offers detailed retrospective life history data with information on the students' pre-tertiary experiences, including their secondary school trajectories and pre-tertiary vocational training. Using these datasets, I was able to compare the educational and occupational careers of higher-education dropouts vs. other educational leavers in sufficient detail since they offer detailed retrospective information on the respondents' educational biography as well as their actual educational and occupational careers.

Chapter 5 addresses the question of how pre-tertiary educational and vocational pathways affect higher-education non-completion in Germany. Students are assumed to be a heterogeneous group concerning their pre-tertiary skills and knowledge, such as vocational training degrees or labour market experiences. Therefore, two outcomes are likely: students either profit from these pre-tertiary skills and knowledge, or such skills and knowledge pull them out of higher education as they open up labour market opportunities. The main conclusion of this chapter is that pre-tertiary pathways influence different types of higher-education outcomes in different ways. While vocational training and labour market experiences have no effect on dropout, students with such a background are less likely to change subjects or higher-education institution.

Furthermore, students who obtained their higher-education entry qualification in upper-secondary education after graduating from lower-secondary education, defined as track mobility, have a higher risk of dropping out. Concerning alternative pathways, i.e. pathways resulting in entry qualifications for higher education that were not obtained in upper-secondary school, I find no significant effects on either type of non-completion. In summary, this chapter shows that pre-tertiary educational pathways are important predictors of success in higher education, as students can profit from vocational and occupational skills and from a more considered choice of their studies.

Chapter 6 concentrates on higher-education non-completion in science, technology, engineering and mathematics (STEM). The data reveal higher non-completion rates for female students than for male students in these subjects. Therefore, this chapter explores how to explain this gender gap. Based on the theoretical model of Tinto (1975, 1993) and Heublein (2014), I examine the impact of pre-tertiary and in-college experiences on non-completion. Since the focus is on Germany, with its strong vocationally orientated education system, I attach particularly high importance to pre-tertiary experiences, especially field-specific experiences. The German literature shows, among other things, that women are less likely to obtain pre-tertiary experience in STEM than men. Theories on field-specific experience predict lower non-completion rates for students who have a clear occupational self-concept combined with high professional role confidence that is in line with their chosen college major (Cech et al. 2011; Holland 1959, 1973; Super 1957). The theoretical assumptions and empirical findings suggest that the lack of field-specific pre-tertiary experience might be the driving factor behind the higher dropout rate among female STEM students. The results show large variations in the explanatory value of pre-tertiary and in-college experiences for the observed gender gap in non-completion. Neither general college preparation nor in-college experiences affects the higher non-completion rate of women in STEM. Unexpectedly, women are more likely to leave post-secondary STEM education although they are at least as (or more) satisfied with their in-college experiences – for example in terms of identifying with the academic environment and interactions with fellow students and faculty – than male students. Field-specific pre-tertiary experience appears to be the main explanatory factor for the gender gap.

Chapter 7 analyses the labour market outcomes of higher-education dropouts. The main research question is whether vocational training qualifications mitigate the risk of protracted labour market transitions and low occupational status when higher education has not been completed. Prior research shows that dropouts have a higher risk of being unemployed, working part time or on fixed-term contracts, and obtain lower wages than higher-education graduates, on average. However, in Germany higher-education dropouts have differing levels of vocational training skills. Many dropouts enter the labour market with a vocational training degree. Since the German labour market can be described as highly credentialist, it can be assumed that dropouts have large disadvantages in labour market transitions but should profit from a vocational training degree. The results show that higher-education dropouts with no formal vocational training certificates have more difficulty finding a stable job than applicants with vocational qualifications. Dropouts who succeed in the labour market, however, achieve status scores that are comparable to those of vocational training graduates who never entered higher education. Comparing the occupational status of dropouts with and without additional vocational training certificates, I find that these formal qualifications do not result in a higher-status first job. I therefore conclude that additional vocational training certificates serve as a safety net if students drop out, by helping them find stable employment more quickly. I find no other evidence that vocational certificates provide additional returns in terms of occupational status.

Chapter 8 addresses the effect of macro-level labour market conditions on the first jobs obtained by higher-education dropouts and graduates. This chapter examines whether the labour market outcomes of graduates and dropouts differ in times of favourable and unfavourable labour market conditions. In line with job competition theory (Thurow 1975, 1979), less-educated individuals draw the short straw when the unemployment rate is high because the more-educated workers force them out of the labour market. Whether this is also true for higher-education dropouts has not been examined yet. Analysing transition rates and occupational positions in times of high and low aggregate unemployment rates, I find that macro-level labour market conditions influence the first employment of higher-education graduates and dropouts in completely different ways. Higher-education dropouts do not take longer to find their first job, and do not find better or worse jobs, when the unemployment rate is high vs. low: they find a

job irrespective of the labour market conditions. Furthermore, their occupational positions do not vary with a shortage of vacancies, but remain on a comparatively low level. By contrast, higher-education graduates' initial employment is significantly more sensitive to the labour market conditions, as they obtain lower-status first jobs when unemployment is high. Thus, this chapter highlights that higher-education dropouts and graduates do not compete for the same positions in the labour market, and emphasises the specific nature of the German labour market, which ensures a direct close match between educational qualifications and labour market positions. This occupational closure still holds in changing economies: regardless of the unemployment rate, higher-education dropouts and graduates never enter the same occupational positions.

9.3. Overarching conclusion

In the introductory chapters, I define two central research issues: (1) the impact of pre-tertiary educational pathways on higher-education non-completion and (2) the effects of higher-education non-completion on first labour market returns. The following sections combine the results of the separate chapters and derive overarching conclusions on the main issues.

9.3.1. Part 1: Causes of higher-education non-completion

In Chapters 5 and 6 I take a closer look at the effect of pre-tertiary educational pathways on higher-education non-completion in general and in STEM fields in particular. The main focus of these chapters is the impact of pre-tertiary experiences, such as pathways to higher education and vocational or labour market skills, on dropping out. Furthermore, I examine the impact of pre-tertiary vs. in-college experiences on non-completion.

I find in Chapter 4 that experiences prior to higher education have different effects on different types of non-completion. My results show that students who enter higher education via *track mobility* have a higher risk of non-completion. These are students who obtained their higher-education entry qualification in upper-secondary education after graduating from lower-secondary education. While it is likely that these students have lower academic ability than those who pursued the traditional path, in

Chapter 5 I am not able to examine this, as there is no adequate variable measuring the aptitude of all students in the data. In Chapter 6 I use the NEPS SC5 data, which contain the score of the higher-education entrance certificate (*Abitur*) for all students. Furthermore, I restricted my sample to respondents who obtained a higher-education entrance certificate. Controlling for the score in Chapter 6 shows that the type of higher-education entrance qualification has no significant effect on the non-completion of post-secondary STEM education.

I acknowledge that using the score is not an optimal proxy for ability for two reasons. First, the grades in upper-secondary education in Germany are not comparable across different student populations. Although some federal states administer centralised examinations in upper-secondary education, this is not common practice. Therefore grades are probably only loosely correlated with actual ability. In addition, the grading conventions may be even less comparable across general and vocational upper-secondary education. Second, the score in upper-secondary education may be a very imprecise predictor of performance in higher education. Students choose their field of study in higher education, whereas in upper-secondary education a broad variety of subjects has to be covered. Optimal proxies for ability are measured competencies, especially subject-specific competencies. One of the main goals of the NEPS is to assess the development of competencies over the life course. In SC6, competence data were collected in Waves 3 and 5, but this information has two drawbacks in the context of this study. First, analysable competence data are not available for every target person in the data, and second, the time span between entering the higher-education system and collecting the competence data is quite long and varies for each respondent. In SC5 competence tests were conducted in Waves 1 and 5, but again, analysable data are only available for a subgroup. Using these data would result in a much smaller sample size. Therefore I decided not to use these measurements. Finally controlling for the score in upper-secondary education in Chapter 6 suggests that the assumption of selection on academic ability does not hold for the STEM field.

Furthermore, I find that general academic preparation has only modest effects on non-completion in STEM. The results related to pathways to higher education furthermore suggest that students who enter higher education via *alternative pathways* have a considerably lower risk of non-completion than traditional students. Alternative

pathways are mainly taken by students who left the general secondary education system but still want to obtain a higher-education qualification – often after a period of employment or vocational training. In contrast to international research, 'non-traditional' students do not drop out of higher education more often in Germany. This may be due to the fact that students who choose alternative pathways in Germany are a select group in terms of aptitude, motivation and goal orientation. Testing this assumption of 'positive selection' would require integrating individuals who took the 'alternative pathway' but did not enter the higher-education system as a control group into the analyses. This has not been done yet. More detailed analyses of *vocational and labour market experiences* show, furthermore, that students with such experience are more likely to stay on their chosen course and graduate earlier than traditional students. This result indicates that students might profit from pre-tertiary vocational and occupational skills. The analysis of the impact of *pre-tertiary experiences* on the non-completion of post-secondary STEM education for female students, moreover, reveals that *field-specific experiences* are the main driving factors. Female students with experience from STEM-related training and courses are more likely to complete their STEM degree than those without such experiences. These results highlight the importance of *field-specific pre-tertiary experiences* for higher-education decisions in the German system.

In addition to pre-tertiary experiences, I also controlled for *in-college experiences* in Chapter 6, which include both *academic integration* and *social integration*. These experiences were found to have highly significant effects on non-completion of post-secondary STEM education. Students who reported high perceived academic performance were less likely to drop out of a STEM degree course. Furthermore, identification with the academic environment lowers the likelihood of non-completion in STEM. Thus, my results show that *academic integration* has a positive effect on higher-educational attainment in STEM fields. It seems that students who meet certain explicit standards of the academic system, and can identify with its norms and values, are more likely to stay in post-secondary STEM education. By contrast, *social integration* seems to have a negative effect on higher-educational attainment. While interactions with students have no impact on non-completion, interactions with faculty make non-completion in STEM significantly more likely. Although this is a rather unexpected result, it may be

because those who have regular and close contact with faculty are students who need special support because of performance problems.

Concerning gender differences in post-secondary STEM education, the results indicate that *pre-tertiary field-specific experiences* are the most important factors for women's educational success in STEM. Women show deficits in pre-tertiary STEM experiences, which seem to pull them out of post-secondary STEM education. *In-college experiences* appear to be less important. It seems that female STEM students do not have problems with the academic and social integration process during higher education. Thus, female STEM students are not assumed to perceive their academic performance more negatively than their male counterparts. Furthermore, they do not seem to experience identification difficulties with the STEM environment, nor are they more likely to be discouraged by their social environment.

In line with the first main guiding research question of this dissertation – "*How do pre-tertiary educational and occupational experiences affect higher-education non-completion in Germany?"* – the results of this dissertation emphasise the importance of pre-tertiary experiences in the analysis of causes of higher-education non-completion in Germany. In addition to pathways to higher education, field-specific experiences such as vocational training or occupational experiences are decisive factors, especially for explaining non-completion in post-secondary STEM education.

9.3.2. Part 2: Consequences of higher-education non-completion

Chapters 7 and 8 examined the labour market outcomes of higher-education dropouts. In Chapter 7 I had a closer look at the importance of formal qualifications for first employment transitions and the occupational positions of higher-education dropouts and graduates of higher education and vocational training. In Chapter 8 I assessed how macro-level labour market conditions affect the first labour market outcomes of higher-education dropouts and graduates, respectively.

The results in Chapter 7 show that higher-education dropouts profit very much from a vocational training degree in their transition into the labour market. While dropouts without vocational qualifications have by far the highest risk of remaining without a stable job, dropouts with vocational qualifications have considerably better

chances of entering a stable job. Their transition rates are comparable to those of higher-education graduates. This result indicates that a formal vocational qualification seems to offset the disadvantages of dropping out by smoothing the transition from education to the labour market. Among dropouts, I found that vocational training qualifications provide a stronger signal to prospective employers than higher-education experiences. However, a smooth transition into the labour market does not necessarily equate with high occupational positions: a job seeker might choose a less attractive job in order to avoid long periods of unemployment. Therefore I also run models comparing the occupational status (ISEI) of first job entrants with different educational outcomes. These models indicate that an additional formal vocational qualification does not improve the occupational status of the first stable job; nor does a non-completed higher-education course lower the occupational status of the first job. The results show no significant difference in the occupational status of the first stable job between vocational training graduates and higher-education dropouts with and without vocational training qualifications. Thus, these results challenge the signalling value of a vocational training qualification. Therefore I conclude that entering the German labour market without formal qualifications is risky. When searching for the perfect candidate, employers indeed seem to use these signals as a screening device. However, I find no advantage for those with vocational qualifications concerning the final occupational position. Among the successful candidates, only a completed higher-education degree results in higher status scores.

In Chapter 8 I clarified the importance of a higher-education degree during economic downturns in Germany. In line with the results of Chapter 7, I find that, in general, higher-education dropouts have lower transition rates than higher-education graduates. This disadvantage increases with higher unemployment rates. Subsequent analyses of occupational positions reveal that higher-education dropouts enter significantly lower-status jobs than graduates. However, the occupational positions of higher-education dropouts remain constant over different unemployment rates, whereas the job status of graduates significantly decreases with rising unemployment rates. In conclusion, higher-education dropouts lose from increasing unemployment rates when securing their first jobs but the occupational position of dropouts varies little in times of weakening labour market conditions. The results highlight that graduates are at more of a

disadvantage than dropouts during economic downturns concerning their occupational position.

In line with the second main guiding research question of this dissertation – "*Are higher-education dropouts worse off in terms of first labour market outcomes compared to upper-secondary education leavers with additional formal qualifications, such as higher-education or vocational training credentials?"* – the results of this dissertation suggest that dropouts generally have lower occupational outcomes than higher-education graduates. If I compare the occupational positions of higher-education dropouts with those of vocational training graduates, however, I cannot detect any labour market disadvantage for dropouts. Furthermore, analysing the effectiveness of changing labour market conditions on occupational outcomes shows a strong resistance of higher-education dropouts to different labour market conditions in Germany. In summary, this dissertation proves that higher-education non-completion has consequences for first labour market outcomes, but that they are not as strong as expected.

Pulling it all together, this work shows that field-specific pre-tertiary experiences are important factors for explaining higher-education non-completion in Germany. Furthermore, higher-education dropouts can benefit from pre-tertiary vocational qualifications when entering the labour market, since they ensure a smooth transition. In addition, the status of the first jobs of higher-education dropouts is relatively consistent with students who have a vocational training degree only (although the status is lower than higher-education graduates' first jobs). Last but not least, the first occupational position of higher-education dropouts remains stable independent of the labour market conditions. Thus since higher-education dropouts find their way into the labour market, higher-education non-completion is not a waste of resources.

9.4. Implications

This dissertation discusses the possible causes and consequences of higher-education non-completion in Germany. More specifically, decisive factors such as pathways to higher education and field-specific experiences were identified to explain non-completion in higher education. The study found that non-completion affects first labour market

outcomes. This dissertation therefore contributes to previous research by offering theoretical and methodological improvements, and is able to extend the scope of higher-education research in Germany by developing a more comprehensive view of the causes and consequences of higher-education non-completion. In the following, I discuss the theoretical and methodological advancements of this dissertation as well as some limitations. Finally, the dissertation concludes with suggestions for further research.

9.4.1. Theoretical contributions

The theoretical model of Tinto (1975, 1993) was originally developed to explain non-completion in the United States. This model assumes a strong relationship between the higher-education system and a student's decision to drop out. Thus, socialisation during higher education, or the person–environment fit, is one of the main explanatory factors in his model. Empirical applications of Tinto's theoretical framework have largely neglected the fact that he also assigned a critical role to perceived alternative options in the dropout decision: "a person will tend to withdraw from college when he perceives that an alternative form of investment of time, energies, and resources will yield greater benefits, relative to costs, over time than staying in college" (1975, S. 97-98). I argue that context conditions outside the higher-education system have to be taken into account when examining the causes and consequences of dropping out. These conditions include structures imposed by the pre-tertiary educational system and the labour market.

It is important to account for the significant social, economic and educational differences between national systems around the world when analysing higher-education non-completion. This dissertation points out that modifications must be made to Tinto's model in order to explain higher-education non-completion in Germany. Based on the assumption that educational attainment is a lifelong process and considering the structural specificities of the German education system, such as the various pathways to higher education and the occupational specificity of the system, the theoretical model of this dissertation emphasises the importance of pre-tertiary experiences. Dropouts in Germany are assumed to have a variety of pre-tertiary experiences that are assumed to influence resources and restrictions in and outside the higher-education system – and therefore to have a direct effect on non-completion of higher education. The results show, for

example, that dropout decisions are not independent of pre-tertiary experiences, and that different types of non-linear pathways into higher education result in different resources and restrictions. A particularly interesting role may be assigned to pre-tertiary vocational training, which has the paradoxical role of providing a safety net on two levels – the higher-education system and the labour market. On the one hand, skills and knowledge obtained in pre-tertiary vocational training are assumed to have a positive effect on study success, as they can be used as resources during higher education. On the other hand, students with pre-tertiary vocational training are supposed to have more attractive employment options outside higher education than other students. If they do not complete their higher-education degree, they can fall back on their vocational training qualifications and use them as a "safety net". From a theoretical point of view, pre-tertiary vocational training is an important factor when analysing higher-education non-completion or examining the labour market outcomes of higher-education dropouts, as described in the next section.

The relationship between education and labour market returns has been examined from different theoretical perspectives, such as human capital theory, signalling and screening theory, matching and job completion theory as well as credentialism theory (see Bills 2003 for a comprehensive overview). The overall assumption is that applicants with higher educational attainment achieve higher returns in the labour market than those with lower educational attainment. According to the specificity of the German labour market, which can be described as an occupational labour market with a high level of regulation, the basic theoretical assumption is that higher-education dropouts will have lower occupational outcomes than graduates from higher education and vocational training. However, a large proportion of German dropouts obtains pre-tertiary formal vocational qualifications. The added benefit of a vocational qualification for higher-education dropouts has not been considered in research yet. Based on the theory of Büchel and Helberger (1995), which assumes that double qualifiers in Germany use a vocational qualification as an "insurance strategy", I hypothesised that higher-education dropouts should profit from their formal qualifications. My results show that they have better chances of entering stable employment than dropouts without vocational qualifications. This result illustrates that additional vocational qualifications should be taken into account when examining the labour market returns of dropouts in Germany. I

also observe that, among successful job applicants, only a completed higher-education degree results in higher-status scores, whereas I do not find significant differences between dropouts with and without vocational qualifications and vocational training graduates who never entered higher education.

Concerning the influence of macro-level labour market conditions on the first jobs obtained by higher-education dropouts and graduates, this dissertation shows that the basic assumption of the job competition theory (Thurow 1975, 1979) has to be reconsidered. According to this theory, more-educated individuals should be less affected by the deterioration of the labour market than less-educated ones. The results of this work confirm that higher-education dropouts enter lower occupational positions than higher-education graduates, irrespective of the labour market conditions. More striking, however, is the result that graduates' first jobs are significantly more sensitive to the labour market conditions than those of dropouts. This indicates that – in contrast to the theoretical assumption – higher-education dropouts are not forced out of the labour market during economic downturns.

9.4.2. Methodological contributions

The main methodological contribution of this dissertation is twofold. First, it evaluates the reasons for higher-education non-completion in a multivariate way in order to account for the theoretically based assumption of the interplay between various factors influencing dropout behaviour. Second, it analyses the consequences of higher-education non-completion for students' first employment outcomes in comparison to other education leavers.

Existing methodological approaches have been refined and adapted in the following ways. To assess the various reasons for higher-education non-completion in Germany, I applied a competing risk model to estimate the impact of prior educational and occupational pathways on the non-completion of higher education in order to account for the categorical nature of non-completion. In contrast to most higher-education research in Germany, which perceives non-completion as dropping out altogether, I distinguished dropping out from non-completion that is followed by an alternative course in higher education, defined as "change". Furthermore, to examine higher-education non-

completion in STEM, I extended the existing multivariate models by considering both pre-tertiary and in-college experiences in my analysis in order to ascertain the main driving factor behind non-completion of post-secondary STEM education. I also included two types of pre-tertiary experiences in my analysis – general college preparation and pre-tertiary field-specific experiences – in order to take into account the strong occupational orientation of the German education system.

To assess the consequences of higher-education non-completion for the student's first jobs, I examined two labour market outcomes for higher-education dropouts in comparison to graduates of higher education and vocational training. First I used a Cox model to assess actual transitions into stable first jobs in order to find out whether higher-education dropouts have more difficulties finding a job than their reference groups. Second, I used a linear regression model to analyse the occupational status of the first job in order to determine whether higher-education dropouts who succeeded in finding a job entered attractive positions. Finally, I went one step further and integrated a macro-level variable into the models. By considering unemployment rates I was able to take into account the labour market situation during the process of first labour market transition and to examine the first jobs obtained by higher-education dropouts vs. graduates in times of favourable and poor labour market conditions in detail.

In summary, this dissertation contributes to the existing German literature by using multivariate models to analyse actual dropout and change. Furthermore, while most German higher-education research focuses on a single higher-education system, I was able to give a picture of non-completion throughout the country by using nationally representative data. And in contrast to most German research on the reasons for (and consequences of) higher-education non-completion, which concentrates only on dropouts, my data enable the analysis of factors that influence the higher-education decisions and labour market outcome of dropouts as well as other educational participants. Finally, I add to existing studies that focus on individual explanations of the labour market outcomes of higher-education dropouts by examining how macro-level labour market conditions affect first employment.

These methodological contributions would not have been possible without the NEPS datasets, which provide detailed retrospective life history data with comprehensive

information on the education and employment biography of each respondent as well as panel data on several subjects.

9.4.3. Limitations

The empirical analyses provided in this dissertation have their limitations. As already mentioned, the analyses are based on two datasets: NEPS SC6 and SC5. The first contains detailed information on the respondents' educational and occupational biographies. These data allow me to define different types of non-completion, such as change of subject or higher-education institution as well as final dropout. However, they do not provide a great deal of information on specific variables of the in-college phase, which is decisive for studying further mechanisms of higher-education non-completion. Information on reasons for non-completion is missing, such as academic ability, motivation or goal orientation. I therefore cannot determine whether respondents leave higher education voluntarily, because of a good job offer for example, or due to deficits in performance or other individual characteristics that have proven to increase the chances of higher-education attainment. In contrast to the common idea of dropout as a "failure", the dropping out may actually indicate success outside higher education. Furthermore, although the data contain detailed information for a very long time span (monthly data from 1944 to 2015), the total number of higher-education dropouts is relatively small. It might be possible that results differ by time or other control variables and the educational outcome. Due to data limitations, I am not able to test these interaction effects directly. However, robustness checks showed relatively consistent results concerning the interaction effects between specific control variables and the central independent variable "educational outcome".

The SC5 dataset contains detailed information on first-year students' pre-tertiary and in-college experiences, which enables me to analyse the reasons for non-completion in more detail than when using the SC6 dataset. However, there are still limitations. First, students have not completed their first degree yet. Therefore, it is not possible to draw conclusions about whether a respondent will ultimately drop out. This was, however, less problematic in the case of Chapter 6, since the aim of this chapter was to identify the reasons why female students leave a higher-education STEM degree course. Second,

since there are no students in the sample who hold a degree yet, comparisons between higher-education dropouts and graduates are not possible. Without comparing both groups, the reasons for higher-education non-completion are difficult to define, since the reasons for graduation are unknown but could be the same as those of a higher-education dropout. Third, since most students are still enrolled, there is no information on labour market transitions. While analyses on occupational outcomes are not possible using the SC5 data, its detailed information on students' pre-tertiary and in-college phases makes it a promising dataset for analysing the causes and consequences of higher-education non-completion. However, only the subsequent waves will allow for performing a reliable analysis.

9.4.4. Prospects

There are two main areas for further research that arise from this dissertation. First, concerning the causes of higher-education non-completion in Germany, this work was able to show that pre-tertiary experiences are relevant factors for explaining non-completion. In line with other research on higher-education dropout (e.g., Heublein et al. 2010, Tieben 2016), the results of this dissertation indicate that, among other things, vocational training qualifications play a major role in improving higher-educational attainment. It is not clear, however, if the positive effects of pre-tertiary experiences arise from the actual skills that may be beneficial in higher education, or if the group of students entering higher education (for example after a period of vocational training) is selected on the basis of other characteristics such as motivation and goal attainment. Theories on field-specific skills (Holland 1959, 1973; Super 1957; Cech et al. 2011) furthermore suggest that students with field-specific experiences develop confidence in their ability to perform their professional role and create a clear self-concept and knowledge about their future occupational field, which makes them more likely to persist and pursue their chosen career. Especially in relation to political implications, it is important to have a closer look at the driving mechanisms associated with pre-tertiary experiences in order to implement educational policies in the right place.

Second, regarding the consequences of higher-education non-completion, this dissertation revealed that higher-education dropout has an impact on first labour market

outcomes. The consequences of higher-education non-completion on individuals' long-term occupational outcomes, however, have not been examined. This dissertation concentrated on first labour market outcomes, as the value of educational attainment is particularly strong at this stage of an individual's career. Furthermore, previous research has indicated that future careers strongly depend on the positions individuals obtain at the beginning of their working life (e.g., Müller and Kogan 2010; Scherer 2004). However, the effects of non-completion might change over the life course in Germany. For example, dropping out (or job loss and unemployment) might have a stigmatising effect on an individual's subsequent occupational pathway (e.g., Burgess et al. 2003, Luijkx and Wolbers 2009). Furthermore, higher-education dropouts accumulate human capital in the form of labour market experiences. Research on job mobility in the labour market shows that experiences seem to become increasingly important for status attainment during an individual's career (Mincer 1984). Changing jobs or employers can lead to an improvement of an individual's occupational status (Gangl 2003). There also seems to be a catching-up effect at work, insofar as those who enter the labour market with a particularly low-status job may expect greater improvements through job mobility (e.g., Allmendinger 1989, Blossfeld 1985, Blossfeld 1987, Gangl 2003). Whether (and in which way) this also holds for higher-education dropouts has not yet been examined. Further research on the long-term consequences of higher-education non-completion would shed further light on its effects and the relative position of dropouts vs. graduates in the German labour market.

Chapter 10 Appendix

Table A 1: Mean values of the variables for students of all subjects and only STEM students; Proportion of missing observations

	Students (all subjects)		Students (only STEM)		proportion of missing observations (per cent)
	Mean values		Mean values		
	male	female	male	female	
Dependent Variables					
Entering STEM	0.55	0.23	1.00	1.00	0.0
Non-Completion	0.09	0.06	0.10	0.13	0.0
Independent variables					
Pre-tertiary experiences					
General academic preparation					
Score German	9.71	10.95	9.24	10.41	2.1
Entrance qualification	0.78	0.87	0.75	0.88	0.0
Field-specific preparation					
Score maths	10.33	10.13	10.65	10.68	2.6
STEM courses	0.72	0.59	0.83	0.76	0.6
Vocational training in STEM	0.10	0.02	0.15	0.04	0.0
In-college experiences					
Academic integration					
Perceived academic performance	2.48	2.56	2.42	2.41	39.3
Identification with environment	3.58	3.64	3.54	3.58	39.4
Social integration					
Interactions with students	3.03	3.06	3.02	3.13	39.3
Interactions with faculty	2.98	2.97	2.97	2.96	39.0
N	5,139	5,870	2,848	1,324	11,009

Table A 2: Leaving post-secondary STEM education. Control variables

	Model 1 AME	Model 2 AME	Model 3 AME	Model 4 AME	Model 5 AME	Model 6 AME
Education of the parents		0.004	0.005	0.007	0.012	0.012
		(0.47)	(0.53)	(0.71)	(1.26)	(1.29)
Type of higher-education system		-0.007	-0.015	-0.012	-0.034*	-0.026
		(-0.56)	(-1.13)	(-0.89)	(-2.54)	(-1.89)
Age at entering higher education		0.023***	0.023***	0.023***	0.022***	0.022***
		(11.81)	(11.82)	(11.44)	(10.29)	(10.14)
Time spent in higher education		-0.009***	-0.009***	-0.008***	-0.006***	-0.007***
		(-19.46)	(-19.43)	(-18.85)	(-13.54)	(-13.69)
Field of study						
Life science *(Ref.)*		*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
Physical science		0.001	-0.001	-0.002	0.003	0.004
		(0.04)	(-0.06)	(-0.10)	(0.15)	(0.18)
Mathematics and statistics		0.002	-0.001	0.003	0.004	0.003
		(0.06)	(-0.04)	(0.11)	(0.14)	(0.11)
Computing		-0.045*	-0.049*	-0.054*	-0.047*	-0.046*
		(-2.05)	(-2.18)	(-2.43)	(-2.21)	(-2.19)
Engineering and engineering trades		-0.043*	-0.046*	-0.042*	-0.038	-0.035
		(-2.09)	(-2.22)	(-1.99)	(-1.88)	(-1.76)
Manufacturing and processing		-0.028	-0.035	-0.041	-0.034	-0.033
		(-0.92)	(-1.15)	(-1.39)	(-1.17)	(-1.12)
Architecture and building		-0.058**	-0.063**	-0.070**	-0.057**	-0.054*
		(-2.67)	(-2.85)	(-3.25)	(-2.68)	(-2.57)
N	4,172	4,172	4,172	4,172	4,172	4,172

Notes: AME; z statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A 3: Interaction effects between gender and pre-tertiary achievement variables

	Model 1 Odds ratios	Model 2 Odds ratios	Model 3 Odds ratios
Gender (female = 1)	1.40	1.34	0.77
	(0.80)	(1.19)	(-0.74)
Pre-tertiary experiences			
General academic preparation			
Score German	0.94**		
	(-2.66)		
Entrance qualification (general = 1)		0.79	
		(-1.76)	
Field-specific academic preparation			
Score maths			0.87***
			(-7.17)
Interaction			
*Pre-tertiary experiences*women*			
General academic preparation			
Score German*women	1.00		
	(0.04)		
Entrance qualification*women		1.02	
		(0.08)	
Field-specific academic preparation			
Score maths*women			1.06
			(1.65)
Constant	0.21***	0.14***	0.49***
	(-6.60)	(-17.23)	(-3.61)
N	4,172	4,172	4,172

Notes: Odds ratios*; t* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B 1: Results of the Cox proportional hazards regression model for the transition into first stable job (unstratified and stratified model)

	Model 1 Cox		Model 2 Cox	
	Hazard ratios	z	Hazard ratios	z
Educational attainment				
Vocational education qualification (only VEQ)	*Ref.*	*(Ref.)*		
Higher-education dropout + VEQ	0.65***	(-3.97)		
Higher-education dropout	0.15***	(-17.80)		
Higher-education degree	0.67***	(-9.03)		
At least one parent higher-education degree (yes = 1)	0.90**	(-3.14)	0.90**	(-3.15)
Age at de-registration	0.99	(-1.14)	0.99	(-0.97)
Sex (male = 1)	1.20***	(5.45)	1.20***	(5.65)
Upper-secondary final score	0.97	(-0.92)	0.97	(-1.01)
Work experience	0.61***	(-11.40)	0.62***	(-11.28)
Education-leaving cohort				
1964–1984	1.10	(1.86)	1.19	(1.69)
1985–1994	1.27***	(4.99)	1.25***	(4.71)
1995–2004	1.23***	(4.18)	1.22***	(3.97)
2005–2014	*Ref.*	*(Ref.)*	*Ref.*	*(Ref.)*
N	4,748		4,748	

Notes: Hazard ratios*; z* statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; *Model 1*: Original model; *Model 2*: Stratified model (stratified variable: Educational attainment)

Table B 2: Results of the piecewise-constant hazard model for the transition into first stable job (first part)

	Model 1		Model 2	
	Hazard ratios	z	Hazard ratios	z
Educational attainment				
Vocational education qualification (only VEQ)	*Ref*		6.64***	(17.80)
Higher-education dropout + VEQ	0.65***	(-3.97)	4.30***	(10.22)
Higher-education dropout	0.15***	(-17.80)	*Ref*	
Higher-education degree	0.67***	(-9.03)	4.48***	(14.83)
At least one parent with higher-education degree (yes = 1)	0.90**	(-3.14)	0.90**	(-3.14)
Age at leaving education system	0.99	(-1.14)	0.99	(-1.14)
Sex (male = 1)	1.20***	(5.45)	1.20***	(5.45)
Upper secondary final score	0.97	(-0.92)	0.97	(-0.92)
Work experience	0.61***	(-11.40)	0.61***	(-11.40)
Education-leaving cohort				
1964-1984	1.10	(1.86)	1.10	(1.86)
1985-1994	1.27***	(4.99)	1.27***	(4.99)
1995-2004	1.23***	(4.18)	1.23***	(4.18)
2005-2014	*Ref*		*Ref*	
T1	0.79	(-1.44)	0.12***	(-10.07)
T2	0.13***	(-10.89)	0.02***	(-17.39)
T3	0.18***	(-9.35)	0.03***	(-16.18)
T4	0.22***	(-8.24)	0.03***	(-15.30)
T5	0.16***	(-9.63)	0.02***	(-16.33)
T6	0.17***	(-9.21)	0.03***	(-15.96)
T7	0.11***	(-10.83)	0.02***	(-17.08)
T8	0.11***	(-10.65)	0.02***	(-16.91)
T9	0.09***	(-11.11)	0.01***	(-17.14)
T10	0.10***	(-10.67)	0.02***	(-16.82)
T11	0.06***	(-11.51)	0.01***	(-17.12)
T12	0.04***	(-11.58)	0.01***	(-16.74)
T13	0.05***	(-11.42)	0.01***	(-16.86)
T14	0.06***	(-11.27)	0.01***	(-16.77)
T15	0.04***	(-11.24)	0.01***	(-16.37)
T16	0.05***	(-11.14)	0.01***	(-16.44)
T17	0.05***	(-11.02)	0.01***	(-16.28)
T18	0.03***	(-10.57)	0.00***	(-15.09)
T19	0.03***	(-10.61)	0.00***	(-15.23)
T20	0.03***	(-10.62)	0.00***	(-15.35)
T21	0.04***	(-10.60)	0.01***	(-15.42)
T22	0.03***	(-10.34)	0.00***	(-14.88)
T23	0.02***	(-9.68)	0.00***	(-13.64)
T24	0.05***	(-10.52)	0.01***	(-15.71)
T25	0.07***	(-10.27)	0.01***	(-15.78)
T26	0.06***	(-10.17)	0.01***	(-15.56)
T27	0.05***	(-10.09)	0.01***	(-15.11)
T28	0.05***	(-9.99)	0.01***	(-15.10)
T29	0.03***	(-9.61)	0.00***	(-14.06)
T30	0.03***	(-9.30)	0.00***	(-13.47)
T31	0.03***	(-9.37)	0.00***	(-13.69)
T32	0.04***	(-9.47)	0.01***	(-14.06)
T33	0.03***	(-9.09)	0.00***	(-13.26)
T34	0.03***	(-9.04)	0.00***	(-13.22)
T35	0.03***	(-8.82)	0.00***	(-12.82)

Table B 2: Results of the piecewise-constant hazard model for the transition into first stable job (second part)

	Model 1		Model 2	
	Hazard ratios	z	Hazard ratios	z
T36	0.03***	(-8.79)	0.00***	(-12.79)
T37	0.04***	(-9.09)	0.01***	(-13.57)
T38	0.02***	(-8.48)	0.00***	(-12.29)
T39	0.05***	(-9.11)	0.01***	(-13.94)
T40	0.03***	(-8.69)	0.00***	(-12.88)
T41	0.03***	(-8.50)	0.00***	(-12.51)
T42	0.02***	(-8.02)	0.00***	(-11.59)
T43	0.02***	(-8.00)	0.00***	(-11.57)
T44	0.02***	(-7.64)	0.00***	(-10.93)
T45	0.05***	(-8.69)	0.01***	(-13.32)
T46	0.02***	(-7.56)	0.00***	(-10.85)
T47	0.01***	(-7.10)	0.00***	(-10.03)
N(Person-Months)	45,611		45,611	
N(Persons)	4,748		4,748	

Notes: Hazard ratios; *z* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C 1: Coefficients of discrete-time event history models of entry into first employment from higher education (first part)

	Model 1		Model 2		Model 3		Model 4	
	Odds ratios	z	Odds ratios	z	Odds ratios	z	Odds ratios	z
Higher-educational outcome								
dropout	0.21***	(-14.89)	0.19***	(-15.42)	0.35***	(-3.32)	0.35***	(-3.35)
graduate	*Ref*		*Ref*		*Ref*		*Ref*	
Unemployment rate[45]	1.01	(1.14)	1.00	(0.36)	1.01	(1.48)	1.01	(0.64)
Interaction effects								
dropout * unemployment rate					0.94*	(-1.70)	0.93*	(-1.88)
graduate * unemployment rate					*Ref*		*Ref*	
At least one parent with higher-education degree (yes = 1)			0.86***	(-3.19)			0.86***	(-3.30)
Age at leaving education system			0.97***	(-3.20)			0.97***	(-3.22)
Vocational training qualification (yes=1)			1.71***	(8.90)			1.71***	(8.84)
Sex (male = 1)			1.41***	(7.33)			1.42***	(7.39)
Upper secondary final score			0.93	(-1.62)			0.92	(-1.62)
Work experience			0.49***	(-12.38)			0.49***	(-12.39)
Education-leaving cohort								
1964-1984			*Ref*				*Ref*	
1985-1994			1.16*	(1.93)			1.16*	(1.91)
1995-2004			1.13	(1.16)			1.12	(1.13)
2005-2014			0.89	(-1.38)			0.89	(-1.35)
T1	*Ref*		*Ref*		*Ref*		*Ref*	
T2	0.10***	(-22.55)	0.10***	(-22.20)	0.10***	(-22.55)	0.10***	(-22.20)
T3	0.16***	(-20.55)	0.16***	(-20.01)	0.16***	(-20.55)	0.16***	(-20.01)
T4	0.21***	(-18.16)	0.22***	(-17.39)	0.21***	(-18.16)	0.22***	(-17.39)
T5	0.13***	(-18.99)	0.14***	(-18.28)	0.13***	(-18.99)	0.14***	(-18.28)
T6	0.14***	(-17.97)	0.15***	(-17.22)	0.14***	(-17.97)	0.15***	(-17.22)
T7	0.10***	(-17.65)	0.10***	(-16.98)	0.10***	(-17.65)	0.10***	(-16.98)
T8	0.10***	(-17.10)	0.10***	(-16.37)	0.10***	(-17.11)	0.10***	(-16.37)
T9	0.07***	(-16.38)	0.07***	(-15.77)	0.07***	(-16.38)	0.07***	(-15.77)

[45] Monthly aggregate unemployment rate (percentage).

Table C 1: Coefficients of discrete-time event history models of entry into first employment from higher education (second part)

	Model 1		Model 2		Model 3		Model 4	
	Odds ratios	z	Odds ratios	z	Odds ratios	z	Odds ratios	z
T10	0.09***	(-16.19)	0.10***	(-15.44)	0.09***	(-16.19)	0.10***	(-15.44)
T11	0.04***	(-14.69)	0.04***	(-14.14)	0.04***	(-14.69)	0.04***	(-14.14)
T12	0.03***	(-13.78)	0.03***	(-13.30)	0.03***	(-13.78)	0.03***	(-13.30)
T13	0.05***	(-14.60)	0.05***	(-14.00)	0.05***	(-14.60)	0.05***	(-14.00)
T14	0.05***	(-14.33)	0.05***	(-13.74)	0.05***	(-14.33)	0.05***	(-13.74)
T15	0.04***	(-13.51)	0.04***	(-12.99)	0.03***	(-13.51)	0.04***	(-12.99)
T16	0.03***	(-13.25)	0.04***	(-12.76)	0.03***	(-13.25)	0.04***	(-12.76)
T17	0.04***	(-13.27)	0.04***	(-12.74)	0.04***	(-13.28)	0.04***	(-12.74)
T18	0.02***	(-11.28)	0.02***	(-10.91)	0.02***	(-11.28)	0.02***	(-10.91)
T19	0.02***	(-12.07)	0.03***	(-11.63)	0.02***	(-12.07)	0.03***	(-11.63)
T20	0.03***	(-12.21)	0.03***	(-11.74)	0.03***	(-12.21)	0.03***	(-11.75)
T21	0.03***	(-12.31)	0.04***	(-11.81)	0.03***	(-12.31)	0.04***	(-11.81)
T22	0.02***	(-11.35)	0.02***	(-10.94)	0.02***	(-11.35)	0.02***	(-10.94)
T23	0.01***	(-9.79)	0.01***	(-9.48)	0.01***	(-9.79)	0.01***	(-9.48)
T24	0.04***	(-12.56)	0.05***	(-11.98)	0.04***	(-12.56)	0.05***	(-11.98)
T25	0.06***	(-12.95)	0.07***	(-12.25)	0.06***	(-12.96)	0.07***	(-12.25)
T26	0.05***	(-12.59)	0.06***	(-11.91)	0.05***	(-12.60)	0.06***	(-11.91)
T27	0.04***	(-11.96)	0.05***	(-11.33)	0.04***	(-11.96)	0.05***	(-11.33)
T28	0.04***	(-11.69)	0.05***	(-11.07)	0.04***	(-11.70)	0.05***	(-11.07)
T29	0.03***	(-10.89)	0.04***	(-10.37)	0.03***	(-10.90)	0.04***	(-10.37)
T30	0.02***	(-10.04)	0.03***	(-9.58)	0.02***	(-10.04)	0.03***	(-9.58)
T31	0.02***	(-9.96)	0.03***	(-9.50)	0.02***	(-9.96)	0.03***	(-9.50)
T32	0.04***	(-10.78)	0.04***	(-10.22)	0.04***	(-10.79)	0.04***	(-10.22)
T33	0.02***	(-9.78)	0.03***	(-9.33)	0.02***	(-9.79)	0.03***	(-9.33)
T34	0.02***	(-9.01)	0.02***	(-8.63)	0.02***	(-9.01)	0.02***	(-8.64)
T35	0.02***	(-9.69)	0.03***	(-9.23)	0.02***	(-9.69)	0.03***	(-9.23)
T36	0.02***	(-8.93)	0.02***	(-8.56)	0.02***	(-8.93)	0.02***	(-8.56)
T37	0.04***	(-10.27)	0.04***	(-9.71)	0.04***	(-10.27)	0.04***	(-9.71)
T38	0.02***	(-9.21)	0.03***	(-8.79)	0.02***	(-9.21)	0.03***	(-8.79)
T39	0.04***	(-10.26)	0.05***	(-9.68)	0.04***	(-10.26)	0.05***	(-9.68)

Table C 1: Coefficients of discrete-time event history models of entry into first employment from higher education (third part)

	Model 1		Model 2		Model 3		Model 4	
	Odds ratios	z	Odds ratios	z	Odds ratios	z	Odds ratios	z
T40	0.02***	(-9.06)	0.03***	(-8.63)	0.02***	(-9.06)	0.03***	(-8.63)
T41	0.02***	(-9.01)	0.03***	(-8.57)	0.02***	(-9.01)	0.03***	(-8.57)
T42	0.02***	(-8.17)	0.02***	(-7.80)	0.02***	(-8.17)	0.02***	(-7.80)
T43	0.02***	(-8.59)	0.02***	(-8.18)	0.02***	(-8.60)	0.02***	(-8.18)
T44	0.02***	(-8.11)	0.02***	(-7.74)	0.02***	(-8.12)	0.02***	(-7.74)
T45	0.04***	(-9.73)	0.05***	(-9.12)	0.04***	(-9.73)	0.05***	(-9.12)
T46	0.02***	(-8.03)	0.02***	(-7.66)	0.02***	(-8.03)	0.02***	(-7.66)
T47	0.01***	(-7.44)	0.02***	(-7.13)	0.01***	(-7.44)	0.02***	(-7.13)
N(Person-Months)	37,896		37,896		37,896		37,896	
N(Persons)	3,271		3,271		3,271		3,271	

Notes: Odds ratios; *z* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C 2: Coefficients of discrete-time event history models of entry into first employment from higher education (without and with upper secondary final score)

	Model 1 Without score		Model 2 With score	
	Odds ratios	z	Odds ratios	z
Higher-educational outcome				
dropout	0.34***	(-3.40)	0.52*	(-1.75)
graduate	*Ref*		*Ref*	
Unemployment rate	1.01	(0.62)	1.01	(0.47)
Interaction effects				
dropout * unemployment rate	0.94*	(-1.87)	0.88***	(-2.64)
graduate * unemployment rate	*Ref*		*Ref*	
At least one parent with higher-education degree (yes = 1)	0.86***	(-3.22)	0.95	(-0.78)
Age at leaving education system	0.97***	(-3.28)	0.96***	(-2.85)
Vocational education and training degree (yes=1)	1.70***	(8.84)	1.72***	(6.21)
Sex (male = 1)	1.41***	(7.37)	1.49***	(5.76)
Upper secondary final score			0.88**	(-2.13)
Work experience	0.49***	(-12.44)	0.43***	(-10.20)
Education-leaving cohort				
1964-1984	*Ref*		*Ref*	
1985-1994	1.17**	(2.05)	1.08	(0.67)
1995-2004	1.14	(1.34)	1.23	(1.44)
2005-2014	0.90	(-1.17)	1.02	(0.17)
T1	*Ref*		*Ref*	
T6	0.15***	(-34.28)	0.16***	(-22.42)
T12	0.08***	(-34.24)	0.09***	(-22.44)
T18	0.04***	(-30.18)	0.04***	(-19.84)
T24	0.03***	(-27.02)	0.03***	(-17.93)
T30	0.05***	(-26.26)	0.06***	(-17.23)
T36	0.03***	(-22.29)	0.03***	(-15.01)
T42	0.03***	(-21.45)	0.03***	(-13.98)
T48	0.02***	(-18.87)	0.02***	(-12.39)
N(Person-Months)	37,896		16,794	
N(Persons)	3,271		1,500	

Notes: Odds ratios; *z* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$;

Table C 3: Coefficients of linear regression model: Job status (ISEI) of the first job for educational leavers (without and with upper secondary final score)

	Model 1 Without score		Model 2 With score	
	Coeff.	t	Coeff.	t
Higher-educational outcome				
dropout	-25.18***	(-5.32)	-27.25***	(-4.45)
graduate	*Ref*		*Ref*	
Unemployment rate	-0.84***	(-4.74)	-1.10***	(-4.39)
Interaction effects				
dropout * unemployment rate	0.52	(0.98)	0.88	(1.13)
graduate * unemployment rate	*Ref*		*Ref*	
Direct transition into labour market (yes = 1)	-3.63***	(-5.73)	-5.06***	(-5.38)
At least one parent with higher-education degree (yes = 1)	0.92	(1.44)	0.62	(0.64)
Age at leaving education system	0.24*	(1.86)	0.48**	(2.50)
Vocational education and training degree	-3.78***	(-4.58)	-3.63***	(-3.03)
Sex (male = 1)	2.70***	(4.14)	2.75***	(2.80)
Upper secondary final score			-2.59***	(-3.19)
Work experience	-1.11	(-1.28)	-1.37	(-1.10)
Education-leaving cohort				
1964-1984	*Ref*		*Ref*	
1985-1994	1.94*	(1.79)	1.86	(1.13)
1995-2004	3.36**	(2.34)	4.65**	(2.18)
2005-2014	1.70	(1.37)	2.99	(1.53)
Constant	71.05***	(21.59)	73.16***	(14.63)
N[46]	2,471		1,145	

Notes: Coefficients; *t* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$;

[46] Only education leavers with a first job.

Table C 4: Coefficients of linear regression model: Job status (ISEI) of the first job for educational leavers (without and with correction for sample selection)

	Model 1		Model 2	
	Coeff.	t	Coeff.	t
Higher-educational outcome				
dropout	-25.08***	(-5.30)	-24.47***	(-5.15)
graduate	*Ref*		*Ref*	
Unemployment rate	-0.85***	(-4.78)	-0.87***	(-4.89)
Interaction effects				
dropout * unemployment rate	0.53	(0.99)	0.63	(1.17)
graduate * unemployment rate	*Ref*		*Ref*	
Direct transition into labour market (yes = 1)	-3.66***	(-5.77)	-3.89***	(-5.80)
At least one parent with higher-education degree (yes = 1)	0.80	(1.24)	0.82	(1.27)
Age at leaving education system	0.25**	(1.99)	0.25**	(1.98)
Vocational education and training degree	-3.76***	(-4.56)	-3.83***	(-4.64)
Sex (male = 1)	2.70***	(4.15)	2.65***	(4.07)
Upper secondary final score	-1.07	(-1.64)	-1.06	(-1.62)
Work experience	-1.09	(-1.26)	-0.95	(-1.08)
Education-leaving cohort				
1964-1984	*Ref*		*Ref*	
1985-1994	1.82*	(1.68)	1.91*	(1.76)
1995-2004	3.16**	(2.19)	3.30**	(2.29)
2005-2014	1.54	(1.24)	1.95	(1.49)
Constant	73.43***	(20.44)	73.79***	(20.50)
N	2,471		3,165	
athrho			-0.09	(-1.03)
lnsigma			2.73***	(191.60)
rho			-0.09	
sigma			15.39	
lambda			-1.43	

Notes: Coefficients; *t* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; *Model 1*: Without correction; *Model 2*: Correction for sample selection – Heckman Selection Model (controlling for: Higher-educational outcome, unemployment rate, interaction 'higher-educational outcome*unemployment rate', parental education, age, vocational training, sex, score, work experience, cohort, search duration)

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