From Educational Decisions to Labour Market Consequences.

Understanding the Interrelation between Sex Segregation and Gender Specific Educational and Employment Trajectories.

Von der Philosophischen Fakultät der Gottfried Wilhelm Leibniz Universität Hannover zur Erlangung des Grades

Doktorin der Philosophie (Dr. phil)

genehmigte Dissertation von

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2021

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Tag der mündlichen Prüfung

08.02.2019

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List of publications and manuscripts

Sub-study I

Hägglund, Anna Erika and Leuze, Kathrin. 2020. Gender differences in STEM expectations across countries: How perceived labour market structures shape adolescents' preferences. *Journal of Youth Studies*. Published online. https://doi.org/10.1080/13676261.2020.1755029

Sub-study II

Hägglund, Anna Erika and Lörz, Markus. 2020. Warum wählen Männer und Frauen unterschiedliche Studienfächer? *Zeitschrift für Soziologie* 49: 66-86.

Sub-study III

Hägglund, Anna Erika. Contextualized Inequality. How Fields of Study Shape the Gender Wage Gap in Germany and Finland. Manuscript prepared for submission.

Sub-study IV

Hägglund, Anna Erika and Bächmann, Ann-Christin. 2017. Fast Lane or Down the Drain? Does the occupation held prior to unemployment shape the transition back to work? *Research in Social Stratification and Mobility* 49: 32-46.

Abstract

Despite tremendous advances in women's educational attainment and employment over time, women still enrol into different fields of study than men and earn less once they enter the labour market. These aspects are interrelated, as fields of study preferred by women are associated with lower wages. This thesis aims to disentangle the process, in which gender differences in field of study choices emerge and transform into gender inequality in the labour market through four steps: occupational expectations in adolescence, field of study choices in higher education, early labour market careers, and subsequent employment trajectories. Empirically, each step is addressed by means of a quantitative analysis, with data sets, key predictors, and modelling strategies accommodating the specific research question at hand.

The results confirm previous research and offer new insights on specific explanations. First, gender differences in task-related preferences, i.e., occupational interests, are important for explaining horizontal sex segregation. Occupational interests are strongly related to subject-specific specialization and performance in the secondary educational system, suggesting that young men and women develop gender-specific skill- and interest profiles throughout their educational trajectories. These profiles seem to align with cultural notions of tasks and skills particularly suitable for each gender. The results also show that the labour market and the occupational structure are important institutions embodying such norms of masculinity and femininity. Thus, certain environments seem to strengthen gender differences in occupational preferences.

Mechanisms driving educational choices, such as interests, seem to differ from those that foster gender inequality in the labour market. Moreover, the extent to which educational and occupational decisions transform into labour market inequality is contingent on the institutional setting. While the results confirm that the sex composition of fields of study and occupation structures gender inequality, it does not evoke disadvantage across all contexts. Finally, horizontal sex segregation does not affect labour market trajectories of men and women similarly. Thus, theoretical explanations need to be adapted to accommodate gender-specific patterns, which, in turn, might be context-dependent.

The horizontal sex segregation is resilient to change if the occupational structure supports a realization of 'gender-typical' occupational interests. Meanwhile, gender differences in occupational interests are not necessarily detrimental for employment trajectories, if the labour market enables highly-qualified women to pursue these paths in well-remunerated occupations.

Keywords:

gender, field of study choices, occupations, sex segregation, labour market inequality, longitudinal

Acknowledgements

Writing this thesis was exciting, challenging, frustrating, and rewarding. It allowed me to spend time thinking about a subject I care deeply about, and to exchange and develop ideas with others. The support of these others was invaluable for starting, continuing, and finishing this project.

First, I wish to thank my supervisors Prof Kathrin Leuze and Prof Juho Härkönen for their encouragement, advice, thorough feedback and, at times, critical gaze. Kathrin, thank you for being enthusiastic about the topic, always taking the time to listen to and solve various theoretical and practical problems, for motivating me to think more thoroughly about relevance and mechanisms, and for showing that small steps in the right direction can lead to the desired outcome. Juho, my thesis profited greatly from your ability to detect the "big", fundamental questions in small details and to identify what is important. Thank you for your patience and guidance through the jungle methodological issues. I also want to thank my co-authors Dr. Ann-Christin Bächmann and Dr. Markus Lörz. Anne, I enjoyed your systematic and thorough approach, especially our multiple checks to ensure the results held. I am confident that we will continue our collaboration. Markus, it is not easy to write a clear paper about a complex topic, but I appreciate your ability to focus on the relevant aspects amid endless findings and possibilities. I hope that we will have the opportunity to focus on some of these endless possibilities in the future.

I wrote the main part of this thesis at Institute of Sociology at the Leibniz Universität Hannover, and had the opportunity to present my work at seminars and colloquiums. I am grateful to all the participants for their constructive feedback and comments. In particular, I wish to thank my colleagues at the chair for educational sociology: Ann-Christin Bartels, Dörthe Gatermann, Roman Jeschke, Anna Marczuk, Katja Pomianowicz, and Jan-Roloff for sharing both the very fun and moderately fun parts of the process. I am also grateful to researchers from other institutions who helped improve this thesis with their detailed feedback, in particular to Rossella Icardi, Laura Menze, and Irene Prix. Finally, I wish to thank the graduate school "Science and Society" at the Leibniz Center for Science and Society for providing me with a 'write up' scholarship. I am also grateful to the Ella and Georg Ehrnrooth Foundation, the Swedish Cultural Foundation in Finland, the Inclusive Growth Research Infrastructure (and InGRID), enabling, amongst others, fruitful research visits to the University of Turku and the Swedish Institute for Social Research (SOFI) at Stockholm University.

While this thesis was written within the university, it certainly spilled over into other areas of my life: my friends, who repeatedly emphasized that this is an exciting topic, and my family, who supported me throughout. But most importantly, thank you Zach for showing that engineers can be decent sociologists, excellent graphical designers and proof-readers, cooks, and problem solvers. Without your love, this would certainly not have been as fun and smooth an adventure.

List of abbreviations

AME	Average Marginal Effect
CATI	Computer assisted telefone interview
DZWH	Deutsches Zentrum für Hochschul- und Wissenschaftsforschung (German Centre for Research on Higher Education and Science Studies)
DIW	Deutsches Institut für Wirtschaftsforschung (German Institute for Economic Research)
FLEED	Finnish Longitudinal Employer-Employee Data
GSOEP	German Socio Economic Panel Study
ILO	International Labour Organization
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupations
KldB	Klassifikation der Berufe (German Classification of Occupations)
MZ	Microzensus
NEPS	National Educational Panel Study
OECD	Organization for Economic Co-organization and Development
PISA	Programme for International Student Assessment (PISA)
SIAB	Sample of Integrated Labour Market Biographies
STEM	Science, Technics, Engineering, and Mathematics

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1 Introduction

The seemingly contradictory trends in men's and women's educational attainment and employment patterns in the past decades have puzzled scholars and policy makers alike. In the last 50 years, the vast majority of post-industrialized economies have witnessed a tremendous increase in female employment (Blau, Ferber and Winkler 2009) and an overturn in gender inequality in education, as girls nowadays outperform boys (Buchmann, DiPrete and McDaniel 2008). Yet development has not occurred equally across all areas. Two aspects of stagnation have received particular attention: Women's underrepresentation in high-status and high-income positions in the labour market and the diverging occupational choices of men and women (Charles 2011; Charles and Grusky 2004; England 2010). Previous research has demonstrated that these aspects are interrelated: Fields of study and occupations preferred by women are associated with, for example, lower wages and lower status work (see e.g., Cohen and Huffman 2003; Kalmijn and Lippe 1997; Reimer and Steinmetz 2009). This raises the question whether women's occupational choices dilute potential gains, which they could achieve through their educational success and increased labour market participation.

To address this concern, this thesis aims to shed light on how gender differences in educational choices emerge and subsequently transform into gender inequality in the labour market. It focuses on highly qualified men and women with a country-emphasis on Germany, but the thesis also comprises two cross-nationally comparative analyses. In particular, it explores educational choices across 32 OECD and European countries, and contrasts employment trajectories in Germany with those in Finland.

1.1 Gender differences in education and employment

In most post-industrial economies, gender inequalities in the educational system have shifted. While women in the 1970s lagged behind in terms of educational attainment, girls nowadays are more likely to obtain a high school degree than boys, receive better grades, and display higher literacy skills (Buchmann, DiPrete and McDaniel 2008; Helbig 2012a; Willingham and Cole 1997). This trend is also mirrored in the higher education system, where women form the majority of students. Thus, as displayed in Figure 1.1a for five countries (chosen as example and including Germany and Finland), educational attainment has risen substantially

over time for both genders, but women seem to have benefited the most (see second y-axis in Figure 1.1a). However, countries differ in the point in time, when a reversal of gender differences occurred, with Finland displaying a visible female advantage already in the 1990s (see first y-axis in Figure 1.1a). Germany, in turn, represents a latecomer, where an equal share of men and women participates in the higher education system (OECD, 2017; Lörz & Schindler 2011).

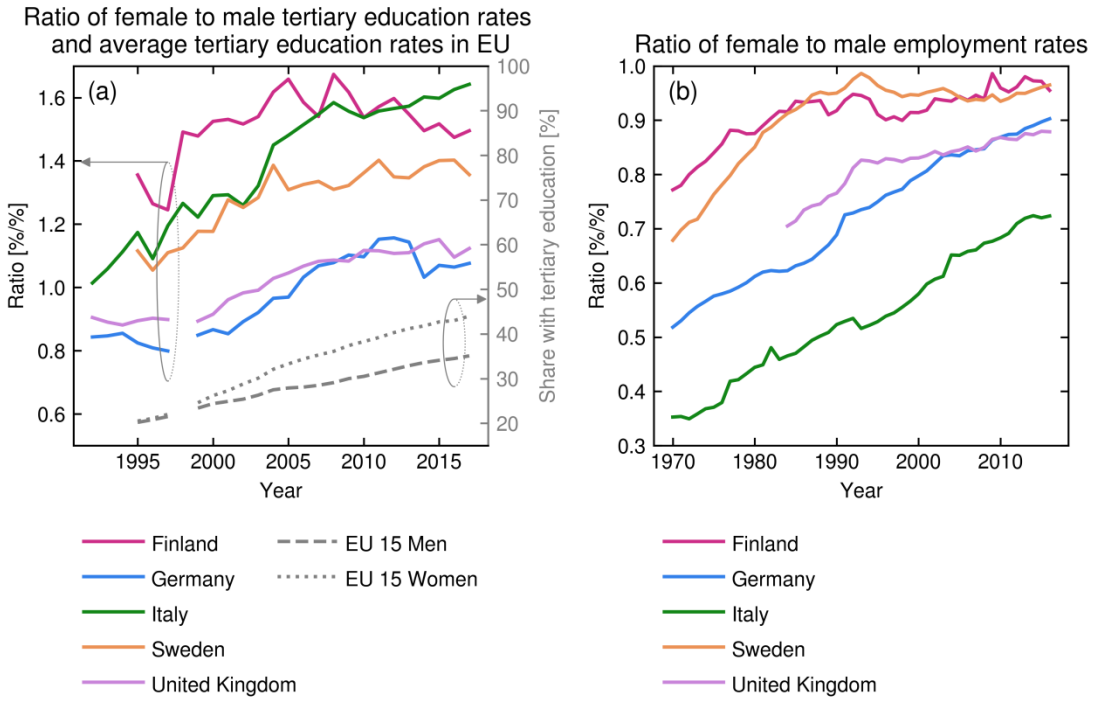

Figure 1.1 Changes in men's and women's educational attainment and employment rate over time.

Notes: (a) depicts the ratio of the share of women with a tertiary degree to the share of men with a tertiary degree. The share refers to the percentage of women and men aged 25-34 with a tertiary degree. The second y-axis shows the shares of women and men with a tertiary degree in the EU 15 countries. (b) describes the temporal development of the ratio between the female and the male employment rates among 15-64 year olds. The employment rate was calculated as the number of employed women or men divided by the population of 15-64 year old women and men, respectively.
Source: (a) Eurostat 2018; (b) OECD 2018a, own calculations

Meanwhile, given that women, and particularly mothers, nowadays engage in full-time employment for longer periods of their lives (Blau and Kahn 2017; Nieuwenhuis, Need and Van Der Kolk 2012), researchers have reported converging labour market patterns between men and women (Aisenbrey and Brückner 2008; Charles 2011). As shown in Figure 1.1b, women's employment rate over time is approaching that of men, although its development and current level differ substantially across countries (Grönlund, Halldén and Magnusson 2017). Compared to countries such as Finland and Sweden, where the female-to-male-

employment ratio reaches almost parity, gender differences in Germany continue to be more pronounced.

Despite these changes, gender differences in the educational system and the labour market prevail. First, men and women continue to opt for different fields in the vocational training and higher education; a phenomenon described as the *horizontal sex segregation* of the educational system (Charles and Bradley 2009; Charles and Grusky 2004).[1] In terms of fields of study choices, men are overrepresented in the STEM-majors (**S**cience, **T**echnology, **E**ngineering, and **M**athematics), whereas women dominate health, education and humanities (Lörz, Schindler and Walter 2011; Morgan, Gelbgiser and Weeden 2013). As a result of the rising share of women in higher education, the overall horizontal segregation declined during the 20th century with women increasingly gravitating towards more prestigious and well-paying fields (Becker 1993). In particular, a higher gender integration of study fields was accomplished as women enrolled into economics and education in the mid-1980s (Mann and DiPrete 2013: 1521). Yet since the 1980s and 1990s the pace of desegregation has slowed down, and in some fields, gender differences have even increased. Particularly technics seem to be resistant to change (Barone 2011: 158; England and Li 2006). This persistent underrepresentation of women in technics and natural sciences has puzzled scholars and policy makers across countries alike, not the least because several industrialised economies experience a shortage of highly qualified workers in STEM occupations (Beede et al. 2011; EIGE 2018; Xie, Fang and Shauman 2015). Thus, the importance of technical fields in driving economic prosperity and innovation has sparked the question why women are not more inclined to enrol into natural sciences and technics (Mann and DiPrete 2016: 568). Figure 1.2 displays how gender-specific fields of study choices are distributed across countries. In the selected countries, engineering and information technologies are disproportionally preferred by men; yet the male-advantage is more pronounced in Sweden and Finland than in e.g. Italy. It is also worth noting that gender differences in natural sciences in all countries are modest.

Given that a degree in a specific field often is prerequisite for entering an equivalent positions in the labour market (Klein 2011), it is not surprising that the gender differences in fields of study choices corresponds to men and women populating different occupations in the labour market (Smyth and Steinmetz 2008). The unequal distribution of men and women across different occupations, i.e. the *horizontal sex segregation* of the labour market, is a persistent feature of modern societies (Charles and Grusky 2004; Hausmann and Kleinert 2014); yet the degree and patterns of horizontal sex segregation differ across countries

[1] This thesis uses the terms 'fields of study, 'study fields', 'major', and 'subject choice' interchangeably.

(Charles 2005). For instance, the extent of occupational sex segregation is higher in countries such as Finland than in Germany and Italy (Charles 1992; Steinmetz 2012).

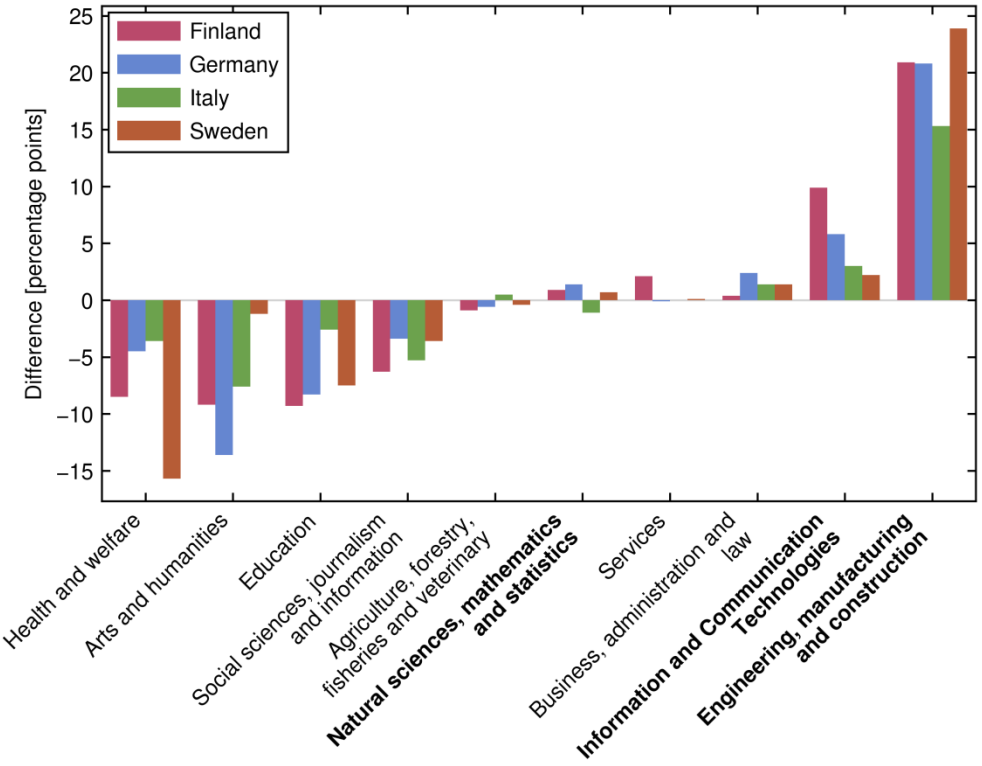

Figure 1.2 Gender differences in fields of study choices across countries among first time Master level graduates (2015)

Notes: The difference refers to first time graduates with a Master level degree in 2015 and is defined as follows: The percentage of women graduating from a specific field is subtracted from the percentage of men graduating from the same field. Positive values indicate a male advantage, whereas negative values denote a female advantage. For presentation reason, UK has been excluded. STEM-fields are in bold.
Source: OECD 2017, own calculations

Besides these horizontal differences, *vertical gender inequalities* in the labour market also persist. The wages of men and women converged steadily in several countries until the 1990s, but the pace of change has stagnated (Blau and Kahn 2017). For instance, the unadjusted gender wage gap in hourly gross earnings in Germany has remained at ca. 20 per cent for the past two decades (Ziegler 2005) and is 21 per cent in 2017 (Destatis 2018).[2] Scholars have noted that the magnitude of wage inequality differs across groups of men and women. In fact, in some countries the gender-based earnings disparities are greater in the upper part of the wage distribution and, closely related, among highly qualified workers (Albrecht, Björklund and Vroman 2003; Blau and Kahn 2017; Evertsson et al. 2009; Grönlund and Magnusson

[2] The unadjusted gender wage gap refers to the difference in wages between men and women, before taking possible explanations into consideration.

2016; Mandel 2012). Accordingly, Figure 1.3 highlights that the unadjusted gender wage gap in hourly earnings is larger among tertiary-educated men and women than among lower skilled workers, particularly in Germany, but also in Finland and Sweden. These patterns have encouraged researches to call for "new puzzles" of gender inequality (see e.g., Grönlund and Magnusson 2016: 91), and to identify mechanisms driving it among highly skilled workers.

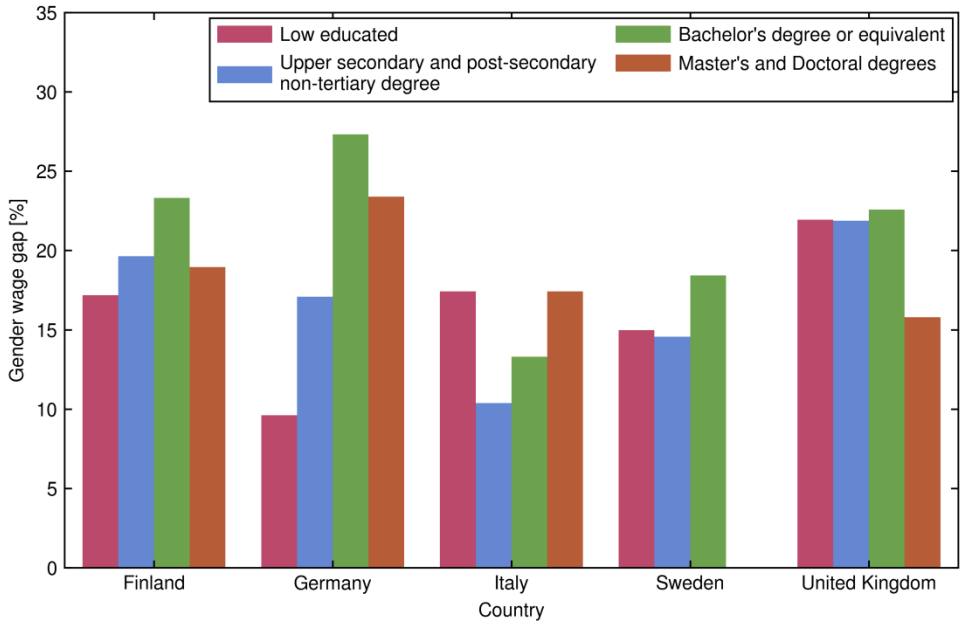

Figure 1.3 The gender wage gap in hourly earnings by educational level

Notes: The gender wage gap is based on mean hourly earnings for the year 2014 among men and women working in firms with 10 or more employees. Low educated refers to the ISCED 2011 levels '0-2'. For Sweden, data on 'Master's and Doctoral Degrees' was not available.
Source: Eurostat 2018, own calculations

To explain why women still lag behind a substantial string of research has focused on the horizontal sex segregation of the higher education system and the labour market (see e.g., Busch 2013a; Cohen and Huffman 2003; England 2005; Ochsenfeld 2014; Reimer and Steinmetz 2009; Roksa 2005). Accordingly, if men disproportionally graduate from fields such as engineering, which come with higher wages, fields of study choices will contribute to the gender wage gap (Kim, Tamborini and Sakamoto 2015; Leuze and Strauß 2014; van de Werfhorst 2002; van de Werfhorst 2004). This indicates that seemingly voluntary processes in labour supply structure labour market inequality between men and women (Correll 2001).

The trends described above seem to suggest that women do not fully profit from their educational advancements, and that the nexus between gender-specific educational choices and labour market inequality comprises several further puzzles. For instance, despite a growing body of research (Busch-Heizmann 2015; Gabay-Egozi, Shavit and Yaish 2015; Morgan, Gelbgiser and Weeden 2013) it is far from clear why young men and women continue to prefer different occupations and enrol into different fields of study. The variation in

horizontal sex segregation across countries also raises the question whether certain environments or institutional surroundings favour the development of gender-specific occupational interests. Furthermore, though the association between the horizontal sex segregation and labour market rewards, particularly wages, is well documented few scholars have examined the extent to which it is context-dependent. Finally, the importance of horizontal sex segregation for understanding gender differences in the labour market could also be restricted to certain outcomes, while playing a minor role in others.

1.2 Aim of the study

The main objective of this thesis is to disentangle the relation between educational choices and gender inequality in the labour market. To this end, it examines four relevant steps: occupational expectations in adolescence, realized fields of study choices in higher education, early career wage trajectories, and finally, the re-entry into employment after job loss. These four steps are discussed in two parts. The first part focuses on supply-side mechanisms, shaping the unequal distribution of men and women across different occupations (Okamoto and England 1999; Xie and Shauman 1997: 253). The key question pertaining to this part is *why men and women display different occupational aspirations and opt for different fields of study?* Since young men and women have not yet entered the labour market, their occupational expectations, and subsequent fields of study choices reflect socialized tastes, previous experiences in the educational system, and perceptions of work. Thus, compared to occupational placement among adults, this group is particularly suited for analysis of preferences and future anticipations, unconstrained by employer involvement (Xie and Shauman 1997; Charles and Bradley 2004). Specific questions are:

1. Which individual-level explanations are decisive?
2. Do institutional environments matter for gender differences in occupational choices, and if so why?

The second part of the thesis explores the consequences of these choices with respect to wages and unemployment trajectories, addressing mechanisms located in the labour market. To this end, it asks *to which extent, and why, do gender-specific occupational choices transform into inequality in the labour market*? The focus on both monetary and non-monetary rewards provides a more nuanced view of the ways, in which horizontal sex segregation of the educational system and labour market influence gender inequality. Specific questions are:

3. Are the lower remunerations associated with female-dominated fields context-dependent?
4. Is horizontal segregation equally important in different labour market outcomes?

Taken together, the thesis aims to understand *why young men and women opt for different fields of study, and under which conditions decisions made earlier in the educational biography have long-standing consequences in the labour market*. These questions are foremost addressed in the German context. In Germany gender differences in fields of study choices are pronounced, as displayed in Figure 1.2. Furthermore, the educational system is strongly linked to the labour market, indicating that employers place a high value on educational credentials when hiring (Müller and Shavit 1998). This makes Germany of substansive interest for the questions at hand, as the consequences of educational decisions should be particulalry marked; an implication that is explored by comparing Germany with Finland. Furthermore, the emphasis of the thesis is on highly qualified men and women, i.e. on adolescents striving towards tertiary education, or employment outcomes among tertiary-educated workers. This restriction has several advantages. In terms of occupational choices, this means that supply-side mechanisms are explored among a positively selected group, where e.g. overall performance and aspirations are high (Mare 1980). Furthermore, compared to lower educational levels, gender differences in labour market attachment are smaller among highly qualified men and women (Konietzka and Kreyenfeld 2010). This allows comparing gender-specific labour market outcomes across countries more easily, given that country-variation in women's selection into employment is smaller (Evertsson et al. 2009). In addition, scrutinizing a more homogenous group avoids conflating different labour market mechanisms in the process, when horizontal sex segregation transforms into vertical inequalities (Leuze and Strauß 2014; Leuze and Strauß 2016).

Empirically, the thesis addresses these questions by means of four quantitative analyses. *Sub-study I* concentrates on an early stage in the educational biography, namely adolescents' occupational expectations, and explores an outcome, where gender differences are pronounced: 15-year old girls' and boys' interest to work in a technical field or in math-intense natural sciences in adulthood. It adds to the literature, by systematically elaborating on the importance of the labour market structure in explaining sex segregation in occupational choices through a cross-national comparison across 35 European and OECD-countries. *Sub-study II*, in turn, addresses men and women's diverging fields of study choices in Germany. By focusing on upper secondary students, it assesses three partly competing explanatory frameworks –the educational biography, vocational interests, and the extended rational choice perspective – and utilizes a more differentiated understanding of field-specific processes than previous research. Turning to the influence of horizontal sex segregation on labour market outcomes, *sub-study III* pursues the well-established association between the sex-composition of fields of study and wages. In contrast to previous research, it embeds it in an institutional approach, raising the question whether and why the effect of subject choices on the gender wage gap among higher education graduates differs between Germany and Finland during the

first ten years after labour market entry. Finally, *sub-study IV* turns to a labour market outcome rarely explored among scholars on occupational sex segregation, namely the re-entry into the labour market after job loss. It addresses whether the unequal distribution of men and women across occupations account for gender differences in German men's and women's transition from unemployment into re-employment.

This thesis provides a thorough theoretical and empirical analysis of mechanisms decisive for each step at hand, and conceptually linking the findings together. This perspective is also crucial from a policy perspective. To increase girls' participation in technical fields, or to target gender wage inequality, policy makers not only require an understanding of key mechanisms within each step, but also of how education and employment trajectories interrelate.

1.3 Structure of the thesis

The structure of the thesis is as follows. The first part (*Chapter 1– Chapter 6*) presents the overall scope, while the second part (*Chapter 7 – Chapter 10*) comprises the four empirical sub-studies.

The following chapter *(Chapter 2)* describes the overall conceptual framework of the thesis. To understand how and why gender-specific educational decisions are related to later labour market inequalities, the four outlined sub-studies are embedded into the broader framework of life course research. *Chapter 3*, in turn, revisits the single steps, by providing an overview of the literature relevant to the subsequent empirical sub-studies, and outlines the research gaps. It starts by critically reviewing the main theoretical explanations for men's and women's diverging occupational expectation and fields of study with respect to empirical evidence. It discusses the association between sex composition of study fields and occupations and labour market returns. *Chapter 4*, in turn, presents the empirical design. The chapter highlights the advantages of the five micro-level data sets utilized in the thesis, and presents the challenges of capturing the horizontal sex segregation as the outcome and the main predictor of an analysis. *Chapter 5* briefly presents the sub-studies (I-IV) and summarizes their results, whereas *Chapter 6* elaborates on the main conclusions, highlighting overall findings and addressing needs for further research.

The second part (*Chapter 7 – Chapter 10*) entails the empirical studies. As outlined earlier, each sub-study is independent and explores a different research question, but they together contribute to the overall aim of the thesis. It is worth noting that discussions of previous research, theoretical models, and findings overlap with the first part of the thesis.

2 Institutional embeddedness of the life course

This thesis investigates how gender specific educational decisions emerge and affect later labour market outcomes. It disentangles this longstanding process into four steps that take place at different time points in the individual life-course and are embedded in a specific institutional context. The following section 2.1 places each step in the individual life course. Section 2.2, in turn, discusses the role of institutions, and presents the relevant contexts from the perspective of gender.

2.1 The life course as an explanatory point of reference

To comprehend the nexus between gender-specific educational choices and labour market inequality, we need to understand how different time points in individuals' lives interlink and which institutions are particularly decisive at each time point. Over the past decades, life course theory has provided an increasingly popular framework for conceptualizing the interplay between the individual life and structural conditions, and allowed researchers to empirically model interdependencies between micro- and macro-level processes (Kohli 2007; Mayer 2009). The life course can be viewed as "sequences of roles and experiences", as individuals and groups follow pathways through education, employment, family life, and retirement (Elder, Johnson and Crosnoe 2003: 8). These pathways or trajectories encompass transitions, where individuals move from one state into another, such as graduate from the education system and enter the labour market (Mayer 2004: 166). Trajectories are interwoven, indicating that individual outcomes are the result of previous transitions and events (Buchmann and Kriesi 2011; Elder, Johnson and Crosnoe 2003: 8-14; Mayer 2004: 164-165). In terms of social stratification, this means that advantages or disadvantages can cumulate over the life course (DiPrete and Eirich 2006). Trajectories are also embedded in historical time and societal institutions (Elder, Johnson and Crosnoe 2003; Mayer 2003), which structure pathways and provide a frame of reference for individual agency (Settersten and Gannon 2005).

The thesis focuses on four individual-level outcomes: gender-specific occupational expectations among adolescents, upper secondary school-leavers' realized fields of study choices, early career trajectories among higher education graduates, and the re-entry into the labour market after job loss. Adolescents' *occupational expectations* represent a first step in making a decision about further educational and occupational pathways (Dombrowski 2015; McDaniel 2016; Schoon and Polek 2011) and are thus influential with respect to their subsequent *fields of study choices* (Legewie and DiPrete 2014). Thus, this process requires

individual agency, but is also deeply embedded in societal institutions, which, in turn, are gendered (Gottfredson and Lapan 1997).

The entry into the labour market and the *first ten years of employment* represent a time point when wage progression and career mobility tend to be the strongest (Härkönen, Manzoni and Bihagen 2016; Kim, Tamborini and Sakamoto 2015) and graduates' family formation takes place (Brandt 2016). These years are consequential for gender inequalities (Braakmann 2013; Leuze and Strauß 2014), as gender differences in early stages stabilize over the employment trajectory. Job-loss, in turn, constitutes a critical event associated with disadvantages in later employment (Arulampalam 2001; Schmelzer 2012; Vandecasteele 2011), but the possibilities to recover and re-enter the labour market varies between men and women (Mavromaras 2003; Strauß and Hillmert 2011). Both early career trajectories and the re-entry into employment after job loss take place in an institutional setting (Gangl 2006; Gash 2008). However, as will be discussed below, previous life course research has not exhaustively assessed the interplay between gender-specific trajectories and institutions.

Taken together, the thesis raises the question whether the four individual-level outcomes interlink directly, providing an explanation for gender-specific labour market advantages and disadvantages, or whether the process is more complex.

2.2 Institutions, gender, and the life course

2.2.1 The importance of institutions

To contextualize individual trajectories, life course research has highlighted the importance of institutions (Mayer 2003). Although conceptualizations of institutions differ across the field, social science scholars tend to agree that they represent formalized procedures and rules, but also embody values, norms, and cognitive schemata, which remain relatively stable over time and apply to all members of a collective (Kohli 2007; Krüger and Levy 2000; Scott 2001). This suggests that institutions entail not only regulative dimensions, but also operate according to cultural practices, which are incorporated in the logic of the institution (Hall and Taylor 1996). Compared to strong emphasis on the historical context among early life course scholars (Elder, Johnson and Crosnoe 2003; Leuze 2010: 36), more recent accounts have identified the educational system, the labour market and occupations, and the family as key institutions for individual life courses (Blossfeld 1987; Krüger and Levy 2001; Mayer 2004; Mayer 2009; Müller and Shavit 1998). Yet two aspects need further consideration. First, life course scholars have seldom systematically elaborated *on the structural dimensions, such as formal barriers, and cultural dimensions, such as norms, of institutions*, particularly when analysing young men's and women's education trajectories and subsequent labour market patterns. In contrast,

gender studies have theorized how structural and cultural aspects of institutions interrelate and (re-)produce gender differences (Correll 2001; Ridgeway 2009; Ridgeway and Correll 2004), describing e.g. men's and women's diverging occupational choices as the result of cultural belief systems and labour market structures (Charles 2017; Charles and Bradley 2009). An inherent difficulty has nevertheless been to comprehend under which conditions and to which extent macro-structural and –cultural gender frames influence individual-level behaviour (Ridgeway 2009: 146)

Second, institutions have different implications for men and women. These *disparate effects of institutions* have most prominently been theorized and empirically assessed with respect to the family. Thus, for women, abundant research documents that family formation interferes with the order and plurality of trajectories, as the birth of a child interrupts employment and results in challenges in combining work and family (Drobnič, Blossfeld and Rohwer 1999; Konietzka and Kreyenfeld 2010; Krüger 1995; Krüger and Levy 2001). For men, however, parenthood supports the standard life course, and can even generate career advantages (Cooke 2014; Härkönen, Manzoni and Bihagen 2016; Killewald 2013). On the institutional level, scholars have embedded these gendered family trajectories into welfare states, social policies, and gender cultures, documenting that the gender-specific consequences of family formation differ across countries (see e.g., Aisenbrey and Fasang 2017; Esping-Andersen 1990; Evertsson 2016; Evertsson, Grunow and Aisenbrey 2016; Gangl and Ziefle 2009; Pfau-Effinger 2004).

In contrast, gender-specific effects of other institutional contexts, such as the educational or employment system, have received less attention among life course scholars. For Germany, one exception is the framework of Helga Krüger (1995, 2003) that links women's employment outcomes to the historical development of the German vocational training system. According to Krüger, the lower career prospects of women are a result of the low status of the school-based sector of the vocational training system, created to equip young women with educational qualifications before their transition into motherhood. School-based vocational training prevails in e.g. service- and health-related fields and is provided by both private and public institutions with varying content-related standards (Hall 2012). Thus, these programs stand in stark contrast to the strongly regulated and standardized 'dual' vocational training system, where learning takes place through apprenticeships in firms and vocational schools (Krüger 2003). However, these considerations have only limited empirical support (Hall 2012) and are not necessarily applicable to higher education graduates, particularly when addressing the consequences of horizontal sex segregation across countries. Taken together, the extent to which the education and employment system, including the occupational structure, shape career trajectories of men and women differently, still needs further theoretical and empirical scrutiny.

Therefore, to explore how institutions (re-)produce gender differences in educational and employment trajectories, this thesis reconciles the analysis of trajectories with a systematic consideration of institutions. When forming an occupational expectation or enrolling into a major, young men and women view possibilities and adjust their preferences according to constraints, which might arise from barriers set up by the *educational system* (Dombrowski 2015; Gottfredson and Lapan 1997; Penner 2008; Schoon and Polek 2011). They also draw on everyday stereotypes of occupations and opt for an alternative they sufficiently identify with (Holland 1973). Thus, the *labour market* and *occupational structure* also shape the extent to which young men and women consider a career in e.g. technics or health as a viable option (Penner 2008; Xie and Shauman 1997). Similarly, the institutional set-up of educational systems and labour markets, or the *linkage* between the two, is decisive for understanding early and mid-career trajectories (Brzinsky-Fay 2007; Di Stasio, Bol and Van de Werfhorst 2016). In addition, men's and women's employment opportunities are structured by the occupations they work in (Damelang , Schulz and Vicari 2015). The following section describes the institutions relevant for the thesis – the educational system, crucial features of the labour market, and the occupational structure – in more detail and relates these to gender.

2.2.2 The role of institutions within the thesis

Previous literature has predominantly described the set-up of *educational systems* in terms of stratification, standardization, and specificity, with the first concept referring to the degree of differentiation in the selection procedures within educational systems, and the second to the extent to which educational curricula follow nationwide standards (Allmendinger 1989; Allmendinger and Hinz 1997; Kerckhoff 2001). Specificity, or vocational orientation, in turn, captures the degree to which educational systems prepare school-leavers for specific occupations in the labour market, and equips them with occupation-specific credentials. These three dimensions are well-established determinants in research on educational attainment (Bol and van de Werfhorst 2013; McDaniel 2010; Scheeren, van de Werfhorst and Bol 2018) and labour market trajectories (Gangl, 2001; van de Werfhorst 2011). While a restricted number of studies also relate them to gender-specific occupational choices, their role in predicting this horizontal outcome is both theoretically and empirically less clear (Han 2015; Hillmert 2015; Mann, Legewie and DiPrete 2015). Instead, this thesis assesses how skills acquired in previous stages of the educational system link to subsequent educational decisions, and how perceptions of fields as male or female affect adolescents' occupational expectations. Specificity, in turn, is utilized to understand how and why educational decisions shape labour market outcomes.

In details, the institutional set-up of the educational-system and labour market, or the *linkage* between the two, shapes graduates' career patterns, or more precisely, their returns to education (DiPrete et al. 2017; van de Werfhorst 2011). Scholars have distinguished between weakly and strongly linked systems, arguing that countries differ not only in the type of skills provided by the education system, but also in the extent to which employers recognize educational degrees as signals of skills (Gangl 2001; Hannan, Smyth and McCoy 1999). Though originally developed mainly with respect to vocational training systems, this distinction has been applied to capture career trajectories among higher education graduates (Giesecke and Schindler 2008; Leuze 2007; Lindberg 2009). Thus, in weakly linked system, such as the UK, educational credentials have a lower signalling value among employers, which results in a higher importance of worker mobility during the early career phase. By contrast, in strongly linked, occupationalised systems, such as in Germany or the Netherlands, employers' reliance on qualifications ensures a smoother transition into the labour market (Di Stasio and van de Werfhorst 2016; Leuze 2010). Since the strong link between the educational system and the labour market systems is supported by other institutional features, such as exhaustive social security (Gangl 2004), occupational mobility throughout the career tends to be low in occupationalised systems (Hillmert 2011; Manzoni, Härkönen and Mayer 2014; Mayer, Grunow and Nitsche 2010).

However, the question whether these education-employment linkages contribute to the understanding of gender inequality in the labour market has only recently attracted further research (see e.g., Blossfeld et al. 2015; Reimer and Steinmetz 2009). Thus, their implications are both theoretically and empirically unclear. On the one hand, strong education-employment-linkages could exacerbate the implications of horizontal sex segregation on labour market returns, if e.g. graduates from engineering enter highly-remunerated positions in technics sector (Solga and Konietzka 2000; van de Werfhorst 2004). On the other hand, further institutions, such as the family, could moderate how education-employment linkages affect men's and women's returns to education, suggesting that vertical inequalities interfere with the allocation process (Busch 2013b; Reimer and Steinmetz 2009). Therefore, a key objective of this thesis is to explore education-employment linkages from the perspective of gender.

Employment trajectories, also after the initial labour market entry, are embedded in *occupations*. Occupations link tasks, skills, and training systems to individuals (Berger, Konietzka and Michailow 2001), and thereby support that the labour market supply, namely the employee, will match the demands of the employer (Dostal 2002; Hoffmann, Damelang and Schulz 2011; Kalleberg and Sorensen 1979). As a structuring feature of the labour market, occupations provide their incumbents with different opportunities and constraints, such as wages, status, working time arrangements, and degree of job-related self-determination (Beck,

Brater and Daheim 1980; Busch 2013a; Weeden and Grusky 2005). A broad string of research argues that these opportunities vary systematically between male- and female-dominated occupations. This indicates that occupations (re-)produce gender-based labour market inequalities on the individual level (Grönlund and Magnusson 2013; Kilbourne et al. 1994).

However, over the last decades, the occupational structure has changed profoundly. The service and public sectors have expanded, as work previously carried out in the private sphere, such as welfare or pre-school education, is now produced in the labour market. In contrast, the agricultural and production sector has diminished (Esping-Andersen 1990; Kleinert and Jacob 2013; Schmid 2001). The increased demand for occupations in which women predominantly work, coupled with the decline of male-dominated routine manual work (Black and Spitz-Oener 2010; Spitz-Oener 2006), influences the attractiveness of career paths. While some scholars view these changes in terms 'pink collar ghettos', arguing that female-dominated, low-remunerated jobs in, e.g. service, trap women (Chan 1999; Charles and Grusky 2004), others highlight that the relation between the sex composition of occupations and labour market returns is more complex and has changed over time (Brynin and Perales 2016; Busch 2017; Magnusson 2009; Magnusson 2013). The thesis addresses the occupational structure as a key institution in two ways. First, the occupational structure, and country-variations therein, provides a context for understanding cross-national differences in adolescents' occupational expectations. Second, the re-employment chances of men and women after job loss in Germany are viewed through the perspective of occupations.

In sum, this thesis focuses on *structural aspects of labour markets and occupations*, arguing that these shape both preference formation of young men and women and career trajectories in adulthood. The educational system and family are mainly, but not exclusively, considered through their interconnection to the labour market.

3 Theoretical explanations and empirical findings

The following chapter discusses previous research on the two objectives of the thesis. First, it describes the main theoretical explanations for young as to why men and women display different occupational aspirations and opt for different fields of study, reviews these with respect to empirical evidence, and outlines the research gaps (section 3.1). The second part (section 3.2) focuses on labour market processes and provides a background for the question why gender-specific occupational choices transform into inequality in the labour market. It presents prevailing explanations for the association between the horizontal sex segregation and labour market rewards, discusses previous findings, and specifies the puzzles that the thesis aims to address.

3.1 Gender differences in occupational expectations and fields of study choices

Given the slow desegregation of field of studies and the persistent earnings' inequality among men and women in the labour market, an increasing number of studies have sought to explain young men's and women's diverging occupational expectations and fields of study choices both in single country contexts and from a cross-nationally comparative perspective. The main emphasis has been on women's underrepresentation in STEM-fields (Wang, Eccles and Kenny 2013; Xie, Fang and Shauman 2015), though studies also scrutinize whether adolescent boys and girls prefer gender (a)typical occupations (Helbig and Leuze 2012; Polavieja and Platt 2014). It is worth noting that scholars often use the terms 'occupational aspirations' and 'occupational expectations' interchangeably. While aspirations refer to idealistic preferences, occupational expectations, also called realistic occupational aspirations, consider preferences adjusted to constraints (Gottfredson and Lapan 1996: 430; Morgan 2006: 1528). This thesis mainly refers to occupational expectation, unless findings explictly relate to aspirations.

The first section (3.1.1) discusses individual-level mechanisms and elaborates on research on single country contexts, with the majority of studies stemming from the US. The following section, in turn, approaches contextual explanations, and outlines the main findings of cross-nationally comparative studies (3.1.2).

3.1.1 Individual-level explanations

Forming an occupational interest is a longstanding process that begins in childhood and evolves in the interaction with significant others, such as parents, siblings, (pre-)school teachers, and peers. Boys and girls are faced with expectations of their social environment, which portrays specific behaviours, personality traits and activities as suitable for men and women (Helbig 2012b; Kohlberg 1966; Salikutluk and Heyne 2017). Even before entering elementary school children can define skills, school subjects, and occupations as male or female, although sex typing becomes more nuanced as children grow older (Ruble, Martin and Berenbaum 2006; Wolter, Kessels and Hannover 2011). This raises the question which single factors are decisive for gender-specific occupational and fields of study choices.

To this end, scholars have focused on prior achievements (Mann and DiPrete 2013; Riegle-Crumb et al. 2012; Wang, Eccles and Kenny 2013); self-assessed abilities (Correll 2001; Wang and Degol 2013); course taking patterns in the secondary educational system (Morgan, Gelbgiser and Weeden 2013), and life and career goals (Gabay-Egozi, Shavit and Yaish 2015; Lörz, Schindler and Walter 2011). In terms of fields of study choices, recent research has also introduced occupational interests as an explanatory mechanism (Legewie and DiPrete 2014; Nagy 2006; Ochsenfeld 2016). These factors have been embedded in partly competing explanatory frameworks, namely rational choice models, culturist explanations, and closely related life course theories, with explanatory models such as status characteristics theory or expectancy-value theory entail entailing elements of all (Eccles 1994). These perspectives provide different approaches to the question whether men's and women's occupational and fields of study choices are bound by constraints or rather guided by differing preferences (Ochsenfeld 2016; Polavieja and Platt 2014; Zafar 2013). It is important to note that classification of each empirical predictor into an explanatory framework is not clear-cut and varies across studies. The subsequent chapter presents these determinants mainly through the rational choice framework, while highlighting alternative interpretations. After discussing occupational interests, it outlines the research gap.

3.1.1.1 Rational choice framework

Proponents of rational choice theory argue that educational and occupational decisions are the result of a utility calculation. Girls and boys weigh *costs* and *benefits* associated with each alternative and estimate the *probability of succeeding*, then opting for the most suitable path (Breen and Goldthorpe 1997; Erikson and Jonsson 1996). Yet girls and boys differ in the utility they attribute to different options (Jonsson, 1999). In line with human capital theory (Becker 1993; Mincer and Polachek 1974), the expected *benefits* are linked to gender specific life-plans, with girls anticipating employment interruptions due to family-related care

responsibilities and boys their role as family providers. Hence, girls should opt for occupations that are associated with higher starting wages, but flatter earning developments, and family-friendly work arrangements. Boys, in turn, should prefer occupations with greater earnings accumulation over the employment biography (Polachek 1981). Empirical support for the model is limited. Recent research shows that gender differences in adolescents' work and life goals are small (Busch-Heizmann 2015), and studies tend to agree that anticipated returns explain at best a modest share of the sex segregation in fields of study choices (Lörz, Schindler and Walter 2011; Mann and DiPrete 2013; Morgan, Gelbgiser and Weeden 2013; Ochsenfeld 2016).

Yet, as several authors have pointed out, the benefits of an occupational choice do not only encompass pecuniary rewards, as men and women prefer occupations that they attach a high value to. This understanding of *non-monetary benefits* is in line with the expectancy value theory in that individuals opt for alternatives corresponding to short and long term goals (Eccles 1994; Eccles 2007). Previous research has established that women and men value different aspects of occupations (Gabay-Egozi, Shavit and Yaish 2015). While young women express a stronger preference for work requiring communication, social skills, and helping others (Busch-Heizmann 2015), boys attribute a higher task value to computers, mathematics, physical objects (Eccles 2007). Similarly, girls and boys differ in intrinsic and extrinsic motivation with girls displaying higher values in the former and boys in the latter (Busch-Heizmann 2015). The higher interest of women in social tasks partly contributes to the gender gap in occupational aspirations and major choices, but these non-monetary benefits cannot close it (Busch-Heizmann 2015; Lörz, Schindler and Walter 2011)

While the monetary costs of an occupational pathway or educational program do not differ between young men and women, *non-monetary costs* might steer women away from male-dominated fields (Jonsson 1999). Accordingly, women avoid entering e.g. an engineering or computing major, where they as a minority would obtain the status of a token. These non-monetary costs could arise for two reasons. First, as stated by cognitive social learning theory (Else-Quest, Hyde and Linn 2010), girls and boys internalize whether a particular skill or career path is considered appropriate for men and women by observing reactions from significant others. Since technics and science are perceived as male domains (Correll 2004; Cvencek, Meltzoff and Greenwald 2011), displaying an interest in these fields might collide with girls' gender identity and call into question their femininity (Eccles 2007; Kessels et al. 2014; Seymour 1995). Second, adolescent girls might take the labour market into account and anticipate future discrimination in male-dominated occupations (Xie and Shauman 1997).

So far, empirical assessments of these arguments have been scarce and mainly limited to analyses on specific universities or study fields. Based on an analysis of two

universities in the US, Seymour (1995) documents that female students in engineering majors experience hostility or discouragement from peers and faculty members. In a study on engineering students in four high-prestige universities in the US, Cech et al. (2011) show that women develop lower levels of professional role confidence than their male counterparts; the latter being related to women's attrition from engineering majors. In contrast, the findings of (Ochsenfeld 2016), which are based on large-scale representative sample of first year university students in Germany, show that neither gendered expectations from friends and family, nor fear of labour market discrimination among women contribute substantially to the horizontal segregation of study fields. These contradicting conclusions raise the question, if non-monetary costs are evoked in specific contexts, such as heavily male-dominated domains, or if instruments applied in large-scale quantitative data sets are not sensitive enough to capture identity threats or anticipated discrimination.

When making an occupational decision, men and women evaluate their strengths and weaknesses in different domains to estimate the likelihood of succeeding in a given option (Mann and DiPrete 2016: 573). According to this line of reasoning, women refrain from scientific or technical fields, because their *expected probability of success* is lower than that of men. Given the importance of abilities in legitimizing inequality (Correll 2001), this argument has given rise to a broad string of research that evaluates gender differences in mathematical and scientific skills. It is, however, not easy to determine a male or female (dis)advantage in achievement, as results are sensitive to measurement and age groups (Ceci, Williams and Barnett 2009; Else-Quest, Hyde and Linn 2010; Wiseman et al. 2009). Nonetheless, gender differences in *average* mathematical competencies are negligible (Hyde et al. 2008; Lindberg et al. 2010), although there is some evidence of a slight male advantage in test scores (Mann and DiPrete 2013; Morgan, Gelbgiser and Weeden 2013; Penner 2008; Riegle-Crumb and King 2010). Men are overrepresented in the right tail distribution of mathematical performance, i.e. among *high-end math* performers (Ceci, Williams and Barnett 2009; Hyde et al. 2008; Penner 2008), but the gender gap in the extremes of mathematics has decreased over the past decades (Riegle-Crumb et al. 2012). Although math performance strongly predicts whether a student expects to work in a technical or scientific field or enrols into STEM-major (Mann and DiPrete 2013; Mann, Legewie and DiPrete 2015), studies arrive at the conclusion that women's underrepresentation in STEM-subjects is neither attributable to average nor to high-end math abilities (Mann and DiPrete 2013; Riegle-Crumb and King 2010; Riegle-Crumb et al. 2012).

Yet individuals do not only consider their absolute skills, but compare performance in one domain relative to another. In an influential study, Jonsson (1999) introduces the notion of *comparative advantages*, which captures such intra-individual evaluations across skill

domains. Accordingly, despite the decline in the male advantage in mathematics and science achievements, young women still outperform boys in reading (OECD 2014; Wang, Eccles and Kenny 2013). This gender difference in ability patterns accounts for a proportion of the gender gap in technical and scientific fields (Jonsson 1999; Wang et al. 2013); yet it does not close it. Given that similarly skilled men and women opt for gender typical fields, the results also suggest that men and women interpret their skills differently (Mann and DiPrete 2016).

Previous research has repeatedly documented that girls systematically undervalue their performance in mathematical and scientific domains, net of objective levels. The lower self-assessment among girls in mathematics can already be detected in elementary school (Wolter, Kessels and Hannover 2011) and persists throughout secondary education (Nagy et al. 2010; Watt 2006). Studies assert that these biases in self-assessment emanate from cultural stereotypes of male and female abilities, i.e. from gender beliefs, which expect men to be more talented in mathematical domains and women in verbal. Thus, a broad string of research documents that the belief in a natural male superiority, i.e. the so called stereotype threats (Penner 2008), affects girls' perceptions of their abilities negatively and discourages them from pursuing a degree in science (Correll 2004; Lörz, Schindler and Walter 2011).

3.1.1.2 Educational biography and occupational interests

The *course work pattern* of girls and boys in the secondary system highlights that gender differences already prevail in early stages of the educational trajectory (Gabay-Egozi, Shavit and Yaish 2015). Although girls' and boys' course taking pattern in the upper secondary school has converged over time (Mann and DiPrete 2013), boys still specialize more frequently in mathematics and natural sciences, while girls opt for languages. The specialization in the secondary system is therefore often described as the first step towards gender-specific fields of study choices (Nagy et al. 2008; Schnabel and Gruehn 2000). Course-taking pattern predicts women's lower enrolment rates in STEM (Lörz, Schindler and Walter 2011; Morgan, Gelbgiser and Weeden 2013), but is not alone sufficient to explain gender differences.

When analysing field of study choices in higher education, sociological research increasingly points to *occupational interests or plans* as explanatory drivers. However, despite promising results, both the theoretical framing and empirical operationalization of this concept has been problematic. For instance, Morgan, Gelbgiser and Weeden (2013) show that gender differences in occupational plans, defined as the expected occupation at the age of 30, account for a substantial proportion of the male-favourable gender gap in STEM-majors; a finding supported by Legewie and DiPrete (2014). The implications of this concept remain vague, because the results raise the question whether the intent to work as e.g. an engineer constitute

a theoretically independent dimension, or is the outcome of the same processes that evoke gender specific major choices. Similarly, Barone (2011: 162) argues that gender segregation of majors is related to a division in care and technics; a distinction that bears a strong resemblance to *non-monetary rewards* discussed earlier (Eccles 2007). While informative, this division underplays that occupational interests might differ in terms of further dimensions.

In contrast, educational psychology has both conceptually and empirically addressed the occupational dimension of fields of study choices, with Holland's theory of vocational choice (1973, 1985) representing a prominent framework. This perspective posits that young men and women seek to match their personalities and interests with corresponding fields of study. Compared to the strong focus on social interest in prior research, the framework of Holland provides a detailed understanding of interest profiles, captured by the so-called RIASEC-model (Realistic, Investigative, Artistic, Social, Economic, and Conservative interests). One advantage is that realistic, i.e. technical and practical interests, are distinguished from e.g. analytical or enterprising ones, and explored as combinations of interests, i.e. interest profiles (Holland 1973; Nagy 2006; Su, Rounds and Armstrong 2009). So far, only a few empirical studies have brought together the vocational decision model by Holland with prevailing sociological explanations (Law 2018; Nagy et al. 2006; Ochsenfeld 2016). While showing its potential for exploring horizontal sex segregation, these studies do not sufficiently relate it to the educational biography, or utilize data appropriate for the empirical assessment. Thus, it is not clear how the 'vocational interests framework' predicts gender differences in fields of study choices, when systematically incorporating further, frequently discussed explanations.

3.1.2 Cross-nationally comparative research

When explaining how gender-specific fields of study choices emerge, individual-level studies often embed each predictor into a broader context to conclude that societal gender roles affect e.g. interests and thereby predispose men and women. Yet authors remain vague about the exact sociocultural factors that evoke these gender differences (see e.g., Barone 2011; Ochsenfeld 2016; Riegle-Crumb et al. 2012). To elaborate on how the broader environment affects young men and women, international comparisons are useful (Penner 2008: 140). On the one hand, gender differences in adolescents' occupational expectations and field of study choices are more pronounced in some countries than in others (Barone 2011; Hillmert 2015; McDaniel 2016; Sikora and Pokropek 2012). On the other hand, prominent explanations for the diverging occupational choices, such as the gender gap in performance or self-concepts, display substantial cross-national variation (Charles et al. 2014; Else-Quest, Hyde and Linn 2010; Penner 2008). The next section summarizes the main theoretical explanations at the

country level. It is worth noting that the majority of these studies focus on gender differences in performance-related outcomes, such as math-literacy or -anxiety, but a growing body of research applies this contextual understanding to occupational expectations and fields of study choices.

3.1.2.1 Gender stratification hypothesis

According to the gender stratification hypothesis, gender disparities in performance or occupational choices are attributable to the status of women and the level of gender inequality in a given country (Else-Quest, Hyde and Linn 2010; McDaniel 2016). In societies, where women lack opportunities, girls do not relate their performance to future labour market prospects, and are as a consequence discouraged from investing in their skills (Baker and Jones 1993). When assessing the hypothesis, studies have raised the question which dimensions of gender stratification evoke differences between young men and women, and whether the hypothesis holds true in relation to different educational outcomes. Generally, empirical evidence supports the stratification hypothesis, particularly with respect to gender-differences in performance (see e.g., Baker and Jones 1993; McDaniel 2010; Penner 2008; Wiseman et al. 2009). For instance, Else-Quest, Hyde and Linn (2010) establish a negative association between boys' advantage in math and the participation of women in the educational system, the share of women in research, and the gender empowerment of a country (i.e. the GEM index).[3] In terms of occupational expectations, gender equality in the public sphere seems to diminish the male advantage in expecting to work in a scientific or technical occupational at the age of 15 (McDaniel 2016). However, McDaniel's (2016) results reveal that gender equality – measured through an index of women's participation in the education system, in the labour market, and in legislation – negatively influences the STEM-expectation among boys, instead of increasing career expectations in science and technology among girls. Though narrowing the male-favourable expectation gap, gender equality does not moderate young men and women's career expectations in the way the theory predicts; an inconsistency the author only briefly elaborates on (McDaniel 2016).

Previous studies also point out that the ameliorating effect of gender equality on the male advantage in performance is not transferable into all performance-related outcomes and does not hold true across all dimensions of gender stratification. In fact, gender equity is related to greater gaps in math self-concepts and anxiety, with girls displaying lower self-concepts in mathematics and higher math anxiety in more gender equal societies (Else-Quest,

[3] The GEM-index is a composite index encompassing female participation in parliamentary, legislative, managerial and professional activities as well as gender income inequality (Else-Quest, Hyde and Linn, 2010)

Hyde and Linn 2010). Furthermore, McDaniel (2016) shows that gender egalitarian values in terms of work and family responsibilities increase the male-favourable gender gap in adolescents' STEM expectations. Hence, in countries, where an egalitarian division of paid and unpaid work between men and women prevail, adolescent boys seem to be more interested in pursuing a career in a STEM occupation compared to girls (McDaniel 2016).

These inconsistencies in empirical results do not necessarily call into question the assumption of the gender stratification hypothesis. However, they encourage researchers to elaborate on the specific conditions under which societal gender inequality affect adolescents' aspirations and abilities. This also suggests that scholars should consider more carefully how indicators of social stratification capture theoretically different aspects of a society's gender-specific opportunity structure, as specific dimensions of equality may play out differently at the individual level.

3.1.2.2 Gender essentialism

The resilience of gender essentialist-beliefs serves as a possibility to reflect why different dimensions of gender stratification lead to contradicting findings (Charles and Bradley 2002; Charles and Bradley 2009; McDaniel 2016). In a heavily cited paper, Charles and Bradley (2009) set out to explain why gender differences in fields of study choices are larger in economically developed countries. They posit that affluent, post-materialist societies refute discrimination based on sex, but simultaneously foster a belief that men and women are different by nature (Charles and Bradley, 2009). As individualism and self-expression are important values in these post-materialist societies, young men and women tend to regard occupational choices as a mean of self-realization and expression of their gender-specific identities. Taken together, young men and women in affluent countries paradoxically are more likely to prefer 'gender typical' study fields and occupations, as men and women are perceived as "equal but different" (Charles 2017; Charles and Bradley 2009; Charles et al. 2014). The analyses of Charles and Bradley (2009), which assess the female composition in fields of study across 44 countries, show that gender differences in advanced economies are mainly driven by girls' affinity for math and the post-industrial restructuring of the economy (Charles and Bradley 2009). A high math affinity among girls at the country level increases female participation in engineering, math and science majors, while reducing it in humanities, social sciences and health. Furthermore, post-industrialism has a positive effect on women's representation in health related majors, while asserting a negative impact on all other fields (Charles and Bradley 2009). The authors regard these findings as support for gender-essentialist believes as an explanatory point of reference.

This argument has given rise to further studies assessing gender essentialist-beliefs in a cross-nationally comparative setting (see e.g., Buchmann, DiPrete and McDaniel 2008; Mann and DiPrete 2016; Sikora and Pokropek 2012). These studies show that societal affluence and post-materialist values (Charles 2017; Charles et al. 2014) and egalitarian attitudes towards the division of paid and unpaid work (McDaniel 2016) strengthen gender differences in occupational expectations, field of study choices, and math self-assessment. In particular, the relationship between societal affluence and gender differences in aspirations seems to persist, also when empirical studies utilize longitudinal trend data and account for alternative explanations, such as women's labour market participation and gender stereotyped associations of STEM occupations (Charles 2017). Yet empirical studies have also challenged the 'gender essentialist' framework. For instance, Mann and DiPrete (2016) suggest that gender stereotypes about math and science as a male domain, rather than societal affluence and gender essentialist believes, explain girls' underrepresentation in science and in technical fields. Thus, when empirical models adjust for performance indicators, gender-egalitarian values are associated with a *smaller* male advantage in STEM aspirations (Mann and DiPrete 2016), contradicting the assumption of Charles and Bradley (2009).

Taken together, the gender-essentialist-framework provides a compelling explanation for the paradox relation between gender equality and horizontal sex segregation. In particular, it highlights why certain dimension of modernization, such as gender egalitarian values, enhance gender differences in field of study choices, while others reduce the gender gap in math performance. Yet a fundamental challenge of the framework is to define gender essentialism, identify indicators capturing it, and to measure mediating mechanisms at the organisational- and individual-level. For instance, while societal affluence is assessed by means of the human development index (HDI) or the Gross Domestic Product (GDP), these indicators do not directly account for gender specific belief systems, essential to the argument (see also McDaniel 2016). Closely related, when criticising the gender-essentialist-framework, Mann and DiPrete (2016) treat gender stereotypes in math as an alternative explanation. Yet their argument raises the question whether math-related believes are an inherent part of gender essentialism, or an independent dimension.

3.1.2.3 Educational and training systems

Institutional features of educational and training systems as well as the school context affect how differences between young men and women play out across countries. In an analysis of early career outcomes among vocational education graduates (VET), Smyth and Steinmetz (2015) lend some support to this argument: in countries with larger vocational training systems men are more likely to work in male-dominated occupations. Correspondingly, Hillmert

(2015) concludes that vocational systems increase the extent of sex segregation in 15-year-old boys' and girls' vocational aspirations. The effects are more pronounced among those who expect to work in mid-level occupations and are thereby likely to be affected by the vocational training systems. Nonetheless, as the author notes, educational characteristics only account for a small proportion of country variation (Hillmert 2015: 142). Additionally, further studies have demonstrated that adolescent boys and girls display a lower interest in life sciences in countries with highly standardised educational systems (Han 2015), whereas the degree of tracking is negatively related to adolescent girls' and boys' STEM-expectations (Mann and DiPrete 2016). Yet the mechanisms driving relation between standardization or tracking and adolescents' aspirations remain unclear. Overall, the findings cast doubts on how useful concepts such as differentiation, standardization, and specificity are for understanding sex segregation in occupational expectations and fields of study choices, particularly in highly qualified fields.

In fact, there are arguments that could explain gender differences. These 'standard' educational dimensions could impact boys' and girls' occupational decisions through creating variation in the performance environment. For instance, countries differ in how they sort students into school programs according to their ability level (tracking). This implies that similarly abled students can be located in low- and high performing environments (Mann, Legewie and DiPrete 2015). In fact, when scrutinizing how math and science proficiency affects adolescents' interest in science and technics, Mann, Legewie and DiPrete (2015) detect that the performance level of schools has a positive effect on STEM occupational expectations in countries, where tracking takes place before the age of 16. In contrast, high performing schools in countries without tracking are associated with lower career expectations in science and technic. This suggests that educational systems moderate how students compare themselves to peers and to which extent math and science skills are perceived as an indicator for being suitable for a career in STEM (Mann, Legewie and DiPrete 2015). Similarly, countries with a high math and science performance could also set higher standards and encourage more competition. This, in turn, sensitises girls to their own performance (Mann and DiPrete 2016). Hence, gender stereotypes about math and science as male domains are evoked in countries with a high overall performance in math and science, causing girls to steer away from technical and science fields.

3.1.3 Research gap

Though previous research on *individual-level predictors* in single country contexts has presented several compelling explanations for the persistent gender differences in occupational choices, three concerns remain. First, a lion's share of the observed gross

differences in men and women's diverging occupational choices remains unexplained. For instance, the covariates incorporated by Mann and DiPrete (2013) account for approximately 57 percent of the gender gap in STEM-fields for the US, while a similar approach for Germany yields 58 percent (Lörz, Schindler and Walter 2011). A further challenge emerges from the strong focus on young women's lower interest in STEM-fields. Scholars note that not all fields within STEM are equally segregated, with e.g. biology in many countries representing a field increasingly populated by women. Yet these considerations are seldom taken into consideration in the empirical design. Some studies analyse technics and science separately, or distinguish medicine as a field attracting women who specialise in natural sciences (Morgan et al. 2013); yet differences within the broad category of 'non-STEM subjects' are underexplored. This raises the question whether fields differ with regard to their explanatory mechanisms (Zafar, 2013). Third, the explanatory power of the vocational choices framework (Holland 1973), stemming from vocational psychology, has not been exhaustively tested with respect to concepts frequently utilised in sociological research (see e.g., Law 2018; Ochsenfeld 2016; Nagy 2006). Thus, it is far from clear how vocational interests align with gender differences in course work pattern, self-assessments, or career plans. To address this concern, the thesis systematically assesses different individual-level explanations, and utilizes a more differentiated conceptualization of fields of study choices.

Several puzzles also remain with regard to *structural explanations*. Compared to the vast literature on cross-national variation in performance-related outcomes, the number of studies assessing men and women's diverging occupational choices across countries is still limited (Charles 2017; Mann and DiPrete 2016; Mann, Legewie and DiPrete 2015; McDaniel 2016). Yet career expectations among adolescents are particularly suited to address the partly contradicting patterns detected by previous research. In fact, young girls' interest in a career in technology and science could be a stronger reflection of a country's opportunity structure than the gender gap in math performance. So far, studies have seldom scrutinised how different dimensions of the opportunity structure shape young men's and women's interests. For instance, the frequently used GEM-index measures gender inequality in society overall, but it is not clear which dimensions are decisive. As Mann and DiPrete (2013:1536) conclude, women have gained access to prestigious career paths outside the STEM-fields, such as in business or law, which require high work commitment and yield high wages. However, these alternative career paths and their importance for adolescents' occupational expectations have seldom been modelled empirically.

Closely related, the post-industrial restructuring of the labour market has been shown to increase gender differences in men's and women's fields of study choices; often captured as the share of the labour force working as employees and in the service sector (Charles and Bradley 2009). This emphasis on service sector, however, conflates differences

across low-, medium-, and high-skilled occupations and professions, which might have disparate effects on the horizontal sex segregation in preferences. Furthermore, while scholars have focused on environments affecting young women's preferences, incentives for young men are less explored. To this end, the thesis combines an extended rational choice framework with socialization-based explanations. This framework provides conceptual tools for viewing occupational expectations as individual choices, which are structured by the context. At the same time, it brings together several aspects of previous literature, such as labour market rewards or gender role-models, into one framework.

3.2 Horizontal sex segregation and gender differences in the labour market

To understand how the horizontal sex segregation of the educational system transforms into vertical gender inequality in the labour market, career patterns of higher education graduates have been of substantive interest to scholars. Gender differences in labour market outcomes are visible already when these tertiary-educated workers enter the labour market. Compared to their male counterparts, highly skilled women are more likely to face unemployment (Fabian et al. 2013), enter lower status positions (Reimer and Steinmetz 2009), and receive temporary contracts (Giesecke and Schindler 2008). Correspondingly, women earn less than men already in the first years after graduation (Leuze and Strauß 2009; Leuze and Strauß 2014; Roksa 2005), and this wage gap seems to widen in the course of employment (Braakmann 2013).

It is well established that women's greater responsibility for family life (Hook 2010) has negative implications for their career trajectories (England 2005; Madero-Cabib and Fasang 2016), as the transition into parenthood fabricates a gender typical division of paid and unpaid work (Dechant, Rost and Schulz 2014; Nitsche and Grunow 2016). However, scholars have raised the question whether prevailing explanations for gender inequality in the labour market overall, are equally important when assessing highly qualified women's lower labour market returns (Drasch 2013; Leuze and Strauß 2014). The next section (3.2.1) begins with a prominent explanation for women's lower labour market remunerations, namely the human capital theory. After elaborating on the explanatory power of this framework for predicting disadvantages of highly educated women, it summarises research on the sex composition of fields of study and occupations (3.2.2) and outlines the research gap (3.2.3).

3.2.1 Human capital theory

The frequently utilised human capital theory regards gender differences in labour market remunerations an outcome of women's lower investment in productivity (Baum 2002; Evertsson and Grunow 2012: 562-63; Mincer and Polachek 1974: 83). Thus, individuals accumulate human capital to maximise lifetime earnings, mainly through investing in education, labour market experience and on-the-job training, which result in an enhanced productivity and thereby wage growth (Becker 1993). Periods out of employment, however, reduce the productivity, since previously acquired skills may deteriorate or suffer from value loss, and workers pass up the possibility to gain more experience. Given the discontinuities characterizing women's employment patterns, their stock of human capital differs from that of men. This is assumed to account for their lower earnings (Mincer and Polachek 1974: 80-81). However, the human capital model has been subject to broad criticism. For instance, wage penalties stemming from work interruptions do not necessarily originate from human capital depreciation. Instead employers might perceive career interruptions as negative signals of work commitment (Evertsson 2016; Evertsson, Grunow and Aisenbrey 2016).

Furthermore, the predictive power of human capital in terms of gender differences might differ across educational groups. The greater earnings power of tertiary-educated worker overall indicate that highly qualified women face greater opportunity costs in terms of wage losses, when interrupting work due to child rearing (Evertsson et al. 2009: 212). Thus, compared to lower educated women, female higher education graduates display higher labour market participation rates after child birth, interrupt employment for a shorter period of time (Drasch 2013; Grunow, Aisenbrey and Evertsson 2011), and engage in full-time employment more often (Konietzka and Kreyenfeld 2010). However, in spite of their stronger labour market attachment, empirical research corroborates the importance family-related factors also for highly qualified workers. Thus, highly qualified women's more frequent career interruptions (Braakmann 2013; Grönlund and Magnusson 2016; Napari 2008) and their stronger responsibilities for young children relative to men (Ochsenfeld 2012; Ochsenfeld 2017) contribute to the gender wage gap in this group. Yet the fact that women earn less than men already in early career years, when most graduates do not have family obligations, suggests that further mechanisms are at stake (Leuze and Strauß 2009; Leuze and Strauß 2014).

Against this backdrop, an increasing number of studies have pointed to qualitative differences in human capital between men and women and referred to gender-specific fields of study choices as an explanatory point of reference (Polachek 1981). Overall, previous research has consistently documented that fields of study are an important layer for understanding differences in labour market outcomes among graduates. Economics,

engineering, natural sciences, and medicine generate the greatest returns and humanistic fields the smallest (Kim, Tamborini and Sakamoto 2015; van de Werfhorst 2002; van de Werfhorst 2004). In terms of the gender wage gap, gender-specific major choices account for 25 percent in the first years after labour market entry among full-time employees in the U.S (Bobbitt-Zeher 2007), whereas the same figure for full time workers five years after graduation is 19 percent in Germany (Leuze and Strauß 2014). Since fields of study choices in the educational system are linked to career paths in specific occupations in the labour market (DiPrete et al. 2017; Klein 2011), it is unsurprising that the occupational sex segregation contributes to the gender wage gap also among highly qualified workers (Leuze and Strauß 2016; Shauman 2006).

Yet the well-established relation between horizontal sex segregation of the educational system and labour market and gender inequalities raises several further questions. First, it is far from clear *why* fields of study and occupation dominated by women yield lower labour market remunerations than those men predominantly opt for. Second, the extent to which horizontal segregation translates into vertical outcomes might depend on *contextual factors*. This suggests that fields of study choices could affect gender inequalities differently across institutional contexts. Third and closely related, the influence of the sex composition might vary across *different labour market outcomes*.

3.2.2 Characteristics of fields of study and occupations

A substantial body of literature has raised the question whether the share of women in a major or an occupation *per se* causes labour market disadvantages, or whether other characteristics systematically vary with the sex composition of majors and occupations. These other characteristics, in turn, are assumed to affect labour market rewards. Explanations have mainly evolved within the two frameworks. The *devaluation theory* relates the sex composition directly to wages, whereas *sorting-based mechanisms* tend to view the lower remunerations of female-dominated fields as consequences of gender-specific preferences (Murphy and Oesch 2016; Ochsenfeld 2014). A substantial corpus of literature also discusses mechanisms located in the labour market, such as crowing (Bergmann 1974; Grönlund and Magnusson 2013) or occupation-specific working time arrangements (Busch 2013a; Leuze and Strauß 2016). Overall, the explanatory power of these frameworks has mainly been assessed with respect to wages. The following section briefly describes the devaluation theory, and the main criticism against it, and then elaborates on three alternative explanations: the specificity of skills, the linkage between educational fields and occupation, and occupational closure by means of educational credentials. While representing different theoretical perspectives, these three concepts enable the thesis to scrutinise the interrelation between skills, labour market

rewards, and gender. When presenting and comparing results across studies, it is worth noting that research on the horizontal sex segregation of the higher education system on the one hand, and research on the effect of occupations on the labour market on the other, focus different populations. Occupational research often scrutinises effects in the labour market overall and thereby includes mid- and low-skilled workers.

3.2.2.1 The devaluation hypothesis

A prominent explanation for the lower remunerations of fields of study and occupation predominantly preferred by women is the *evaluative discrimination of female work*, i.e. the *devaluation hypothesis* (Kilbourne et al. 1994). This framework argues that tasks and jobs traditionally considered female are subject to cultural devaluation due to their close proximity to unpaid, reproductive tasks in the private sphere (see e.g., Charles and Grusky 2004; England et al. 1994; Liebeskind 2004). Stereotypes about female work requiring little skills and no qualifications are then transferred to fields of study and occupations that women predominantly opt for. This depreciation results in lower labour market remunerations (Cohen and Huffman 2003). A crucial tenet of the argument is that devaluation is analytically independent of other characteristics of the fields of study or occupation, and concerns both male and female graduates and occupational incumbents (England et al., 1994). A further implication of the devaluation hypothesis is that wage penalties successively increase with the share of women in an occupation (Grönlund and Magnusson 2013).

A broad range of studies lend support to the negative association between labour market remunerations, mainly wages, and the share of women in jobs, majors or occupations across country contexts such as the US, Germany, and Sweden (Achatz, Gartner and Glück 2005; Bobbitt-Zeher 2007; Cohen and Huffman 2003; Kilbourne et al. 1994); a finding often interpreted in favour of the devaluation hypothesis. Yet, as several scholars have pointed out, empirical assessments are often flawed in their design (see e.g. Grönlund and Magnusson 2013; Shauman 2006). First, a fundamental problem arises from the insufficient consideration of confounding mechanisms at the level of majors or occupations (Gerber and Cheung 2008; Ochsenfeld 2014; Tam 1997). Studies assessing these rivalling explanations arrive at contradictory conclusions. While some identify a robust, statistically significant sex composition coefficient, net of occupational or fields of study controls (see e.g., Grönlund and Magnusson 2013; Murphy and Oesch 2016; Perales 2013), others refute that the share of women drives the effect (Leuze and Strauß 2016; Ochsenfeld 2014; Tam 1997). For instance, based on fixed-effects estimations Busch (2013a) shows that female-typical tasks, such as caring or accommodating, mediate the negative effect of female-dominated occupations on wages in the German labour market. Because estimates adjust for a substantial set of

individual- and occupation-level covariates, the author concludes that female-typed tasks suffer from qualitative devaluation. Leuze and Strauß (2016), in turn, find limited support for this conclusion, when restricting the focus to female-typed tasks among highly qualified workers in Germany. Thus, despite advances in empirical estimation strategies, evidence is still inconclusive.

A further challenge is the changing association between occupational sex segregation and earnings over time. The post-industrial restructuring of the labour market has resulted in an increasing demand for high-skilled work, profiting particularly women (Black and Spitz-Oener 2010; Spitz-Oener 2006), while a slow decline in the overall occupational sex segregation has taken place (Brynin and Perales 2016; Hausmann and Kleinert 2014). Brynin and Perales (2016) do not detect wage penalties for female-dominated high-skilled occupations in the UK, and relate this finding to the changing nature of the labour market. Similarly, the association between the sex composition of occupations and wages seem to have decreased over time in the US (Busch 2017). Apart from these temporal changes, studies exploring the functional form of the association between an occupation's sex composition and wage level document a non-linear effect (Brynin and Perales 2016). For instance, Murphy and Oesch (2016: 1239) establish for Germany, Switzerland, and the UK that wage penalties are pronounced after a "tipping point", identified as at least 60 percent women in an occupation, whereas differences between integrated and male-dominated occupations are negligible. Similarly, results for Sweden highlight that occupations with a balanced sex composition yield the highest wages (Magnusson 2013). Finally, empirical evidence suggests that the sex composition of majors and occupations affects men and women differently, though the extent to which men or women face stronger penalties from female-dominated occupations or majors seem to vary across studies (Busch 2017; Leuze and Strauß 2014; Murphy and Oesch 2016; Perales 2013).

3.2.2.2 Gender differences in skills and specialization

Turning to the rivalling mechanisms, the causality asserted by the devaluation hypothesis is called into question, if men and women *self-select* into differently rewarded fields of study and occupations. When scrutinizing how such selection processes produce gender differences in wages, scholars have referred mainly to two theories: gender role socialization and the specialised human capital. These two perspectives share the assumption that women value non-pecuniary aspects of educational programmes and working life, which yield lower labour market rewards (Ochsenfeld 2014; Shauman 2006).

First, the higher remunerations of male-dominated fields could stem from breadwinner roles assumed by men (Hakim 2002; Ochsenfeld 2016). Gender role socialisation

encourages men to opt for marketable skills, whereas women's choices are guided by a stronger preference for cultural or social aspects of fields. These aspects, however, face an unfavourable relation between supply-demand on the labour market (Hakim 2002; Ochsenfeld 2014). Though explicit empirical assessments of this argument at the level of majors or occupations are less frequent, van de Werfhorst (2002) demonstrates that fields differ in the extent to which they equip graduates with economic, technical, cultural, and communicative resources. The findings of Ochsenfeld (2014) suggest that the career orientation of students, measured as an adherence to the male-breadwinner ideology at level of majors, vary systematically between male- and female dominated fields of study. This, in turn, explains the lower remunerations associated with a higher share of women in a given field.

Second, differentials in returns between male and female-dominated fields could emanate from gender-specific skill investments. This line of argument is most explicitly formulated by the *specialised human capital hypothesis* (Becker 1993), which in addition to the quantity of investment also distinguishes between qualitative dimensions. Scholars tend to separate general, firm- and occupation-specific skills, though acknowledging that all skill investments comprise both specific and general elements (Estevez-Abe, Iversen and Soskice 2001; Tam 1997). According to this framework, firm-specific skills entail the highest investments costs both among employers and employees, as these skills only increase productivity in the firm, in which they were acquired. To compensate for the risks, and to minimise turnover, employers reward skill-investments with higher wages (Becker 1993; Polavieja 2008). Occupation-specific skills are transferable across jobs, but can only be fully recouped in the specific occupation. In contrast, general skills are associated with low investment cost, as they are tied neither to specific occupations nor to firms. Given that their supply is assumed to be higher, they yield lower remunerations.

The specialised human capital hypothesis attests that men and women rationally acquire different combinations of general and specific training (Polachek 1981). To maximise earnings, men are inclined to invest in firm- and occupation specific skills. Women, in turn, anticipate discontinuous employment biographies due to childbearing and prefer general skills and correspondingly, work in generalist occupations. The high portability of general skills enables women to change employer and occupation more flexibly, and reduce earnings losses after employment interruptions (Becker 1993; Polachek 1981: 64). On the individual-level, this suggests that women's lower labour market remunerations originate from gender differences in the type of human capital. Similarly, the negative association between labour market remunerations and female-dominated fields of study or occupations could be driven by differences in specialization. However, it is worth noting that gender differences in skills do not necessarily originate from self-selection, as assumed by the specialised human capital framework. Employers might refrain from providing women access to specific skills, as

women cannot recoup the investments in case of family-related employment interruptions (Estévez-Abe 2005). Thus, women's lower investments in specific skills would not emerge from self-selection, but rather from employer discrimination.

Finally, while drawing on a different theoretical background, school-to-work literature has also elaborated on returns to different types of skills (Noelke, Gebel and Kogan 2012). Thus, scholars frequently distinguish between general and occupation-specific fields, conceptualizing occupation-specific skills as strong pathways or linkages between fields of study and occupations (DiPrete et al. 2017; Noelke, Gebel and Kogan 2012; Roksa 2005; Shauman 2006). This suggests that fields of study, also in tertiary education, differ in their vocational orientation and the extent to which they link graduates to specific occupations and careers in the labour market. The higher labour market remunerations of specific fields are then a consequence of their clear skill profiles, which reduce insecurity and training costs among employers (Klein 2011; Spence 1973). However, it is worth noting that this corpus seldom discusses field-specific remunerations as a result of self-selection.

Empirical evidence confirms that specific skills are positively associated with returns (Grönlund and Magnusson 2013; Perales 2013; Shauman 2006). For instance, in a heavily quoted study, Tam (1997) finds that occupations requiring specific skills yield higher wages than those based on general skills. Similarly, graduating from a field with strong linkages to specific occupations is beneficial with respect to occupational status (Noelke, Gebel and Kogan 2012; Roksa and Levey 2010), and professional and managerial employment (Roksa 2005). Specificity also seems to vary by the sex composition of majors and occupations, with studies predominantly documenting lower degrees of job-specialization and occupation-specific skills as well as lower participation in job training in female-dominated occupations (Grönlund 2012; Grönlund and Magnusson 2013; Perales 2013) and fields of study (Ochsenfeld, 2014). Yet, when exploring different aspects of job-specialization, Perales (2013) detects a positive association between the participation in further education at the occupational-level and the share of women. Finally, it is contested whether specialization explains the lower remunerations of female-dominated fields and the gender wage gap. For instance, Polavieja (2008) identifies job-specialization as a crucial explanation for the lower wages in female-dominated occupations in Spain; a finding supported by studies on Sweden (Grönlund and Magnusson 2013) and the U.S. (Tam 1997). Other studies, in turn, cannot confirm this relation (see e.g., Murphy and Oesch 2016; Perales 2013).

3.2.2.3 Occupational closure

The higher labour market rewards associated with specific skills can also be an outcome of *occupational closur*e. According to this long-standing framework, occupations act as groups

to monopolise their position in labour market, and thereby establish a favourable relation between supply and demand (Hinz and Abraham 2008; Weeden 2002). To secure rents, and counteract competition in the labour market, occupations protect skills and tasks from other occupations and establish boundaries between insiders and outsiders. This enables group members to increase returns in relation to non-members, as occupational closure raises overall wage level of an occupation and thereby benefits the individual worker (see e.g., Beck, Brater and Daheim 1980; Bol and Weeden 2015; Haupt 2012; Tilly 1998). To this end, occupations utilise five different strategies, namely educational credentialing, certifications, licensing, voluntary associations and unionizing (Weeden 2002). For the thesis, only education-related strategies are important.

Educational credentialing imposes legal or technical barriers for outsiders to work in an occupation. By requiring that incumbents possess diplomas, occupational groups exercise control over the types of skills that are needed. If access to educational programs is limited, this strategy allows occupational groups to affect the relation between supply and demand (Bol and Weeden 2015). Furthermore, to exclude others from performing similar tasks in the labour market, state granted licenses are required (Weeden 2002: 62). Empirical research confirms that educational credentialing and licensing have a significant, positive effect on wages in the United States (Weeden 2002). For Germany, particularly educational credentialing has been proven a successful strategy both in terms of wages and non-monetary outcomes (Bol and Weeden 2015; Haupt 2012; Menze 2017). However, it remains unclear, whether occupational closure differs systematically between male and female-dominated occupations and constitutes a fruitful framework for understanding women's lower remunerations. While Krüger (1996; 2003), whose argument was presented in the previous chapter, characterizes male-dominated occupations as being more closed, these arguments have seldom been elaborated on empirically.

3.2.3 Research gap

The substantial corpus of literature addressing the consequences of horizontal sex segregation for gender inequality provides mixed evidence. As such, this is not surprising, since previous studies analyse different country contexts and time periods, focus on different groups of men and women, and utilise varying measures for confounding mechanisms at the level of majors or occupations. Nonetheless, findings are inconclusive as to the association between the sex composition of majors and occupation and labour market remunerations. In particular, the circumstances, under which women's occupational choices are detrimental with respect to later career trajectories, are still far from clear.

In addition to the ongoing debate on explanations for this association, two further aspects call for scrutiny. First, only a restricted number of studies explicitly address differences in the implications of horizontal sex segregation across countries (see e.g., Murphy and Oesch 2016; Reimer and Steinmetz 2009; Smyth 2005). Given the broad and long-standing line of research on cross-national variation in labour market outcomes and the importance of institutions for understanding it (Allmendinger 1989; Buchholz et al. 2009; Hall and Soskice 2001), the existence of such a void is surprising. For instance, the explanatory power of men's and women's differing fields of study choices for the gender wage gap has been documented in several country contexts such as the U.S (Bobbitt-Zeher 2007; Shauman 2006), Germany (Braakmann 2013; Leuze and Strauß 2009; Ochsenfeld 2014), the Netherlands (Kalmijn and Lippe 1997), and Finland (Napari 2008). However, it is far from clear whether fields of study choices translate into earnings disparities similarly across countries. Because institutions play a key role in structuring career paths, this thesis raises the question whether the consequences of horizontal sex segregation among higher education graduates is context-dependent.

Second, the strong focus on wages, has neglected the question, whether the sex composition of occupations structure other labour market outcomes. So far, studies on the German labour market have shown that women working in female-dominated occupations display longer parental leave durations (Bächmann and Gatermann 2017; Ziefle 2009) and are more likely to obtain work for which they are overqualified in their early career stages in West Germany (Trappe, 2006). Furthermore, gender differences in unemployment durations seem to be related to the sex composition of the occupation held prior to unemployment in East Germany shortly after the German re-unification (Falk 2005). Thus, to contribute to the understanding as to why the sex composition of occupations affect labour market remunerations, this thesis explores the effects of several occupational characteristics on the transition from unemployment into re-employment in Germany.

4 Data and operationalization

4.1 Empirical design, data sets and sample selection

The objectives of this thesis – to understand how gender differences in educational choices emerge and transform into gender inequality in the labour market – places high requirements on the empirical design. As described in the introduction, each empirical sub-study focuses on a different stage in the individual life course, ranging from occupational expectations in adolescence to both monetary and non-monetary returns in the labour market. Thus, the choice of outcome, key predictors, data sets, and modelling strategies need to accommodate the specific stage in the life course. Table 4.1 provides an overview of the empirical design, and presents the research questions, the operationalisation of both the dependent and main independent variables, sample selection, as well the chosen method. More detailed information are provided in the empirical chapters (Chapter 7 – Chapter 10).

The following section briefly describes the chosen individual-level data sets and elaborates on their advantages compared to other data sources. To answer the key questions of the thesis, data needs to comprise both sufficient sample sizes and detailed information on the trajectory at hand. To this end, each sub-study draws on a different data set particularly suitable for the research question. In Germany, several large-scale longitudinal surveys including the German Socio Economic Panel Study (GSOEP), the National Educational Panel Study (NEPS), or the German school leaver survey, collect microdata on educational and employment trajectories over a longer period of time. Yet, as will be shown below, these studies differ in emphasis and cannot alone provide detailed accounts on how gender differences emerge in each stage of the life course.

Table 4.1 Overview of empirical design

	Sub-study I	Sub-study II	Sub-study III	Sub-study IV
Research question	Does the structure of labour markets affect the gender gap in STEM occupational expectations?	Why do men and women opt for different fields of study in Germany?	Does the effect of subject choices on the gender wage gap differ across Germany and Finland? Can the gender wage gap during the first ten years after graduation be attributed to education-employment linkages in these countries?	Does the occupation held prior to unemployment influence the transition back to work? Is the share of women the decisive factor for shaping gender differences in re-employment or are differences driven by other, associated occupational characteristics?
Dependent variable	The effect of being male on expressing a STEM occupational expectation at age 30 (in AMEs)	Realised field of study choice in tertiary education divided into five categories (engineering, natural sciences, medicine, business and law, humanities and social- and behavioural sciences)	Logarithm of hourly wage	Re-entry into employment with at least 15 paid working hours per week after job loss
Main predictors	Number of researchers (full time equivalent) per 1000 inhabitants engaged in Research and Development (R&D); size of service sector; share of women working in a managerial occupation relative to all employed women aged 15 to 64 years; share of women who	Course work pattern in upper-secondary school; vocational interests (RIASEC); expected benefits (importance of career and family); fear of discrimination in male- or female-dominated occupation; grades; self-assessed strengths and weaknesses	Share of women per field of study; field-specific education employment linkages ('local linkage score')	Sex composition of occupation held prior to unemployment (male-dominated, integrated, female-dominated); annual unemployment rate; heterogeneity of degrees in an occupation ('the dispersion index'); proportion of

	graduated in a STEM field in higher education			employees in the industrial sector per occupation.
Data set, type of analysis (time frame)	Program for International Student Assessment (PISA) merged with country-level indicators from OECD, ILO, Eurostat Cross-sectional (2015)	German School Leaver Survey Cross-sectional (2010)	German Socio-Economic Panel Study merged with the German Microcensus; Finnish Longitudinal Employer-Employee Data merged with the Structure of Earnings Data Longitudinal (1993-2016)	National Educational Panel Study starting cohort 6 merged with Microcensus and Sample of Integrated Labour Market Biographies (SIAB) Longitudinal (1996-2010)
Sample	15-years old girls and boys with an explicit occupational expectation in 35 OECD and European countries	Secondary system school-leavers with a higher education entrance qualification, who either were already enrolled into higher education or had firm plans to do so six months after graduation.	Graduates from a tertiary education institution, aged 23-35 when graduating (excluding BA-graduates from universities of applied sciences in Finland).	Workers aged 20-54, when entering unemployment. Sample excludes labour market entrants and unemployment spells preceded by short employment episodes. The transition from employment into unemployment has to be immediate.
Method	Two-step estimation, feasible generalised least squares (FGLS) estimator	Multi-nominal logistic regression models (AMEs), Fairlie decomposition	Linear three-level random-coefficient regression	Cox proportional-hazards regression

4.1.1 Programme for International Student Assessment

Analyses of the occupational expectations among adolescents in 35 well-established OECD and European countries are carried out with data from the Programme for International Student Assessment (PISA) 2015, which entails information on more than 540,000 15-year-old pupils from 35 OECD countries and 37 partner countries and economies (OECD 2017). The PISA study takes place every three years and collects cross-nationally comparable data on key competencies, i.e. reading, science, and math literacy, but the study also asks students to report a broad set of individual, household, and school characteristics, such as self-assessments in specific skill domains or socio-economic information on the family background (OECD 2009).

The PISA survey utilises a two-stage stratified sampling strategy. First, schools are selected by means of criteria such as school size, programme, or region, with some countries over- and under-sampling certain school types (OECD 2009). In a second step, a student or class sample is drawn from each school; yet the probability of a student being selected differs across schools and countries. To account for the sampling design, estimates are weighed with the final student weight, as provided by PISA. Following recommendations by PISA (OECD, 2009), all weights are normalised at the country-level, ensuring that the sum of the weights within each country equals the number of observations of the respective country samples. Finally, compared to a random sampling strategy, the two-stage design by PISA, which samples students after selecting schools, increases the uncertainty associated with population estimates. Therefore, the computation of the sampling variance is accounted for by using 80 Fay's replicate weights (OECD, 2009).

In addition to detailed information on performance and self-assessment, the PISA study asked adolescents about their occupational expectations at the age of 30. The analyses in sub-study I consider adolescents who express an occupational expectation and exclude those who did not provide an answer, or were uncertain; a decision that resembles the strategy of McDaniel (2015). So far, the question about adolescents' occupational expectations has been included in the PISA rounds 2003, 2006, and 2015. While the main analyses are based on the 2015 data, data from 2006 data is utilized for robustness checks. Further country-level indicators are based on data from e.g. the OECD and Eurostat. Thus, by merging the PISA 2015 data with an extensive set of country-level indicators, the analyses explore whether the institutional environment shapes gender differences in adolescents' occupational expectations.

4.1.2 The German School Leaver Survey

To test mechanisms driving gender differences in the *field of study choices* in Germany, the second sub-study (II) draws on the school leaver survey 2010 (Studienberechtigtenpanel 2010); a representative sample of German upper secondary graduates, who obtained a higher education entrance qualification in 2010 (Lörz, Quast and Woisch 2012). This longitudinal study is collected through a mail survey by the German Centre for Research on Higher Education and Science Studies (DZHW). In December 2009, six months prior to graduation, 29,500 high school students were surveyed for the first time, and asked to report e.g. educational histories, work-and life goals, and occupational interests (*first wave*). Approximately two-thirds (22,885) of these respondents provided valid addresses and were asked to participate in the second survey in December 2010, ca. six months after leaving the secondary school system. This second wave gathered 8,636 responses, which indicates a response rate of 37.7 %. To adjust for the selection into participation, the data set provides weights based on official statistics adjusting for sex, type of school, type of higher education entrance qualification, and federal state (Lörz, Quast and Woisch 2012: 8-9). To analyse fields of study choices in the transition into higher education, the sample is restricted to respondents who either were already enrolled into higher education (46%) or had firm plans to do so (26%).

Compared to the GSOEP or the NEPS starting cohort 5, which have been utilised to analyse gender-specific occupational interests or fields of study choices in Germany, the school leaver survey has many advantages. For instance, compared to the relatively small sample sizes of adolescents in the GSOEP (see e.g., Busch-Heizmann 2015), the 5,332 school leavers participating throughout the first and the second wave enable analyses to explore field-specific patterns for one graduation cohort in detail. Furthermore, given that life-goals, self-concepts, and vocational interests are surveyed prior to enrolment into the tertiary system, the longitudinal design of the school leaver survey eliminated biases resulting from a recollection error. This feature distinguishes it from the NEPS starting cohort 5, which samples first year students, and as a consequence cannot consider adjustments of e.g. work-life goals that might occur after the transition into higher education (see e.g., Ochsenfeld 2016).

4.1.3 The German Socio Economic Panel Study and the Finnish Longitudinal Employer-Employee Data

The subsequent sub-study (III) tracks the *gender wage gap in hourly earnings among tertiary-educated men and women during the first ten years after graduation in Germany and Finland*, and draws on two longitudinal data sets. The educational and labour market trajectories of German higher education graduates are based on the German Socio-Economic Panel Study (GSOEP); a representative study of private households, which since 1984 is collected by the

German Institute for Economic Research (DIW). The GSOEP supplies detailed, high-quality annual data on earnings, educational attainment, and characteristics of current employment, as well as monthly records of labour market participation for approximately 30,000 individuals in 14,00 households (Gerstorf and Schupp 2016; Wagner, Frick and Schupp 2007). For Finland, the analyses use rich register-based data from Statistics Finland. Information on educational, employment, and family histories are based on the Finnish Longitudinal Employer-Employee Data (FLEED); a randomly drawn 1/3 sample of individuals aged 15-70 who lived in Finland at least one year between 1988-2014. Because the FLEED-data only includes measures of annual labour earning, which also capture gender differences in working time, it is merged with the Structure of Earnings data. This latter data set is a subsample of the FLEED-data and contains detailed accounts on working time, hourly and monthly wages, overtime compensation, and bonuses for the time frame 1995-2014. It is worth noting that the Structure of Earnings data is constructed through a combination of data sources: it includes information collected by employer organisations from their members as well as data from Statistics Finland's wage and salary inquiries (OSF 2018). The data covers all public sector employees, whereas the coverage of private sector workers reaches approximately 80 %, after weighing the data. The structure of earnings data also excludes firms with less than six employees and self-employed individuals, as well as those whose employment contract began or ended in the month of data inquiry. Nonetheless, in terms of earnings, the information is comparable with hourly wages estimated with the GSOEP.

For both countries, the analyses observe tertiary-educated workers' employment trajectories during the first ten years after entering the labour market. To ensure a sufficient number of observations for Germany, the analyses consider individuals graduating in the time frame 1992-2010, following their wage trajectories for the first ten years or until 2016. The Finnish analyses are conducted on highly qualified men and women graduating in the years 1994-2008, with the last observation occurring in 2014. Over this time period, which is required to yield a sufficiently large sample for Germany, the composition of graduates changes. Chapter 9 discusses the implications of these changes in composition with respect to modelling strategy.

Nonetheless, this longitudinal design is a clear advantage compared to earlier research on gender inequalities among highly qualified men and women. The vast majority of cross-nationally comparative studies, even when focusing on two countries, have utilised cross-sectional data, such as the Labour Force Survey (Giesecke and Schindler 2008; Machin and Puhani 2003) or REFLEX (Steinmetz and Reimer; Triventi; Prix 2013), whereas past research on Germany has drawn on the DZHW Graduate Panel. The latter collects information on higher education graduates approximately one, five, and ten years after graduation, but most empirical assessments focus on one of these time points (see e.g., Brandt 2016; Leuze

and Strauß 2016; Ochsenfeld 2014). Yet analyses of the gender wage gap on single-time-point data cannot equally capture women's family and job histories (Gangl and Ziefle 2009) and are sensitive to women's selection into employment (Brandt 2016).

4.1.4 The National Educational Panel Study

To address gender differences in a non-monetary labour market outcome, namely *the re-entry into the labour market after job loss*, sub-study IV utilises data from NEPS starting cohort 6 (adults). Starting in 2009/2010, the data comprises information on approximately 17,100 individuals representative for the German birth cohorts 1944-1986 collected by means of a computer assisted telephone interview (CATI). Each wave of the NEPS collects both panel and retrospective information on a wide range of life-course areas, capturing e.g. schooling, vocational training, employment, unemployment and child histories (Allmendinger, et al., 2011). The transition from unemployment into employment, analysed in sub-study IV, is based on retrospective data, whose quality is ensured through two main features. First, life histories in the NEPS are collected by means of a modularised design. This means that respondents are asked to report all spells of specific life domains, such as all employment or unemployment episodes, as opposed to giving information on events and transitions along a time line. This design encourages respondents not only to give information on major life events, but enhances the recollection of shorter episodes, crucial in the analysis of unemployment trajectories (Drasch et al. 2016: 337). Second, the NEPS data revision module assesses the consistency and completion of the individual life course. To this end, the interviewer prompts the respondent to edit implausible parallel spells or include information in longer gaps (Allmendinger et al. 2011: 296; Ruland et al. 2016: 372-373). Taken together, these feature should reduce the bias caused by recollection errors in reporting retrospective information (Blossfeld, Golsch and Rohwer 2007: 19-20).

The monthly recording of detailed employment and unemployment spells in the NEPS data has several advantages compared to e.g. the GSOEP, which has previously been utilised in analyses of unemployment trajectories (see e.g., Gangl 2004). First, life-course data covers a longer period of time without suffering from panel attrition (Blossfeld, Golsch and Rohwer 2007). Furthermore, detailed information on job characteristics, such as position or occupation, is available for each spell on a monthly level, and not annually at the time of the interview, as in the GSOEP (Manzoni 2012). Thus, the analyses are based on individuals, who have graduated from the educational system and entered significant employment. The individuals were also employed at least six months prior to job loss

4.2 Operationalization of key concepts

The aim of this thesis is two-fold in that it explores mechanisms driving men's and women's diverging occupational expectations and fields of study choices, as well as the consequences of these decisions on later labour market outcomes. Conceptually this means that the horizontal sex segregation is both the *explanandum* and the *explanans* of the study. The following chapter elaborates on the operationalization of the horizontal sex segregation as a *dependent* (sub-study I and II) and *independent variable* (sub-study III and VI). It also presents a new measurement, developed by DiPrete et al. (2017), for capturing pathways between fields of study and occupations, which are assumed to vary systematically between female- and male-dominated fields. All further discussions on definitions or variables relevant for each sub-study can be found in the empirical chapters.

4.2.1 Horizontal sex segregation as an outcome

Previous studies have predominantly analysed explanations for women's lower interest in a career in science and technics or lower enrolment rate into STEM-majors (see e.g., Lörz, Schindler and Walter 2011; McDaniel 2016). This approach does not differentiate natural sciences from technics, and also understates differences within the broad group of non-STEM fields. Sub-study I and II address these concerns. First, given that the male advantage in engineering and technics fields has been particularly resistant to change (England and Li 2006), sub-study I examines the gender gap in adolescents STEM occupational expectations. Thus, the answers to the question "What kind of job do you expect to have when you are about 30 years old?" were coded by the PISA-study into the International Standard Classification of Occupations 2008 (ISCO08) on a 4-digit level. STEM is defined as an expectation to work in an occupation in the ISCO 08 sub-major groups 21 "Physical, mathematical and engineering science professionals", and 25 "Information and Communications Technology Professionals", which comprise technology and engineering as well as the math-intense natural sciences mathematics, statistics, physics, and chemistry.

Sub-study II, in turn, focuses on gender differences in five broader fields of study categories, namely engineering, natural sciences, medicine, business and law, as well as humanities, behavioural and social sciences. This categorization takes into consideration that the horizontal sex segregation of higher education is related to a division in care and technics (Barone, 2011). As argued by Barone (2011: 162), subjects differ in their closeness to care and interactional work in the labour market, and conversely, also technics and science majors display different degrees of technicality. Yet, as opposed to the science-technics-divide, the five different fields utilised in sub-study II bare a strong resemblance to the actual major groups that young men and women chose between, while being more detailed than in previous

research (Gabay-Egozi, Shavit and Yaish 2015). Focusing on five groups also ensures sufficiently large sample sizes for a detailed analysis of mechanisms in each field.

4.2.2 Horizontal sex segregation as a predictor

Earlier research has repeatedly reported on challenges in measuring the association between the sex composition of fields of study or occupations and labour market remunerations. These challenges arise by and large from two sources, namely classification schemes and the number of observations in single categories. First, measures of segregation are affected by the level of detail, in which fields of study or occupations are captured. Accordingly, aggregate categories such as 'engineering and technics' often conflate within group differences and tend to report lower levels of segregation (Machin and Puhani 2003; Smyth 2005; Steinmetz 2012). Drawing on broader groups also hampers cross-national comparisons of segregation, because differences in patterns could merely reflect variation in the composition of categories (Charles and Grusky 2004: 32; Steinmetz 2012: 62). Thus, when analysing how fields of study choices impact graduates' wages, sub-study III draws on the detailed ISCED 2013 classification of fields. This classification is adjusted and harmonised to available categories in the FLEED, GSOEP, and German Microcensus, resulting in approximately 40 different fields across graduate cohorts.

A further challenge for the analysis of *occupational sex segregation* arises from the occupational classification system itself. Classification schemes developed in the 1960s and 1980s, such as the International Standard Classification of Occupations 1968 or 1988 (ISCO68, ISCO88) or the German Classification of Occupations 1975 or 1988 (KldB75, KldB88), reflect the structure of the economy at the time and depict occupations in the industrial or production sector in greater detail than e.g. service or administration (Matthes, Burkert and Biersack 2008). These differences in detail are gender related, since schemes consolidate occupations in which women predominantly work into larger unities and fail to capture new occupations, which emerged in the shift towards a service sector economy. Thus, standard occupational classifications do not depict women's labour market participation, which coincides with the growth of the service sector, in sufficient detail (Steinmetz 2012: 67-68). Sub-study IV addresses these concerns by using a modified version of the German Classification of Occupations 1988, which combines occupations with strongly similar skills, tasks, and licenses into broader categories (Hausmann, Zucco and Kleinert 2015). Based on a procedure developed by Matthes, Burkert and Biersack (2008), this classification scheme utilises a 'matrix of similarity' to identify combinations of such occupations, that incumbents can switch between without substantial amounts of additional training. (Hausmann, Zucco and

Kleinert 2015: 10-11). Thus, from the original 334 occupations, this classification identifies 254 different occupations.

A common approach to measure characteristics of fields of study or occupations, such as their sex composition, is to aggregate individual-level information by means of classification schemes. To generate reliable estimates, single fields of study or occupation needs to entail a sufficient number of observations. Yet previous literature has insufficiently elaborated on the trade-off between utilizing detailed categories and creating characteristics based on a larger number of observations. Accordingly, the smallest number of observations required for each category varies substantially across studies and ranges from 20 (see e.g. Busch 2013b; Ochsenfeld 2014; Shauman 2006) to 75 (DiPrete et al. 2017). Given the smaller sample sizes of the individual-level data sets for Germany, i.e. the GSOEP and NEPS starting cohort 6, this thesis utilises two further data sources, namely the German Microcensus, a representative 1 per cent sample of the German population, and the register-based Sample of Integrated Labor Market Biographies (SIAB). These high quality data sets ensure that occupations can be captured in detail based on sufficient sample sizes. Each category entails at least 30 observations.

4.2.3 The specificity of skills and educational credentialing

A central challenge in exploring whether women predominantly opt for fields of study or occupations requiring general, rather than specific skills is to define specialization and identify indicators capturing it. This difficulty has not only puzzled scholars testing the specialised human capital hypothesis (Polavieja 2008; Shauman 2006; Tam 1997), but remained a challenge in the literature on school-to-work transitions (see e.g. Giesecke and Schindler 2008; Noelke, Gebel and Kogan 2012; Reimer, Noelke and Kucel 2008; van de Werfhorst 2002). In spite of similarities, these streams seldom compare operationalization of specificity. In the following, this thesis elaborates on frequent operationalisations of occupation and firm-specific skills, as well as education-employment linkages, and presents a new measure for capturing occupation-specific pathways (DiPrete et al. 2017), used in sub-studies III.

4.2.3.1 Occupation- and firm-specific skills

A crucial tenet of the specialised human capital hypothesis is that investment costs of specific training are higher; yet these costs cannot be observed directly (Tam, 1997). Instead empirical assessments regard occupational skills or training opportunities as indicators of investment, although studies seldom include measures of both firm- and occupation-specific specialization simultaneously. To determine differences between occupations in their degree of specificity, studies in the U.S. tend to draw on standard measures for occupational skill-specialisation, as

reported by the Dictionary of Occupational Titles (DOT). These measures are based on the required time spent in training, and take into consideration that vocational specialization can occur in both the educational system and on-the-job (Shauman 2006: 593; Tam 1997: 1664; Weeden 2002: 76). However, such standardised information is not available for several European countries, including Germany and Finland. Instead, a frequent approach has involved utilizing survey data on respondents' perception of required training and skills, either as aggregated characteristics of fields of study or occupations, or as individual-level predictors (Leuze and Strauß 2009; Menze 2017). For instance, in an analysis of German vocational training graduates (Menze 2017) draws on respondents' assessment of whether skills acquired in the vocational training system are useful in current employment, and distinguish between degree holders who remained and switched occupation. Accordingly, specialised training indicates that occupationally mobile individuals cannot utilise skills gained in training to the same extent as those who did not change occupation (Menze 2017). While these indicators capture perceptions of specific skills, as provided by educational programs, they neglect that the accumulation of occupation-specific skills continues in working life (Tomaskovic-Devey and Skaggs 2002) and can be acquired through informal training (Grönlund 2012).

To measure *firm-specific skills* or *on-the-job training*, studies frequently include the time respondents estimate that another person with the right qualification would need to learn respondents job well (see e.g. Grönlund, Halldén and Magnusson 2017: 104; Grönlund and Magnusson 2013: 1011; Polavieja 2008: 203). However, as scholars note, this measure does not explicitly distinguish between general and specific training (Grönlund and Magnusson 2013) or whether skills are acquired through investment in formal or non-formal training on the job. Moreover, to measure the degree of specialization in a given field of study, Ochsenfeld (2014) uses the share of graduates who participated in on-the-job training provided by the employer. While this feature certainly highlights differences between fields of study in the extent to which they provide access to firm-specific training in labour market, it conflates characteristics of educational programs with subsequent opportunities in the labour market.

4.2.3.2 Occupational specificity as pathways

A further approach to capture specificity has involved the match or linkages between educational programs and specific occupations (see e.g, Leuze and Strauß 2009; Roksa, 2005). Thus, instead of defining specificity in terms of acquired skills or amount of training, studies have examined so-called routes between college majors and specific occupations in the labour market. For instance, Shauman (2006: 592-593) argues that a major-occupation pathway is significant, when at least 15 % of college-educated occupational incumbents have obtained a degree from a particular field. Other studies, define majors as specific when 75 % of graduates

work in occupations related to their fields (Roksa 2005; Roksa and Levey 2010), or in a matching occupation (Leuze and Strauß, 2009). Although informative about the degree to which certain vocational programs or fields of study link to specific positions in the labour market, the proposed definitions of horizontal matches or required thresholds seem arbitrary. Moreover, these measures do not take distributional differences of graduates across occupations and fields of study into consideration.

Thus, to analyse whether the sex composition of majors systematically vary with the degree of specificity in a given major, the sub-study III focuses on field-specific education-employment linkages. It draws on the a new entropy-based measure, the local linkage score, developed by DiPrete et al. (2017). Compared to the researcher-based definitions of field-specific matches or critical thresholds for specificity, this continuous measure approximates the extent to which graduates from a given field of study cluster in a broader or narrower set of occupations. As noted in equation (1), the local linkage score reflects the gain in predicting a workers' occupation, if educational qualifications are known, compared to the unconditional prediction. It estimates how the distribution of tertiary degree holders from a specific field across occupations differs from the overall distribution of workers across occupations (DiPrete et al. 2017: 1920).

$$M(ed)_g = \sum_j p_{j|g} \times \log\left(\frac{p_{j|g}}{p_j}\right) \qquad (1)$$

In this sense, it allows the analysis to scrutinise the extent to which career opportunities are bound to specific occupations. While the local linkage score does not measure skills as such, it can be assumed that tightly coupled fields, e.g. medicine, also provide occupation-specific knowledge in the training program.

5 Results

This chapter provides an overview of the research questions and main findings in each empirical study. The sub-studies I-IV are included as individual chapters in the second part of the thesis (Part B, Chapter 7 – Chapter 10)

5.1 Institutions and occupational expectations

One key objective of the study was to explore how features of the broader environment foster horizontal sex segregation. To this end, *sub-study I* raises the question why the male advantage in adolescents' interests to pursue a career in STEM occupations are larger in some countries than in others. By combining the extended rational choice framework with socialization-based approaches, the study focuses on the labour market as an institutional context. It argues that the labor market influences the gender gap in adolescents' STEM expectations by shaping benefits and costs attached to different options, and by embodying norms of masculinity and femininity. Empirically, the study links individual occupational expectations in 35 OECD and European countries, drawn from the PISA-2015 study, to macro-level indicators on the structure of the labour market. To sufficiently consider that the influence of individual-level predictors, such as parental background, math performance or enjoyment of science, differs across the countries (Heisig, Schaeffer and Giesecke 2017), the study utilises a two-step modelling strategy (Lewis and Linzer 2005).

First, boys display a higher interest in working in STEM occupations in all countries under study, but country variation is also substantial. Second, the first-step regression results show that the unadjusted male-favourable STEM-expectation gap decreases only moderately, when incorporating well-researched individual-level predictors, such as enjoyment of science or math literacy. However, the extent to which these predictors reduce gender differences also varies across countries.

Turning to country-level explanations, Figure 5.2 displays the regression results of the second-step, with the predicted gender gap in STEM career expectations plotted against the respective country-level predictors. It shows that the male favourable gender gap is larger countries, where the post-industrial restructuring of the labour market, measured by the size of the service sector and the share of women working in managerial occupations, is pronounced. The tertiarization of the labour market led to an increased demand for female-typical work and created opportunities for women both in low- and high-status positions. Yet rather than driving girls away from STEM occupations, supplementary analyses suggest that this restructuring seems to push boys into science and technology (see Chapter 7). This

indicates that boys are attracted to science and technology, i.e. male-typical fields, particularly if female-typical work is broadly available, both in low- and high-status positions. We also expected countries with greater opportunities in science and technology to fuel boys' interests in pursuing a career in STEM. Unexpectedly, such countries do not display larger gender expectation gaps. Finally, a higher representation of women in STEM fields does not reduce the gender expectation gap. Taken together, the results highlight that the labour markets matter, but the interrelations are more complex than theoretically assumed.

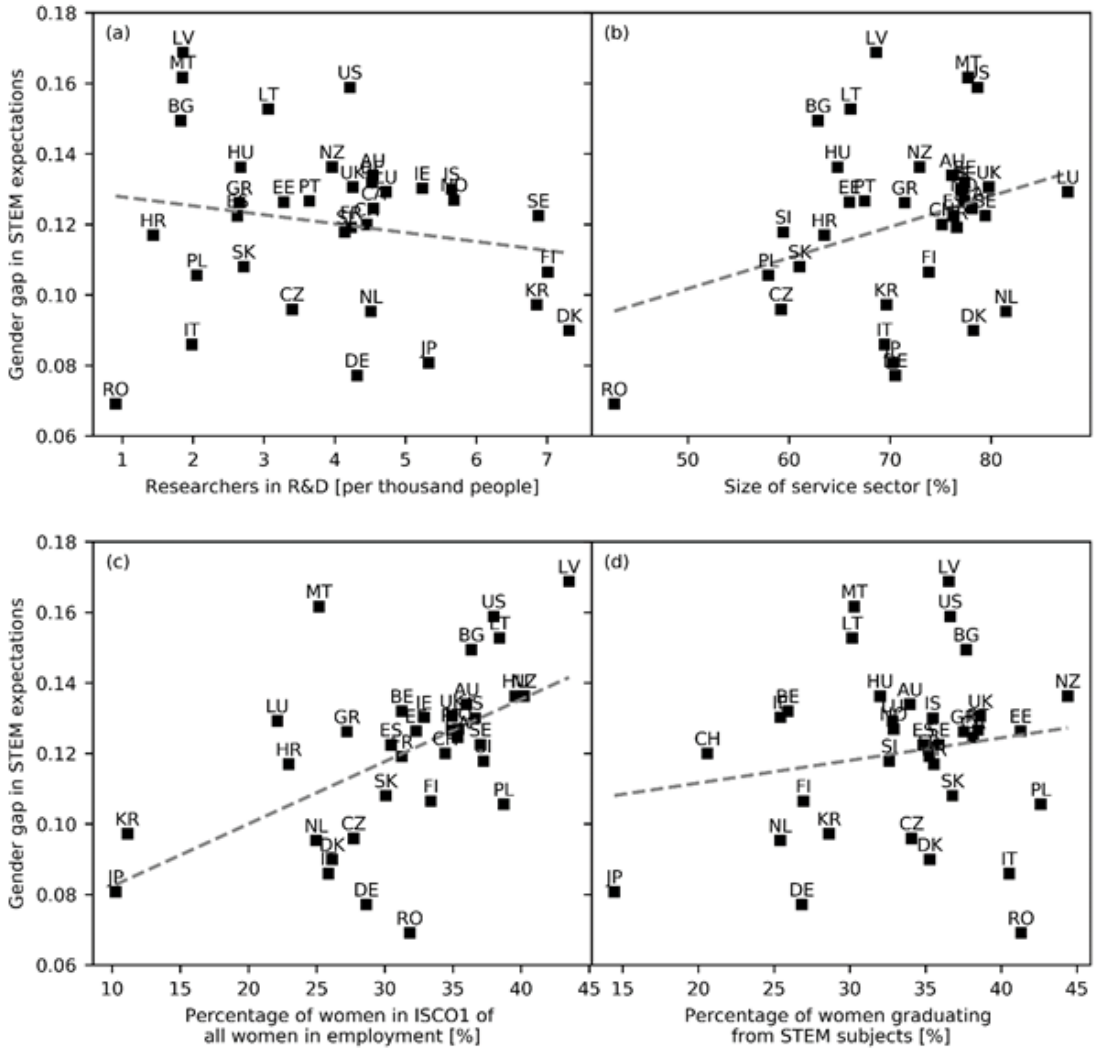

Figure 5.1 Predicted gender gap in STEM career expectations (full model)

Notes: The dependent variable expresses the effect of being male on STEM occupational expectation (in AMEs), adjusted for individual-level controls. On the country-level, the models control for the male-to-female employment rate, the overall country-level math and science performance, and sex differences in science self-efficacy.

5.2 Fields of study choices and individual-level determinants

To scrutinise individual-level explanations, *sub-study II* focuses on upper-secondary school graduates in Germany and aims to explain gender differences in enrolment into five different fields of study (engineering, natural sciences, business and law, medicine, and humanities as well as behavioural and social sciences). The analysis explores three partly competing perspectives: the previous educational biography, the rational choice framework, and finally, occupational interests (Holland 1973); a framework less frequently utilized in sociological research. Empirically, the study draws on the school leaver survey 2010 (DZHW) and employs multi-nominal regressions and Fairlie-decompositions (Fairlie 2005).

As Figure 5.2 (M1) highlights, the male overrepresentation is the largest in engineering and technical fields, and amounts to almost 34 percentage points, whereas women's overrepresentation is most pronounced in humanities, educational fields, and social sciences (28 percentage points).

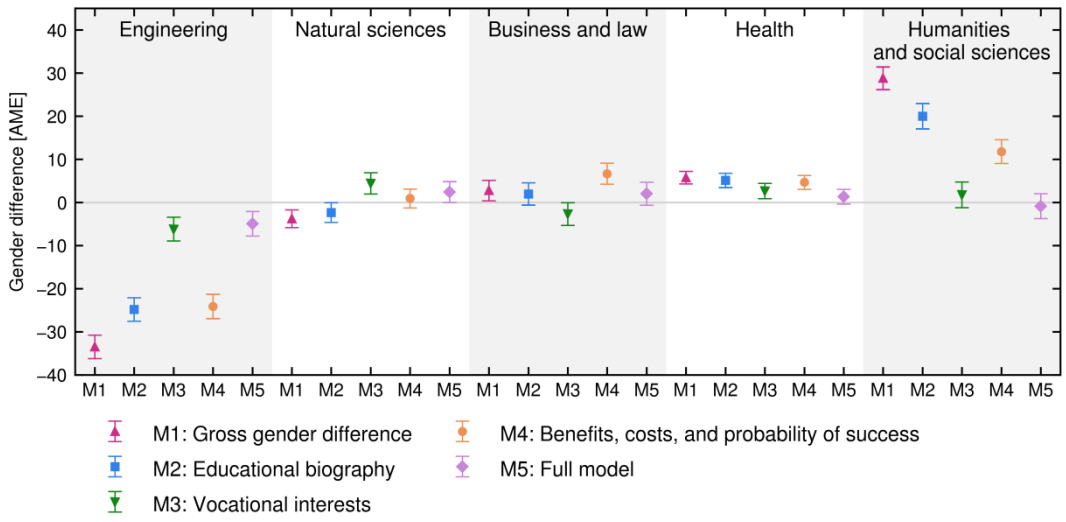

Figure 5.2 The effect of being female on fields of study choices in Germany

Notes: The female coefficient is based on multi-nominal regressions and expressed as AMEs (with 95% confidence intervals). The first model (M1) displays the gross gender difference, while the subsequent models (M2-M4) adjusts the female coefficient for covariates, relevant for each theoretical framework. The final model (M5) considers all explanations simultaneously.

In terms of explanations, cost- and benefit calculations play at best a minor role in understanding why men and women opt for different fields of study. Instead, specialization in the upper secondary system, self-assessed abilities, and most importantly, occupational interests account for a substantial proportion on of the gender gap in the five fields under study. For instance, the fact that women display lower realistic (technical) interests, i.e. express a lower preference for e.g. 'working with raw materials,' and value social and artistic

tasks higher, such as 'listening to problems of others' or 'formulate a sentence beautifully' contribute substantially to their underrepresentation in engineering and their overrepresentation in humanities and social sciences. Further analyses reveal that course work patterns, self-assessment, and occupational interests are interrelated. Thus, occupational interests reflect subject-specific specialization in the upper secondary system as well as self-assessments of skills. This suggests that boys and girls develop gender-specific skill- and interest profiles throughout the educational system (see Chapter 8).

Finally, the covariates are highly predictive of gender differences in fields of study choices, accounting for ca 88-100 % of the observed gender gap in each field (M5 in Figure 5.2). This explanatory power is substantially higher than that of previous studies (see e.g., Lörz, Schindler and Walter 2011; Mann and DiPrete 2013; Ochsenfeld 2016). Taken together, the results suggest that gender differences in field of study choices emerge as a long process, in which gender-specific course work patterns, self-assessment, and interests mutually reinforce each other.

5.3 The consequences fields of study choices

A further aim of the thesis was to analyse whether the lower remunerations associated with female-dominated fields are context-dependent. It is well-established that gender differences in fields of study choices explain the lower wages of highly qualified women relative to their male counterparts. Yet previous studies often neglect that fields of study influence wages in an institutional setting, which could have different implications for the gender wage gap across countries. Therefore, *sub-study III* raises the question whether and why the effect of subject choices on the gender wage gap among higher education graduates differs between Germany and Finland. Theoretically, it focuses on the set-up of the educational system and the labour market, or more precisely, the linkage between the two.

The study suggests two possible patterns: On the one hand, fields of study choices could influence the gender wage gap through a gender-neutral coupling between the educational system and the labour market, indicating that graduates enter corresponding positions in the labour market. On the other hand, country configurations of gender inequality could moderate this processes and thereby affect how men's and women's skill-investments are associated with wages. Thus, the latter pattern suggests that education-employment linkages have disparate effects on wages of men and women. Empirical analyses are based on two longitudinal data sets: the German Socio Economic Panel Study (GSOEP) and Finnish register data (Finnish Longitudinal Employer-Employee Data (FLEED), Structure of Earnings). To assess whether fields of study choices predict the gender wage gap over the first ten years after graduation in Finland and Germany, the study employs hierarchical linear

random-coefficient estimations, taking into consideration that wage observations are nested in individuals and fields of study (Rabe-Hesketh and Skrondal 2012).

Table 5.1 Random coefficient models for estimating the logarithm of the hourly wage in Germany and in Finland

	M0	M1	M2	M3	M4
Germany (N: 1800, n: 8148)					
Female (*Ref.* male)	-0.114***	-0.067***	-0.062**	-0.062**	-0.067**
	(0.017)	(0.020)	(0.021)	(0.021)	(0.021)
Share of Women in Field of Study (10%)			-0.015*	-0.018*	-0.031***
			(0.008)	(0.008)	(0.009)
Education-Employment Linkage				0.036+	0.065*
				(0.022)	(0.028)
Cross-level -interactions					
Share of Women in Field x Female					0.019*
					(0.010)
Local Education-Employment Linkage x Female					-0.037
					(0.025)
Constant	2.399***	2.329***	2.332***	2.33***	2.328***
	(0.061)	(0.066)	(0.065)	(0.064)	(0.064)
Individual, period, and sample controls	Yes	Yes	Yes	Yes	Yes
Finland (N: 47607, n: 309950)					
Female (*Ref.* male)	-0.093***	-0.053***	-0.053***	-0.056***	-0.053***
	(0.003)	(0.007)	(0.007)	(0.008)	(0.007)
Share of Women in Field of Study (10%)			-0.005	0.004	0.008*
			(0.003)	(0.003)	(0.004)
Education-Employment Linkage				0.06***	0.047***
				(0.01)	(0.011)
Cross-level -interactions					
Share of Women in Field x Female					-0.005
					(0.003)
Local Education-Employment Linkage x Female					0.026**
					(0.008)
Constant	3.022***	2.958***	2.96***	2.95***	2.95***
Individual and period controls	Yes	Yes	Yes	Yes	Yes

+ p < 0.10, * p<0.05, ** p<0.01, *** p<0.001, standard errors in parenthesis.

Notes: Restricted maximum likelihood estimation. Models control for labour market experience, firm size and public sector employment, family characteristics, age at graduation, type of degree, graduation cohort, year fixed effects. For Finland, the field-specific education employment linkage is interacted with year-dummies (reference year 2005).

Source: FLEED merged with Structure of Earnings, GSOEP (v33.1) merged with Microcensus.

First, the unadjusted gender wage gap in hourly wages during the first ten years after graduation is not substantially larger in Germany than in Finland (not shown); a country pattern that differs from studies utilizing monthly earnings (see e.g. Triventi 2013). Unsurprisingly, in Germany the share of women in a field of study is negatively associated with hourly wages, and accounts for a proportion of the gender wage gap (see Table 5.1). In Finland, the sex composition *per se* does not contribute to the gender wage gap. But most importantly, fields of study choices have disparate effects on the wages of men and women, indicating that the coupling between the educational system and labour market is not gender neutral. Instead in Germany, highly qualified women do not experience the same wage

advantages as men, when graduating from a male-dominated field. In Finland, in turn, particularly women seem to profit from fields with strong linkages to specific occupations. Taken together, the results show that the institutional set-up of the education system and the labour market is a fruitful framework for understanding how fields of study choices translate to earnings inequality, but it needs to be viewed from the perspective of gender.

5.4 Occupational sex segregation and the re-employment after job loss

To explore how occupational segregation affects gender inequality over the employment biography, the *sub-study IV* embarks on a non-monetary labour market reward, namely German men's and women's transition from unemployment into re-employment. It asks whether gender differences in unemployment trajectories can be explained by men and women working in different occupations prior to unemployment. In particular, it explores whether the sex composition of the pre-unemployment occupation is crucial for structuring unemployment trajectories, or whether other, associated occupational characteristics drive the effect. As main competing mechanisms at the occupational-level the analyses consider the occupation-specific unemployment rate, occupational closure, and the share of occupational incumbents working in the production sector. This framework is assessed by combining individual retrospective life histories of men and women aged 25-50, drawn from the German National Educational Panel Study (NEPS) with longitudinal panel data on occupations (SIAB, Mikrozensus).

The results of the Cox proportional-hazard models indicate that men display steeper re-entry rates into employment, also after accounting for prominent individual- and macro-level determinants (see Figure 5.3). However, this male advantage is reduced substantially, when the models incorporate the sex composition of the occupation held prior to unemployment. Working in a male-dominated occupation prior to unemployment influences the transition rate into employment positively, and accounts for gender differences in unemployment trajectories at the individual level. The competing mechanisms cannot fully explain why male-dominated occupations seem to be associated with higher re-employment rates. But most importantly, the analyses reveal that the effect of occupations is restricted to men's transitions into re-employment, while exerting little predictive power among women. Instead, individual-level predictors seem to structure German women's transition back to work.

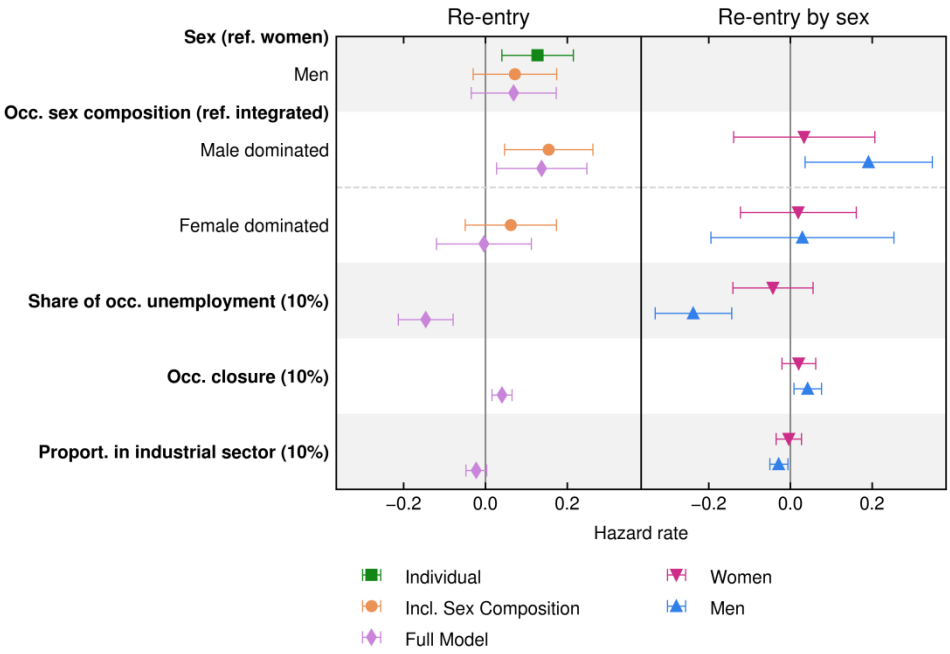

Figure 5.3 The effect of sex and occupational characteristics on re-employment after job loss

Notes: The estimates of the Cox proportional-hazard models are reported as coefficients (95% confidence intervals). The first model accounts for all individual- and macro-level characteristics (individual), whereas the subsequent models incorporate the sex composition of occupations. The final model includes further characteristics at the occupational-level (full model). The full model is estimated separately for men and women.
Individual-level controls include: age, pregnancy, age of youngest child in household, educational level, employment biography, ratio time in reference occupation, migrant background, receipt of unemployment benefit, East/West. On the macro-level, models control for change in GDP and unemployment rate. The share of academics per occupation is included as an occupational control.

6 Discussion

6.1 Horizontal sex segregation and supply-side mechanisms

One objective of the thesis was to provide a more detailed account of how individual- and country-level processes shape gender differences in occupational and fields of study choices. To this end, the following chapter discusses and summarizes the findings of sub-study I and II.

First, the analyses revealed that gender differences in young men's and women's occupational expectations and fields of study choices can partly be attributed to key characteristics, such as, self-assessment, course work pattern, or enjoyment of science. At the same time, the explanatory power of these characteristics seems to vary across both outcomes and countries. For instance, gender-specific course work patterns, vocational interests, and self-assessment of mathematical, science, and communication skills, largely account for men's and women's diverging fields of study choices in Germany. In contrast, incorporating covariates for self-concepts and performance at the individual-level hardly reduces 15-year old boys' higher probability to express a STEM occupational expectation. The latter finding is in line with previous research, stating that the complex process of forming occupational expectations during adolescence is difficult to model empirically (Helbig and Leuze 2012).

Country differences are also observable. Individual-level covariates reduce the gender expectation gap in STEM occupations moderately in e.g. Germany, Japan, and France, while hardly predicting it in e.g. Finland, Estonia, or Lithuania. This pattern raises the question why adolescent girls in for example Finland, irrespective of performance, refrain from technical fields. Cross-nationally comparative research on labour market remunerations has stressed that the explanatory power of theories might differ across countries (see e.g., Di Stasio, Bol and Van de Werfhorst 2016; Di Stasio and van de Werfhorst 2016). However, research on occupational expectations or fields of study choices rarely utilises such a contextual understanding of micro-level theories, raising the question, why e.g. gender differences in self-assessments should be more important in one context than in another (Nagy et al. 2008; Nagy et al. 2010).

The thesis also provided insight into the explanatory power of different micro- and macro-level factors, crucial for understanding the horizontal sex segregation. The main findings on the individual- and country-level will be presented systematically, by following the conceptual logic of the extended rational choice perspective. Occasionally, when other frameworks capture the results better, these will be referred to instead.

According to rational choice framework, and closely related, expectance value theory, *expected benefits* could drive gender differences in occupational and fields of study choices. These benefits have been conceptualised as life- and career plans, in terms of income, prestige or work-life balance (Jonsson, 1999, Polachek, 1981), but also as a general preference for certain tasks, such as working with computers or helping others (Eccles, 1994). On the individual-level, sub-study II provided only limited support for the significance of anticipated life and work goals for fields of study choices in the German context, corroborating previous results (see e.g., Busch-Heinzmann 2015; Lörz, Schindler and Walter 201; Mann und DiPrete 2013; Okamoto and England 1999; Ochsenfeld 2016). For instance, gender differences in the importance of family were small, and family-related considerations only affected the choice of humanities and social sciences among women. Correspondingly, gender-specific career expectations in terms of salary and prestige contributed to women's overrepresentation exclusively in humanities and social sciences, exerting no influence on the gender gap in the other four fields, such as engineering or natural sciences. Above all, interests in specific tasks, which were captured by means of the RIASEC-framework (Holland, 1973), were highly predictive of gender differences in fields of study choices.

On the macro-level, the findings also cast doubt on the explanatory power of expected benefit, conceptualised as the incentive structure of the labour market. Adolescent boys were assumed to respond positively to opportunities in high skilled technical and science occupations. Girls, in turn, were expected to avoid STEM fields in countries where the post-industrial restructuring of the labour market is more pronounced. The results showed that opportunities in science and technics did not impact the male advantage in STEM expectations. Moreover, the gender expectation-gap is bigger in countries with a larger service sector and where a higher share of women works in upper management. Thus, the results are in line with studies arguing that the service sector attracts female workers (see e.g., Nieuwenhuis, Need and Van Der Kolk 2012), and contributes to horizontal sex segregation of the higher education system (Charles and Bradley 2009).

However, supplementary analyses suggest that post-industrial restructuring pushes boys into STEM, rather than steering girls away. Put differently, labour markets where female-typical work is broadly available, both in low- and high-status positions, seem to encourage boys to pursue male-typical career paths and avoid the less valued sphere of female-dominated occupations. This indicates that structure of the labour market seems to affect gender differences by evoking cultural norms rather than rational, utility-based calculations.

Social costs could steer young men and women away from gender atypical fields. These costs could arise for several reasons, such as anticipated discrimination in male-dominated occupations (Kanter 1977), or through normative threats to gender identity, when young men and women consider a gender atypical career path (Kessels et al. 2014). Overall,

the results did not lend support to these considerations neither on the individual- nor on the country-level. The empirical analyses assessed different dimensions of social costs: At the individual-level, the first sub-study incorporated two indicators directly measuring anticipated labour market discrimination in male- and female-dominated occupations, but neither predictor influenced gender differences in fields of study choices in Germany substantially. On the country-level, the gender expectation gap in STEM occupations remained unaffected by the share of women graduating from technical or scientific fields in the tertiary education system; an indicator assumed to capture cross-national variation in the threat to gender identity. Thus, a stronger representation of young women in gender atypical fields does not increase adolescent girls' interest in a career in technics and science, by reducing social costs.

The results on social costs give rise to three different interpretations: First, fear of discrimination or for violating gender norms might not be as important an explanation for gender differences in occupational choices as often assumed in previous literature. Second, the indicators utilised to assess anticipated discrimination or the fear of violating social norms might be too crude to capture subtle processes. The study of Ochsenfeld (2016), which explores social costs through the expectations of friends and family, lends support to the first interpretation. In contrast, the qualitative interviews of Seymore (1995) or quantitative analyses performed on engineering students in single universities (Cech 2015; Cech et al. 2011) show that social costs matter. Thus, the thesis cannot rule out problems of measurement. A final possibility is that social costs are relevant at an earlier time point in the life course, when interests in specific subjects are shaped (Salikutluk and Heyne 2017). Hence, when analysing occupational expectations or fields of study choices the conformity with gender norms might be an inherent part of e.g., task orientation, self-assessment, or even performance in gender atypical subjects (Nagy et al. 2010), rather than a fear of beeing a minority or experiencing discrimination.

Finally, a substantial body of research has raised the question whether young men's and women's diverging occupational expectations and fields of study choices stem from *gender differences in performance*, often framed as the probability of success (Jonsson 1999). The findings of sub-study II identify subjective assessments of strengths as one important explanation. Also after incorporating the intra-individual relation between the final grade in mathematics and German (i.e. the comparative advantage) and course taking patterns, self-assessment – in particular, young women's lower evaluation of their mathematic skills and higher evaluation of their communication skills – predict gender-specific fields of study choices in Germany. Hence, as argued by Correll (2001, 2004), stereotypes about male and female skill domains seem to bias young men's and women's perceptions of their abilities, and influence their occupational choices.

Taken together, gender differences in task-related preferences are important for explaining horizontal sex segregation. The results align with previous studies on occupational interests (Law 2018; Legewie and DiPrete 2014; Morgan et al. 2013; Ochsenfeld 2016), but highlight that these interest are strongly related to subject-specific specialization and performance. Theoretically, this indicates that young men and women – when forming an occupational expectation or opting for a field of study – draw on cultural notions of tasks and skills particularly suitable for each gender (see also Cech 2013; Charles and Bradley 2009; Eccles and Wigfield 2002; Ochsenfeld 2016; Ridgeway and Correll 2004; Riegle-Crumb et al. 2012). The labour market, in turn, embodies such norms of masculinity and femininity. Cultural notions of male and female domains seem to shape self-assessments of skills, specialization in earlier stages of educational system as well as occupational interest, rather than evoking fears of discrimination in gender atypical fields.

6.2 Horizontal sex segregation and its effect on labour market outcomes

The second key objective of the thesis was to address the conditions, under which horizontal sex segregation of higher education and the labour market transforms into gender inequality in returns. In the following, the main findings of sub-study III and sub-study IV are discussed. While addressing similar questions, differences in design between these studies allow the thesis to elaborate on the core research questions more exhaustively. Thus, sub-study III and IV analyse different labour market outcomes, country contexts, and groups, with sub-study IV scrutinizing unemployed workers across *all* educational levels.

First, the analyses corroborate previous findings in that the horizontal sex segregation predicts labour market remunerations in the occupationalised German labour market, net of individual-level characteristics and across the different samples. While the association between the share of women in an occupation and wages is well-established (Busch 2013a; Liebeskind 2004), sub-study IV interestingly revealed that re-employment after job loss also varies by the sex-composition of occupations. Unsurprisingly, the results showed that the sex-composition of occupations and fields of study account for gender differences at the individual-level. For instance, sub-study III confirmed that the gender wage gap among highly qualified workers in Germany can be attributed to wage penalties associated with the share of women in a given field.

Yet, when comparing the gender wage gap among tertiary-educated workers across countries, the results do not indicate a similar, negative effect of the sex composition *per se* in Finland. Despite frequent descriptions of Finland as a context with a strongly segregated higher education system and occupational structure (Grönlund, Halldén and Magnusson 2017;

Steinmetz 2012), the sex composition alone does not predict wage disadvantages to the same extent as in Germany. Not observing a wage penalty for female-dominated fields of study is as such not surprising. As scholars have shown, the share of women does not exert a negative influence on wages, when scrutinizing high skilled occupations or occupations in the upper part of the wage distribution (Brynin and Perales 2016). Yet the finding highlights the advantages of a contextual approach: horizontal sex segregation structures gender inequality, but not across all contexts.

Second, analyses for Germany reveal that that the association between the sex composition of majors or occupations and labour market returns persists, also after incorporating major- and occupational-level controls. For instance, sub-study IV showed that those who worked in a male-dominated occupation prior to unemployment experienced faster re-entries into the labour market, irrespective of the occupation-specific unemployment rate, the educational-level of the occupation, the degree of occupational closure, and the share of occupational incumbents working in the industry. The mechanisms driving the advantages of male-dominated occupations have puzzled a large corpus of research. Scholars often regard any independent effect of the sex-composition as evidence of cultural devaluation of women's work (Leuze and Strauß 2009; Murphy and Oesch 2016). Yet such a 'remaining effect' seems particularly interesting with respect to the re-entry into employment after job loss in Germany. In Germany, occupation-specific educational credentials structure labour market trajectories, and occupational boundaries are strong (Müller and Shavit 1998). Thus, it seems unlikely that employers advertising for positions in e.g. gender-balanced occupations would prefer incumbents from male-dominated occupations due to the higher societal value of their skills. Thus, the finding calls for further scrutiny of differences between male-dominated, integrated, and female-dominated occupations.

Third, when analysing mediating characteristics, the findings both confirm and challenge prevailing theoretical argumentations and empirical evidence. For instance, the degree of occupational closure moderately reduces the positive effect of male-dominated occupations on the re-entry into the labour market after job loss. Similarly, the occupation-specific unemployment rate partly mediates the effect of an occupation's sex composition on the transition into employment, although women, contrary to the crowding hypothesis, do not seem to work in occupations where unemployment is more frequent.

Above all, the results point to the potential of education-employment linkages for understanding gender differences in labour market outcomes The field-specific new measure for these linkages, i.e. the local-linkage score (DiPrete et al. 2017), surprisingly indicated that tertiary-educated women in both Germany and in Finland on average graduate from majors with stronger linkages to specific occupation in the labour market than men. Highly-qualified women in both countries seem to invest in occupation-specific human capital to a higher

degree than their male counterparts. This finding contradicts the specialised human capital hypothesis, which assumes that women anticipate employment interruptions and prefer fields with a lower degree of specificity but higher transferability (Polachek 1981). Moreover, the findings do not indicate that specialization accounts for the lower remunerations of female-dominated majors and occupations (see e.g., Grönlund and Magnusson 2013; Murphy and Oesch 2016). On the contrary, for Germany the results revealed that strong education-employment linkages mitigate the negative consequences of the sex-composition of majors. Thus, further research is warranted to elaborate on different dimensions of specialization, in specific how specialization on the job and education-employment linkages structure career opportunities (see also Perales 2013).

But most importantly, the sex composition of fields of study and occupations have gender-specific consequences. In Germany, occupational characteristics seem to structure the transition from unemployment into employment only among men, while women's re-entries are predicted by well-known individual-level covariates, such as the age of the youngest child. Thus, the positive effect of having worked in a male-dominated or closed occupation, or an occupation with a favourable relation between supply and demand, only holds true to men's transition back to work. Similarly, in Germany the sex-composition of majors seems to have a stronger impact on men' wages than on women's, suggesting that women do not profit from male-dominated fields to the same extent as men. In Finland, in turn, fields of study with strong pathways to occupations are more beneficial for women than for men.

The explanations for these disparate effects among men and women will most likely differ between assessed labour market outcomes and the institutional set-up of different countries. However, the findings suggest that occupations as a feature of a country's labour market interact with institutions relevant for family trajectories. While previous research calls into question whether motherhood as such drives occupational sex segregation (England 2005), the development of occupational structures, in terms of career ladders or working time arrangements, might be related to the family as an institution. For instance, highly qualified women graduating from male-dominated fields in Germany might experience difficulties recouping their investments in a labour market sector, where overtime is prevailing (Busch 2013b; Cha and Weeden 2014; Leuze and Strauß 2016). In Finland, in turn, structured career ladders – prevailing in occupations with a strong link to the education system – could mitigate consequences of career interruptions and prevent employer discrimination. Finally, the close proximity of women's life to family might questions the importance of occupations, when women re-enter employment after unemployment . In fact, selection into employment, conditional on the household context, might be a more important factor (Gangl and Ziefle 2009). These gender-specific patterns might be independent of actual parental status, as the anticipation of children affects employers' investment in women (Busch 2013b; Estevez-Abe

2005, 2006). Taken together, these results imply that theoretical explanations need to be adapted to accommodate gender-specific trajectories. These trajectories, in turn, might vary across contexts.

6.3 Gender-specific educational decisions and employment trajectories from a life course perspective

A key aim of the thesis was to examine how gender differences in occupational choices emerge and affect future labour market outcomes. It argued that this longstanding process needs to be disentangled into different steps, which, in turn, are embedded in specific institutional contexts.

The first two steps – occupational expectations and fields of study choices –were viewed as individual decisions, which are structured by the possibilities and constraints set up by the education system and the labour market. The results showed that fields of study choices are the outcome of a complex process, in which gender-specific course taking patterns, perceptions of strengths and weaknesses, and interests interact. Thus, rather than being steered by perceived benefits and costs, young men and women seem to seek a match between the surrounding environment and their skills, strengths, and interests (Holland 1973). The skill- and interest-domains in this environment, however, are gendered. In terms of institutions, this suggests that the educational system structures and (re-)produces gender-specific skill- and interest profiles. Furthermore, structural dimensions of the labour market seem to intertwine with a cultural understanding of work typically performed by men or by women (Busch 2013b).

Taken together, horizontal sex segregation might be hard to change, if the occupational structure supports a realization of 'male- and female-typical' occupational interests. Meanwhile, the low preference among young women for technical work, and their higher interest in social and artistic tasks might not be detrimental with respect to employment trajectories, if the labour market enables women to pursue these paths in well-remunerated occupations (Magnusson 2013).

Turning to the consequences of educational choices on the labour market, the results confirm that decisions made earlier in the educational biography are important for understanding later career outcomes. Yet the mechanisms driving educational choices, such as interests, seem to differ from those fostering gender inequality in the labour market. The idea of self-selection, prevailing among human capital models, assumes such a direct relation between field of study choices and labour market outcomes, The findings of this theses, however, did not identify careerist aspiration, the importance of family life, or the fear of social costs as the main predictors of young men's and women's diverging occupational

choices. Thus, mechanisms important for occupational choices are not, at least directly, linked to those evoking gender differences in employment trajectories. However, given the role of family in later labour market trajectories, the findings raise the question whether men and women adapt and adjust their goals over the course of higher education and early career, or whether mechanisms located in the labour market are more relevant. For instance, the results highlighted that highly-qualified women in Germany graduating from male-dominated fields receive lower remunerations than their male counterparts. From a policy perspective, it is crucial to understand whether differences in working preferences or alternative mechanisms, such as labour market discrimination, are decisive for this pattern.

Finally, the results highlighted that women's occupational choices do not necessarily dilute the potential gains, which they have achieved through their educational success. Put differently, the lower remunerations associated with women's occupational choices are context-dependent. To understand why and when female-dominated fields of study and occupations are associated with disadvantages, an institutional perspective is important. While the thesis suggested that the family on the institutional-level might moderate how, for instance, education-employment linkages structure employment opportunities, it also highlighted the importance of scrutinizing explanations across contexts in greater detail.

6.4 Limitations and implications for further research

The concluding section of this thesis elaborates on limitations of this work and discusses potential further research. To understand how and why horizontal gender differences in occupational choices transform into vertical inequality in the labour market, the thesis adhered to a life-course perspective and scrutinised four different stages in the educational and employment trajectory, ranging from adolescence to mid-career outcomes. The thesis was able to identify crucial explanations for men's and women's diverging occupational choices at the individual level, and to embed these explanations in an institutional framework. It also concluded that the horizontal sex segregation is an important feature for understanding individual-level outcomes; yet the underlying reasons must be viewed in context. Meanwhile, it is clear from the findings that an even longer perspective is needed to capture the specific processes. Closely related, the results encourage future research to describe both outcomes and key mechanisms in greater detail.

First, the strong interrelations between occupational interests, self-assessments, and specialization in the secondary system, detected in sub-study II, provided an intriguing answer to the question why men and women opt for different fields of study in Germany. Further research should elaborate on the temporal order of these dimensions. To understand how gender-specific skill- and interest-profiles emerge, and shape occupational choices, it is

necessary to consider how these dimensions mutually reinforce each other. However, such an approach requires longitudinal data following individuals from early childhood until the transition into higher education, and ideally, measuring both the family as well as the school context. For Germany, the complex cohort design of the National Educational Panel Study (NEPS) might in the future allow researchers to view these long-term processes. Meanwhile, the need to capture processes in detail also requires researchers to focus on new questions. For instance, the importance of single explanations might be conditional to the circumstances under which occupational choices take place. Thus, as Eccles points out (2007), the differing motivations guiding individuals need to be taken more comprehensively into account. To this end, the supplementary analyses of sub-study II assessed individual-level explanations for men and women separately. These showed that the choice for a specific field of study broadly follows similar patterns for both genders. Further analyses could then address the question, whether groups of young men and women differ in their motivations.

In addition to analysing interdependencies in these key predictors, the actual choice process could also be modelled in more detail. So far, little is known about the pool of alternatives young men and women consider when opting for a field of study (Alon and DiPrete 2015). This also holds true with respect to adolescents' occupational preferences. Thus, the PISA data allowed the thesis to compare STEM expectations across countries, while taking a broad range of relevant individual-level explanations into consideration. However, the emphasis of PISA on occupational expectations, without considering idealistic aspirations, precludes analyses from scrutinizing the complex processes, where wishes are adjusted to constraints. As Gottfrendson and Lapan (1997: 426) highlight "many young people seem to have needlessly and inappropriately narrowed their options at an earlier age, leaving them with only the remnants of choice". Thus, future research could explore in greater detail how institutional features shape interest formation and the extent to which existing preferences are realized. These processes might differ between young men and women.

Similarly, the implications of horizontal sex segregation for labour market consequences raise further questions. To better understand how differences *both* across countries *and* between men and women emerge, future research should scrutinize career progression in greater detail. For instance, scholars could elaborate on employment trajectories of highly qualified workers and focus on occupational mobility. Such an approach would allow analyses to address whether women graduating from male-dominated fields actually opt out from e.g. technics, and as a consequence, encounter difficulties in strongly occupationalised labour markets. Alternatively, working time arrangements or working culture in male-dominated occupations could hamper the prospects of women to experience upward mobility. We also know less about career advancement within and across strongly and weakly linked fields, and whether these career paths differ between men and women. Thus,

the findings of this thesis relate back to the question, in which aspects female- and male-dominated occupations differ, and encourage further research to address the context-dependency in greater detail.

7 Sub-Study I: Gender differences in STEM expectations across countries: How perceived labour market structures shape adolescents' preferences

Abstract

Despite the reversal of gender differences in educational attainment, women continue to be underrepresented in STEM (Science, Technology, Engineering, Mathematics) occupations. Yet comparative studies indicate that the male advantage in STEM fields varies across countries. To understand how these country variations come about, this study analyses the gender gap in adolescents' STEM expectations. While previous research mainly focused on the role of the cultural environment and the education system, this study contributes to the literature by investigating the opportunity structures of the labor market. We investigate how employment opportunities in science and technology, the post-industrial restructuring of labor markets in both low- and high-status occupations, and women's success in graduating from STEM fields might explain the gender gap in STEM expectations. Empirically, we analyze 15-year-old pupils' occupational expectations from the OECD's PISA 2015 study linked with macro-level indicators in 35 EU and OECD countries by means of two-step multilevel models. Results indicate that the gender gap in STEM expectations is larger in countries with a more pronounced post-industrial restructuring of the labor market. However, rather than steering girls away from the STEM sector, post-industrial restructuring increases boys' STEM expectations and thus seems to strengthen their gender-typical tasks preferences.

Keywords

Occupational expectations, STEM, gender, cross-national variations, education systems, labour markets

DOI

https://doi.org/10.1080/13676261.2020.1755029

8 Sub-Study II: Warum wählen Männer und Frauen unterschiedliche Studienfächer?

Zusammenfassung

Trotz der seit mehreren Jahrzehnten bestehenden geschlechtsspezifischen Unterschiede in der Studienfachwahl, ist es der bisherigen Forschung nur zum Teil gelungen, die zugrundeliegenden Ursachen empirisch herauszuarbeiten und die geschlechtsspezifische Studienfachwahl vollständig zu erklären. Der vorliegende Beitrag geht daher aus verschiedenen interdisziplinären Blickwinkeln der Frage nach, warum Männer und Frauen unterschiedliche Studienfächer wählen und betrachtet hierbei fünf Fächergruppen.

Die Ergebnisse der multinominalen logistischen Regressions- und Dekompositionsanalysen zeigen, dass die geschlechtsspezifischen Unterschiede hauptsächlich aus vorgelagerten Bildungsentscheidungen und den damit zusammenhängenden Interessen- und Leistungsprofilen resultieren. Die kulturelle Zuschreibung von geschlechterkonformen Verhaltensweisen zeigt sich hierbei nicht in antizipierten Diskriminierungsprozessen, sondern in einer geschlechtsspezifischen Wahrnehmung der eigenen Fähigkeiten und der Entwicklung unterschiedlicher Berufsinteressen. Die Geschlechterunterschiede in den verschiedenen Fächergruppen sind jedoch teilweise auf unterschiedliche Ursachen zurückzuführen.

Schlüsselwörter

Geschlecht – Studienfachwahl – Bildungsentscheidung – Geschlechtersegregation

Why do men and women differ in their choice of fields of study?

Abstract

Despite persistent gender differences in field-of-study choices, existing research has not exhaustively explained why men and women continue to opt for different fields of study. This study aims to address this question by combining different explanatory frameworks and exploring the gender gap in five different fields of study. Utilizing multinomial regression and decomposition analyses, our results show that gender differences in field-of-study choices are mainly attributable to the student's previous educational biography, self-assessment of performance, and occupational interests. These, in turn, are strongly interrelated. Thus, cultural notions of masculinity and femininity do not seem to manifest themselves in anticipated discrimination in gender atypical fields, but rather in the development of gender-specific ability and interest profiles. However, the results also reveal that mechanisms contributing to the gender gap differ somewhat across fields of study.

Keywords

gender – field of study choices – educational decisions – sex segregation

DOI

https://doi.org/10.1515/zfsoz-2020-0005 .

9 Sub-Study III: Contextualized Inequality. How Fields of Study Shape the Gender Wage Gap in Germany and Finland

Abstract

Gender specific fields of study choices have been shown to predict the gender wage gap among highly educated workers in several countries; yet cross-national comparisons are few. Using longitudinal data from the German Socio Economic Panel Study (GSOEP) and Statistics Finland, this study addresses whether the institutional context moderates how fields of study choices translate into gender-based earnings differentials in Germany and Finland. In particular, it explores one institutional feature: the linkage between the educational system and the labour market. By comparing Finland and Germany, the study aims to identify whether this coupling is gender-neutral, or whether country configurations in gender inequality affect the allocation of graduates to labour market positions. The results indicate that fields of study have disparate effects on men and women; moreover, patterns differ across the countries. In Germany, women graduating from male-dominated fields cannot recoup their investment to the same extent as their male counterparts. In contrast, in Finland, women profit more than men from fields with strong linkages to occupations. The findings highlight the importance of considering features moderating the linkage process and generating gender-based wage differentials in higher education graduates' early career.

Keywords

Higher education graduates, gender wage gap, fields of study choices, Finland and Germany

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9.1 Introduction

Despite women's educational advancements (Buchmann, DiPrete and McDaniel 2008), and the convergence of men's and women's labour market biographies (Aisenbrey and Brückner 2008), gender wage inequalities persist and are particularly pronounced among highly qualified workers (Evertsson et al. 2009, Grönlund and Magnusson 2016, Mandel 2012). Yet gender-based wage differentials among tertiary degree holders differ between countries already during the early career (OECD 2017): Whereas the unadjusted gender wage gap in monthly earnings five years after graduation peaks at 39 % in Germany, it is lower in the Nordic countries, e.g. approximately 27 % in Finland (Triventi 2013).

A prominent cause for the lower labour market remunerations of highly educated women in several countries are their fields of study choices (Kalmijn and Lippe 1997, Ochsenfeld 2014, Roksa 2005, Shauman 2006). Men predominantly major in STEM-fields (**S**cience, **T**echnology, **E**ngineering, and **M**athematics), whereas women dominate health, education and humanities (Barone 2011, Mann and DiPrete 2013). Accordingly, female-dominated fields of study are in several countries associated with lower wages, such as in the U.S. (Roksa 2005, Shauman 2006), Germany (Leuze and Strauß 2014, Machin and Puhani 2003), and Finland (Napari 2008). Yet previous studies have less frequently addressed the question whether the consequences of men's and women's diverging fields of study choices differ across countries, despite evidence of substantial cross-national variation in returns to education (Di Stasio and van de Werfhorst 2016, Giesecke and Schindler 2008, van de Werfhorst 2011). Thus, a large corpus of literature documents that the institutional set-up of the educational system and the labour market – or the linkage between the two – shapes graduates' career patterns (Gangl 2001, Marsden 1990, Müller and Shavit 1998). These linkages could be an intriguing framework for exploring the association between the sex composition of fields of study and wages across countries: If fields of study link to labour market positions differently across countries, their influence on the gender wage gap could also differ. Therefore, this study addresses the following research questions: *Does the effect of subject choices on the gender wage gap differ across Germany and Finland? In particular, can the gender-wage gap during the first ten years after graduation be attributed to education-employment linkages in these countries?*

The design of this study builds upon previous literature in two distinct ways. First, the cross-national comparison allows the study to explore whether the implications of horizontal sex segregation in the tertiary education system on wages are context-dependent. Second, the study contributes to the understanding of education-employment linkages, by relating this explanatory framework to gender inequality. In particular, it explores two distinct patterns: On the one hand, women's lower wages could emerge from a gender-neutral coupling

between the educational system and the labour market, where male and female graduates from a given field of study enter corresponding positions in the labour market. On the other hand, men's and women's skill investments might have disparate effects on wages, corresponding to country configurations of gender inequality (Estévez-Abe 2005, Reimer and Steinmetz 2009, Steinmetz 2012). A comparison of Finland and Germany allows the study to investigate these possible patterns, as they represent countries with stronger education-employment linkages; Germany to an even higher extent than Finland (Hannan, Smyth and McCoy 1999: 24). Yet highly qualified women's labour market opportunities are assumed to differ across the countries (Estévez-Abe 2006, Mandel 2012).

Empirically, the study uses longitudinal data from the German Socio Economic Panel Study (GSOEP) and Statistics Finland to assess how the gender wage gap unfolds in Germany and Finland over the first ten years after graduation in the time frame 1993-2016. By looking at a continuous time span of ten years, this design advances previous research on wage inequality among highly educated men and women, which have primarily focused on single time points, such as five or ten years after graduation (Braakmann 2013, Leuze and Strauß 2016, Ochsenfeld 2014, Triventi 2013). In addition, it draws on a new conception to measure education-employment linkages that has not been utilized with respect to the gender wage gap (DiPrete et al. 2017, Forster and Bol 2018)

The remainder of the paper is as follows: Section 2 summarizes previous research and elaborates on a framework for understanding cross-national differences in how fields of study choices affect the gender wage gap in Finland and Germany. The subsequent section describes the methodological design (Section 3). After presenting the results (Section 4), findings will be summarized and elaborated upon (Section 5).

9.2 State of research and theoretical considerations

9.2.1 Previous research on fields of study choices and the gender inequality

The human capital theory is frequently utilized to explain the gender wage gap. It maintains that individuals aim to maximize their lifetime earnings by investing in human capital, mainly through education, labour market experience, and on-the-job training. The gender wage gap is the outcome of women's lower investments, given their focus on family-related activities (Mincer and Polachek 1974). Men and women are also assumed to acquire different mixtures of general, occupation-, and firm-specific human capital, which differ by investment costs, portability, and wage returns (Polachek 1981, Polavieja 2008). A crucial tenet of the argument is that women prefer fields requiring a larger extent of general skills, in which family-related

employment interruptions are associated with smaller losses in earnings. Yet general skills yield lower earnings (Polachek, 1981: 64). Apart from the transferability of skills, fields predominantly preferred by women could also be connected to jobs supporting women's responsibilities for family-life (Hakim 2002). Thus, women might prefer female-dominated fields, because they offer family friendly working arrangements, such as less overwork, more flexibility or greater part-time opportunities, although these arrangements are associated with lower wages (Cha and Weeden 2014). Previous research on the gender wage gap in different country contexts partly corroborates these assumptions. For instance, studies have shown that women are underrepresented in specialized fields and occupations (Shauman 2006, Tam 1997), although some studies refute that this association drives the gender wage gap among highly qualified workers (Leuze and Strauß 2009, Ochsenfeld 2014). Furthermore, gender differences in working-time arrangements both at the individual and occupational level contribute to the gender wage gap (Leuze and Strauß 2016, Magnusson and Nermo 2017, Shauman 2006, Triventi 2013).

Yet both skill investments and their consequences for labour market rewards are conditional on institutional features (Estevez-Abe, Iversen and Soskice 2001). This suggests that the process by which fields of study generate gender-based wage differentials may differ between countries. Existing cross-nationally comparative studies lend support to this assumption, but studies are often based on cross-sectional data or lack an institutional framework (Machin and Puhani 2003, Reimer and Steinmetz 2009, Triventi 2013). This study addresses these shortcomings by exploring the gender wage gap across two different country contexts, and combining research on horizontal sex segregation with the institutional framework of education-employment linkages.

9.2.2 Explanatory framework and country descriptions

Educational systems differ in the extent to which they equip higher education graduates with specialized skills and prepare them for specific occupations in the labour market (Giesecke and Schindler 2008, Leuze 2007, Reimer, Noelke and Kucel 2008). Previous typologies of school-to-work transitions have comprised this feature, often referred to as an education-employment link or occupational specificity, as a characteristic of a country's educational systems as a whole, or a *between-country* characteristic. More recent literature highlights that specificity varies substantially across fields of study within countries (DiPrete et al. 2017, Noelke, Gebel and Kogan 2012, Reimer, Noelke and Kucel 2008, van de Werfhorst 2004), depicting it as a *within-country* characteristic. The latter argument has also frequently been related to the sex composition of study fields, with scholars suggesting that the lower specificity of female-dominated fields, or occupations, explain their wage disadvantages

(Perales 2013, Shauman 2006, Tam 1997). Yet cross-national analyses of this argument are rare (for an exception, see e.g., Murphy and Oesch 2016).

Meanwhile, literature on horizontal sex segregation has presented several further explanations for the lower wages of female-dominated fields of study, with the evaluative discrimination of skills being prominent. According to this framework, fields preferred by women are subject to a lower cultural appreciation, and thus lower wages, due to their close proximity to unpaid, reproductive tasks in the private sphere (see e.g., England et al. 1994, Leuze and Strauß 2014). However, the sex composition of fields has also been shown to vary systematically with the careerist intentions of graduates (Ochsenfeld 2014). Furthermore, the gender wage gap among highly qualified men and women can be explained by differences in occupational working-time arrangements, since female graduates work in occupations with higher shares of part-time and lower shares of over-time (Leuze and Strauß 2016)

Nevertheless, to understand how fields of study choices contribute to the gender wage gap across countries, education-employment linkages could be an important layer both as a *between*- and a *within-country* characteristic. Both Finland and Germany display a tighter coupling between the educational system and the labour market; Germany to somewhat a higher extent than Finland (Hannan, Smyth and McCoy 1999: 24). Thus, if the allocation of graduates to corresponding positions in the labour market follows gender-neutrally, fields of study choices should contribute to the gender wage gap similarly across the countries. However, institutional features particularly important for highly qualified women's employment opportunities could moderate how fields of study choices link to positions in the labour market. Previous literature has suggested that Germany and Finland differ in this regard (Estévez-Abe 2005, Mandel 2012). This indicates that skill-investments might predict wages differently between men and women across the countries.

9.2.2.1 Education-employment linkages as a between country characteristic

To conceptualize why the assignment process of graduates to labour market positions varies between countries, scholars have traditionally differentiated between occupationalised systems, and their maximum contrast, organisation-based systems (Marsden 1990, Müller and Shavit 1998)[4]. One key difference between these systems is the type of skills transmitted in the educational system, with occupationalised systems equipping students with occupation-specific knowledge and skills, and organisational systems providing general training (Gangl, 2001). This has implications for how employers perceive educational credentials of higher

[4] Although originally mainly developed for the VET system these classifications have also been successfully utilized in studies analysing higher education graduates (see e.g. Leuze 2007, Giesecke and Schindler, 2008, Lindberg 2009).

education graduates. In organisation-based systems educational credentials have a lower signalling value, and employers rely on on-the-job training or qualification obtained in the labour market (Leuze 2007). In contrast, in occupationalised systems educational credentials provide employers with signals of skills, enabling graduates to enter into matching positions and occupations in the labour market (Di Stasio and van de Werfhorst 2016). It is important to note that this strong link between the educational system and the labour market systems persists beyond the initial early career stage, as e.g. strong labour market regulations and unions foster it (Bol and van de Werfhorst 2011, Di Stasio, Bol and Van de Werfhorst 2016, Gangl 2004). Hence, occupational stability over the career trajectory prevails in occupationalised systems (see e.g., Manzoni, Härkönen and Mayer 2014)

In terms of gender-specific wage trajectories, research has repeatedly demonstrated that women are overrepresented in fields of study associated with lower wages in the labour market. Similarly, female-dominated occupations yield lower wages, although wage penalties have been shown to be less pronounced among high-skilled workers (Brynin and Perales 2016). Yet the extent to which graduates from female-dominated fields of study enter and continue working in lower remunerated, female jobs in the labour market should vary across systems (Giesecke and Schindler 2008, Reimer and Steinmetz 2009). Given that employers in occupationalised systems regard educational credentials as signals of knowledge and skills, and graduates aim to recoup their skill investments, graduates from female-dominated fields of study can be expected to enter corresponding occupations more often than their counterparts in more loosely coupled systems. Moreover, strong occupational boundaries in the labour market (Allmendinger and Hinz 1997, Sacchi, Kriesi and Buchmann 2016) will hamper the possibilities of graduates from female-dominated fields of study to change into more lucrative jobs.

Earlier research has unambiguously characterized Germany as an occupationalised system, also in the tertiary system (Giesecke and Schindler 2008, Leuze 2007), whereas school-to-work transitions in Finland have received less attention. Although the training system in Finland entails a higher degree of occupational specificity than traditional organisation-based systems (Lindberg 2009, Prix 2013) research on transition regimes tends to separate Finland from Germany. Finland is usually characterized as a decoupled system, where signals of educational degrees remain strong (Hannan, Smyth and McCoy 1999). This suggests that Finland displays weaker education-employment-linkages than Germany, although this difference can be depicted as one in degree rather than in regime type.

Taken together, the relation between fields of study choices and wages should be greater in strongly coupled systems. Although women's lower wages can be attributed to the sex composition of fields of study in both countries, *this association should be stronger in Germany than in Finland (H1a).*

However, the sex composition of fields of study could have disparate effects on wages of men and women. First, previous research has demonstrated that women do not benefit from male-dominated fields of study, such as engineering, to the same extent that men do (see e.g., Olitsky 2014, Reimer and Steinmetz 2009). There are several possible explanations for this pattern, such as exacerbated employer discrimination in an environment, where women are the minority (Kanter 1977), or working-time arrangements in male-dominated fields, assumed to be especially family-unfriendly (Solga and Pfahl 2009). In fact, women have been shown to drop out from technical and scientific occupations more often than women in other, professional fields (Glass et al. 2013). These gender-specific returns of male-dominated majors should in turn differ across countries. If women graduating from male-dominated fields of study wish to enter lucrative positions in other occupations, they will face stronger barriers in countries, where education-employment linkages and occupational boundaries are strong (Reimer and Steinmetz, 2009). Taken together, *men should benefit more from male-dominated fields than women, particularly in Germany* (*H1b*).

On the other hand, previous studies have also shown that women face stronger wage penalties in female-dominated fields and occupations than men (Leuze and Strauß 2014). This disadvantage is assumed to stem from employers' perception of men as status high and more competent than women (Ridgeway and Correll 2004, Ridgeway 2014), particularly salient if men pursue a gender-atypical career. Thus, compared to women in female-dominated fields, employers and supervisors will offer men more promotion prospects and support their wage raises (Leuze and Strauß 2014, Williams 1995). This trend should differ across countries. Scholars have argued that employers' incentive to favour men is higher in countries with well-developed family policies, since extensive support for family-related work interruptions and work-family compatibility increases the costs of female labour among employers (see e.g., Estévez-Abe 2005, Mandel and Semyonov 2005, Mandel and Semyonov 2006). This discourages employers to invest in women, and results in stronger disadvantages among women, particularly at the top. Germany and Finland differ in the generosity of family policies. The institutional arrangements in Germany, despite substantial changes during the past decades (Drasch 2013), continue to encourage one or one-and-a-half earner arrangements (Evertsson, Grunow and Aisenbrey 2016), where women often have to opt for either work or family (Grönlund and Magnusson 2016). In Finland, extensive parental leave schemes and a publicly subsidized child-care system support longer employment interruptions among mothers and, after a re-entry into the labour market, a dual-earner model (Ray, Gornick and

Schmitt 2010).[5] Taken together, the negative effect of female-dominated fields on wages should, in contrast to the previous hypothesis, be stronger among women than among men given employers' preference for men. If this preference varies according to the generosity of family policies, which are more extensive in Finland, *women's lower wages in female-dominated fields relative to men are particularly pronounced in Finland (H1c)*.

9.2.2.2 Education-Employment Linkages as a Within Country Characteristic

Education-employment linkages vary substantially across fields of study within countries (DiPrete et al. 2017, van de Werfhorst and Kraaykamp 2001). Previous research has utilized the degree of occupational specificity to distinguish between academic, occupation-specific and applied fields of study (Noelke, Gebel and Kogan 2012, Reimer, Noelke and Kucel 2008): Academic programs, such as humanities, mathematics, and social sciences, equip graduates with analytical, general skills, whereas occupation-specific fields, e.g. law or teaching, prepare graduates for specific occupations and professions. Applied programs, such as engineering, computer science or business, can be located between these two types (Noelke, Gebel and Kogan 2012).

There are several reasons to assume that fields of study entailing specific skills or strong education-employment linkages should yield higher wages. As argued by the specialized human capital hypothesis, investments in occupation-specific skills are more risky, as they are non-portable and bound to occupations, but also rewarded by higher wages compared to general skills (Becker 1962, Polachek 1981, Tam 1997). Furthermore, fields involving a high degree of occupational specificity provide employers with a clearer signal of skill-profiles, reduce insecurity and training costs of employers, and thereby increase remunerations (Klein 2011, Spence 1973). Wage advantages of strong education-employment linkages might also emerge from institutionalized closure mechanisms in the labour market in that occupations restrict access by means of credentialing (DiPrete et al. 2017). This strategy establishes a favourable supply-demand relationship between graduates and positions in the labour market, and secures higher wages (Weeden 2002). However, the wage advantages associated with strongly linked fields of study have been shown to differ across institutional contexts. As Bol and Weeden (2015) argue, the remunerations of strong field-specific education-employment linkages are particularly high in occupationalised systems, where educational credentials structure monetary remunerations.

[5] Although Germany introduced an earnings-related parental leave scheme in 2007, and continuously expands the availability of child-care, the family policies of the countries differ substantially during the majority of the time period of the analysis (i.e. 1991-2016, see 3. Data and Methods).

Turning to the gender wage gap, differences in field-specific education-employment linkages should account for the lower wages of female higher education graduates (Polachek, 1981; Shauman, 2006). If field-specific linkages exert a stronger effect on wages in Germany (Bol and Weeden 2015), their contribution to the gender-wage gap should be higher in Germany than in Finland. Therefore, *hypothesis 2a holds that women's lower earnings are more strongly attributed to field-specific linkages in Germany than in Finland*.

However, field-specific education-employment linkages could have disparate effects on the wages of men and women, which, as a result of family-friendly policies, might differ across the countries (Estevez-Abe 2005, 2006). If employers anticipate work interruptions and a higher responsibility for family among women, they are more reluctant to invest them in terms of e.g. promotions or on-the-job training. As a consequence, women should experience better career opportunities in occupations, where entry and upward mobility are structured by educational qualifications, rather than employer involvement (Estévez-Abe 2006: 154). This indicates that the positive gradient between education-employment linkages and wages is gender specific, since women benefit more from graduating from strongly linked fields, such as medicine or law. If employers' disincentive to equip women with firm-specific skills varies by the extent of work-family compatibility, this trend should be more pronounced in countries with exhaustive family-friendly policies. *Hence, women profit more from occupation-specific fields than men, particularly in Finland (H2b).*

9.3 Data sources and statistical modelling

This study traces wage trajectories of tertiary degree holders during the first ten years after graduation. To create comparable groups, the definition of tertiary degree holder differs between the countries. While the higher education system in both countries encompasses university and non-university institutions (the latter entitled *universities of applied sciences*), they differ with regard to stratification. In Germany, the main difference is not in recognition, but rather in the knowledge transmitted, with universities of applied sciences (*Fachhochschulen*) focusing on practical knowledge and universities on academic and scientific. Labour market outcomes of graduates do not vary substantially by type of tertiary degree (Leuze 2011). By contrast, the Finnish higher education system entailed only universities until the mid-1990s. Universities of applied sciences (*ammattikorkeakoulu*) emerged as a result of an education reform, in which 2-3 year long intermediate, vocational training programs (*opisto*) were standardized and gradually upgraded to the tertiary level as Bachelor degree programs (Prix 2013). Studies consistently report on lower labour market outcomes among non-university graduates (Prix 2009, Sirniö, Kauppinen and Martikainen

2016). Therefore, this study excludes BA-graduates from non-university institutions in Finland.

The analyses are based on two longitudinal data sets: the German Socio Economic Panel Study (GSOEP, v33.1) and register-based data provided by Statistics Finland. Both data sets comprise annual records of educational, employment, and family biographies, and detailed accounts of earnings. The German Socio-Economic Panel Study (GSOEP) is a representative study of private households, which since 1984 is collected by the German Institute for Economic Research (Gerstorf and Schupp 2016, Wagner, Frick and Schupp 2007). For Germany, the analyses are conducted on 1800 individuals who obtained a BA- or higher degree from a tertiary education institution between 1992-2010, following their employment patterns for a maximum of ten years, or until 2016. This time period is required in order to guarantee a sufficient sample size.[6] Educational and employment trajectories in Finland are based on the Finnish Longitudinal Employer-Employee Data (FLEED), which is a 1/3 randomly drawn sample of individuals aged 15-70 who lived in Finland at least one year between 1988-2014. Information on wages is obtained from the Structure of Earnings data; a subsample based on the FLEED-data that provides detailed accounts on wages, working time, and occupations. The analyses are conducted on 47 607 individuals, who received a lower (*Bachelor*) or higher (*Master*) tertiary degree from a Finnish university institution, or a master's degrees from universities of applied sciences between 1994-2009, covering their wage trajectories in the time frame 1995-2014 for ten years at the most. For both countries, the sample is restricted to individuals aged 23-35 when graduating, and excludes self-employed, as well as individuals with missing values on further covariates.

The analysis utilizes the natural logarithm of the hourly wage as a dependent variable and focuses on fields of study as a key explanation for the gender wage gap over the first ten years after graduation.[7] This indicates a three-level longitudinal design, with wage observations nested in individuals nested in fields of study. The study utilizes a random-coefficient model, specifying an individual-specific random intercept (level 2), a field-of-study-specific random intercept (level 3), and a fields-of-study-specific random slope for female (taking the values 0 or 1).[8] This results in modelling the variance rather than only the

[6] Information on the time of graduation from higher education originates from two sources. For ca 77 % of the sample the graduation was surveyed in the annual questionnaires, whereas 23 % reported the year of graduation in the retrospective biography questionnaire. The multivariate models control for the source of information.

[7] The hourly wage is estimated as (= gross monthly earnings + overtime compensation + (annual extra bonuses + holiday payments/12) / weekly working hours (including paid overtime / 4.345). In both countries the wages are adjusted to 2010 consumer price index.

[8] In terms of fields of study (level 3), this means that the models include a mean intercept for fields of study, and the deviation of each field of study's intercept from the mean intercept. Similarly, the model entails the deviation of the fields-of-study specific slope female from the mean slope female.

mean value (Rabe-Hesketh and Skrondal 2012).[9] The main predictors, i.e. fields of study characteristics, are introduced in a step-wise manner. To test for gender-specific effects of major characteristics, cross-level interaction effects between the female slope and the share of women in a field of study and the field-specific education-employment link are estimated. It is worth noting that the coefficients for the sex composition and education-employment linkage express how men and women sort into labour market as a result of their fields of study choices. This indicates, for instance, that the sex composition of fields of study also captures the effect of occupational sex segregation in the labour market, to the extent it is related to fields of study. Further sorting into female- or male-dominated occupations is measured in the slope for female (see Ochsenfeld 2014: 542)

The analyses focus on two characteristics of fields of study, namely the sex composition and education-employment linkage, as main explanations for gender-based wage differentials. To ensure that single fields entail a sufficient number of individuals, these characteristics are for Germany generated in *Mikrocensus* –a representative sample of one percent of the German population – and matched to the individual level data in GSOEP. For Finland, these predictors are calculated by means of the FLEED and Structure of Earnings data. Field characteristics are based on a detailed classification and included as time-invariant predictors, obtaining the value of the graduation year. For Germany, estimations in *Mikrocensus* are weighted. The sex composition of fields of study expresses the percentage of women in each field among tertiary degree holders aged 23-35. Fields with less than 30 graduates were combined with larger fields.[10] While the multivariate analyses include sex composition linearly, the descriptive analyses also separate between female, male, and integrated fields to aid interpretation of country differences. A field of study is considered female-dominated when at least 70 per cent of its graduates are women, and male-dominated if less than 31 per cent are female. Integrated fields lie in the middle of this demarcated continuum.

To determine the link between fields of study and labour market positions, this study draws on a new entropy-based measure by DiPrete et al. (2017). This approach differs from several previous studies, which have classified fields as either general or occupation specific (Roksa 2005) or utilized subjective measures of specificity of program (Leuze and Strauß 2009, Noelke, Gebel and Kogan 2012). A further approach has involved field-specific measures of the on-the-job training or further education provided by the employer (Ochsenfeld

[9] The intraclass correlation for fields of study, estimated by means of a random-intercept model, in Germany is p = 0.096, whereas the corresponding figure for Finland is p = 0.125.
[10] As results are sensitive to the number of categories (Smyth 2005), fields of study are categorized according to the detailed ISCED 2013 classification, identifying 39 different fields in Germany and 45 in Finland.

2014), yet this measurement focuses mainly on firm-specific rather than on occupation-specific human capital. In contrast, the "local linkage score" (DiPrete et al. 2017) measures the extent to which degree holders from different fields of study cluster in a broader or narrower range of occupations. Simplified, if highly educated workers with a degree in medicine mainly work in specific occupations, such as physician, this indicates a narrower clustering, i.e. stronger linkages between fields of study and occupations. In specific, the local-linkage score estimates how the distribution of tertiary degree holders with a field-specific degree across occupations differs from the overall distribution of workers across occupations. Following DiPrete et al. (2017: 1920), the estimator is based on all workers aged 15-64 and requires each field to entail at least 75 tertiary degree holders.[11] Table 9.3 (appendix) displays for both countries the average sex composition and local linkage score of study fields as their standard deviation over the time frame of the analysis.

The analysis controls for a set of individual- and macro-level covariates shown to predict both wages and the gender wage gap. First, it includes type of degree as a categorical variable, which for each country captures relevant degrees in the tertiary system. The models also adjust for years spent in full- and part-time employment since graduation, with part-time experience weighed with 0.5, and its quadratic term. While the GSOEP collects monthly data on employment, unemployment and family-related interruptions, detailed information on the length of family leaves is not available in the FLEED-data. Therefore, time out of the labour market is approximated by imputing 12 months of parental leave for each woman, when a child is born; an assumption that corresponds to previous studies on parental leave duration in Finland (Salmi and Lammi-Taskula 2009). Longer leaves are ascribed if mothers were not employed in the subsequent year after child-birth and/or received child home allowance. Additionally, the analysis accounts for the age of the youngest child, a partner in the household, and ethnic background. Following previous research (Busch 2013, Roksa 2005), the models adjust for the association between wages and employment characteristics, by including firm size and public sector employment. Because firm size is not reported among public sector employees in Finland, one categorical variable combines both pieces of information, distinguishing firms with less than 20 employees; 20-199; 2000-1999; at least 2000 employees; public sector employees; and missing information. It is important to note that these employment characteristics might mediate the association between fields of study and wages. For instance, the negative relation between female-dominated fields and wages might be a consequence of employment in the public sector or smaller firms. As such

[11] $M(ed)_g = \sum_j p_{j|g} \times \log\left(\frac{p_{j|g}}{p_j}\right)$, denote field-specific linkage scores. The total linkage strength of the sampled tertiary-level fields can then be written as the weighed sum the field-specific linkage scores, $M = \sum_g p_g M(ed)_g$ (DiPrete et al. 2017: 1920-21).

mediation processes partly reflect the field-specific match of graduates to labour market positions, the estimations are run excluding these employment characteristics. While moderately increasing the coefficient for female and the sex composition, the country patterns do not differ from findings presented here (results available upon request). The analyses controls for whether respondents were older than 32 years when graduating – a covariate assumed to capture labour market experience prior to graduation – ethnicity, and for Germany, whether respondents live in East or West Germany.

Finally, observing wage trajectories of higher education graduates entering the labour market at different time points (hereafter graduate cohorts) indicates that the composition of the sample might change over time. Similarly, the effect of the covariates can differ across the observation window. Analyses for Germany reveal that estimate sizes and directions are relatively stable across graduate cohorts and time points. The Finnish sample, however, is sensitive to specifications. On the one hand, the share of women graduating from the tertiary education system increased substantially over the time period, with women disproportionally opting for weakly linked fields (see Table 9.4 in appendix). On the other hand, the macro economic conditions changed, as Finland experienced a rapid growth after economic depression in the 1990s and an increase in the tech and electronic sector (Uusitalo and Vartiainen 2008). To take these temporal changes into consideration, the analyses for Finland include year fixed effects, interacted with the field-specific education employment linkage, and controls for graduate cohorts. To display the patterns over time, Table 9.8. presents models estimated for different graduate cohorts. For Germany, the models included fixed year effects and controls for cohorts. The distribution of variables is presented in Table 9.5 (appendix).

9.4 Results

9.4.1 Descriptive results

Figure 9.1 gives a first impression of how the median hourly gross wage differs between men and women during the first ten years after graduating from higher education and entering the labour market in Germany (*left-hand side*) and Finland (*right-hand side*). Although women earn less than men already in the first years after graduation, men experience a steeper wage growth than women in both countries. The predicted gender wage gap in hourly earnings during the first 10 years after graduation is approximately 20 % in Germany, compared to 18 % in Finland, when controlling for period effects and year of graduation (not shown). Hence, the difference between the countries is less marked than in previous studies that assessed monthly earnings (Triventi 2013).

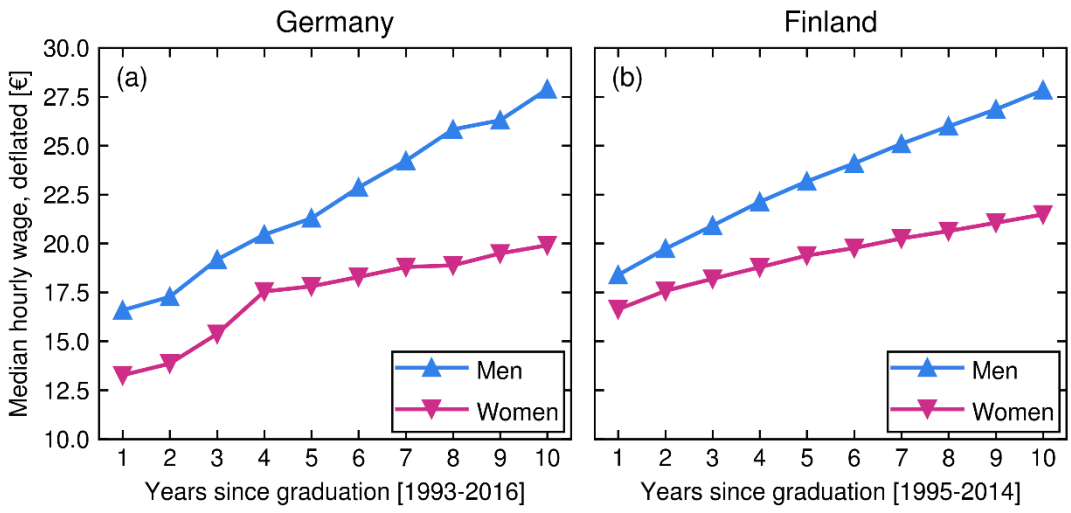

Figure 9.1 Median hourly gross wage (in Euro) during the first ten years after graduation in Germany and Finland

Source: FLEED (1995-2014); GSOEP v33.1 (1993-2016).

Before exploring how gender-specific fields of study choices translate into earnings disparities between men and women, Table 9.1 depicts the main predictors for men and women separately. These descriptive results comply with country differences detected in earlier studies (see e.g., Charles and Bradley 2009, Smyth 2005, Steinmetz 2012). In both countries, men and women opt for different fields of study; yet segregation by sex appears somewhat stronger in Finland particularly among women, as 54 % of women graduate from female-dominated fields, compared 40 % in Germany (Table 9.1). As shown in Table 9.3 (appendix), the sex composition of single fields follows similar patterns in the countries, with some notable differences in life sciences, where medicine and biology entail a higher share of women in Finland than in Germany.

Turning to field-specific education-employment linkages, variation seems to be more marked across fields than countries, as indicated by the local linkage scores and the total linkage strength (see Table 9.3, appendix). Medicine, law, but also theology represent fields with strong linkages to specific occupations, whereas e.g. history, language acquisition, and business are weakly linked. But most importantly, the results reveal that women are not underrepresented in strongly linked fields; in fact, in both countries women graduate on average from fields displaying stronger education-employment linkages than men (Table 9.2). The positive correlation between the local linkage strength and share of women in a field of study underpins this finding (Table 9.3).

Table 9.1 Descriptive statistics for main predictors of samples by gender (person-years).

	Germany				Finland			
	Women		Men		Women		Men	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Share of women in fields of study (%)	58.827	18.971	40.936	21.582	67.144	19.589	43.366	23.118
Sex composition of fields of study, categorical								
Male-dominated field	0.073		0.358		0.068		0.394	
Integrated field	0.523		0.498		0.394		0.437	
female-dominated field	0.403		0.144		0.538		0.169	
Local linkage strength	2.087	0.828	1.874	0.772	2.245	0.790	1.964	0.674

Notes: Estimates for both countries are weighed. A description of all variables can be found in Table 9.5 (appendix)
Source: FLEED merged with Structure of Earnings, GSOEP (v33.1) merged with Microcensus

9.4.2 Multivariate results

Table 9.2 presents the findings of the step-wise models for both countries (for full models, see Table 9.6 and Table 9.7 in appendix). The base line model (M0) displays estimates from a linear random-intercept regression, with wage observations nested in individuals, to demonstrate the gender wage gap without considering the variance structure of fields of studies. The following models (M1-M4), in turn, display the results of the three-level random-coefficient specification, crucial to assess how characteristics of study fields are associated with wages. Thus, by comparing the effect of the sex composition (M2) and the field-specific education-employment linkage (M3) for each country, the models explore whether the lower wages of highly qualified women are the result of a gender-neutral allocation process. By estimating cross-level interaction effects between fields of study characteristics and the female coefficient (M4) the study aims to answer the question, whether horizontal differences in educational choices have disparate effects on the wages of men and women. It is important to note that this design cannot test for causal differences, but reports on trends in Germany and Finland.

Table 9.2 Random coefficient models for estimating the logarithm of the hourly wage in Germany and in Finland

	M0		M1		M2		M3		M4	
Germany (N: 1800, n: 8148)										
Female (*Ref.* male)	-0.114***	(0.017)	-0.067***	(0.020)	-0.062**	(0.021)	-0.062**	(0.021)	-0.067**	(0.021)
Share of Women in Field of Study (10%)					-0.015*	(0.008)	-0.018*	(0.008)	-0.031***	(0.009)
Education-Employment Linkage							0.036+	(0.022)	0.065*	(0.028)
Interactions										
Share of Women in Field x Female									0.019*	(0.010)
Education-Employment Linkage									-0.037	(0.025)
Constant	2.399***	(0.061)	2.329***	(0.066)	2.332***	(0.065)	2.33***	(0.064)	2.328***	(0.064)
Individual, period, and sample controls	Yes		Yes		Yes		Yes		Yes	

	M0		M1		M2		M3		M4	
Finland (N: 47607, n: 309950)										
Female (*Ref.* male)	-0.093***	(0.003)	-0.053***	(0.007)	-0.053***	(0.007)	-0.056***	(0.008)	-0.053***	(0.007)
Share of Women in Field of Study (10%)					-0.005	(0.003)	0.004	(0.003)	0.008*	(0.004)
Education-Employment Linkage							0.060***	(0.010)	0.047***	(0.011)
Interactions										
Share of Women in Field x Female									-0.005	(0.003)
Education-Employment Linkage									0.026**	(0.008)
Interaction effect: Year (*Ref.* 2005) x education-employment linkage										
1998 x education employment linkage							0.037***	(0.005)	0.037***	(0.005)
2001 x education employment linkage							0.02***	(0.004)	0.02***	(0.004)
2010 x education employment linkage							-0.18***	(0.004)	-0.18***	(0.004)
Constant	3.022***		2.958***		2.96***		2.95***		2.95***	
Individual and period controls	Yes		Yes		Yes		Yes		Yes	

+ p < 0.10, * p<0.05, ** p<0.01, *** p<0.001, standard errors in parenthesis.

Notes: Restricted maximum likelihood estimation. Models control for labour market experience, firm size and public sector employment, family characteristics, age at graduation, type of degree, graduation cohort, year fixed effects. For Finland, the field-specific education employment linkage is interacted with year-dummies. To obtain an understanding of the pattern over time, models display three years as an example. Full models in Table 9.6 and Table 9.7 (Appendix).

Source: FLEED merged with Structure of Earnings, GSOEP (v33.1) merged with Microcensus

The baseline model (M0) presents the gender wage gap conditional on individual-level and time controls. The results confirm well-established findings: Compared to the raw gender wage gap, which amounts to 20 % in Germany and 18 % in Finland, women's lower wages can in both countries be attributed to e.g. prior labour market experience and employment characteristics, although the gender wage gap remains statistically significant with an approximate 9-11 % wage disadvantage for women. Yet, when models take the variance structure of fields of study into consideration, the female coefficient decreases substantially (M1), particularly in Finland. Incorporating the sex composition of fields does not further affect the size of the gender wage gap in Finland; in fact, the association between sex composition of a given field and wages is weak (M2).

For Germany, results are consistent with previous studies in that the share of women in a given field seems to affect wages negatively and reduces the gender wage gap moderately.[12] Thus, in Germany, net of individual- and employment characteristics, the gender wage gap can partly be attributed to the lower returns associated with female-dominated fields. At a first glance, the results are in line with hypothesis H1a and suggest that the coupling between the educational system and the labour market, as a country-level characteristic, allocates women into lower remunerated positions in Germany to a higher extent than in Finland, where a similar pattern cannot be detected.

The subsequent models (M3) explore this assumption further, by incorporating the field-specific education-employment linkage to the model. For Germany, the multivariate results underpin the unexpected descriptive findings: Whereas education-employment linkages exert a positive, though not statistically significant effect on wages, they strengthen the influence of the sex composition on wages. This suggests that fields of study, which are connected to specific occupations in the labour market, impede wage penalties associated with a higher representation of women. For Finland, the results show that the effect of education-employment linkages varies over time. In fact, particularly in the first ten years of the observed time period, strongly linked fields seem to yield higher wages, but in later years the effect is negative. Taken together, the results confirm that field-specific linkages are associated with wage benefits, particularly in the occupationalised German labour market, and to some extent in Finland. But most importantly, in Germany education-employment linkages seem protect graduates from female-dominated fields; a finding that contrasts the assumption of stronger occupation-specific pathways in male-dominated fields of study.

Of theoretical relevance is the interaction effect between the female coefficient and major characteristics (M4). The findings indicate that the coupling between the educational

[12] When the model is specified as a random-intercept, its effect size is somewhat larger (0.019). Both the estimate sizes as well as their explanatory power on the gender wage gap resembles findings reported by previous studies (Leuze and Strauß 2014; Ochsenfeld 2014).

system and the labour market is not gender-neutral, but in fact influences the wages of male and female graduates differently, and varies notably across the countries. Turning to the sex composition of fields, the results for Germany shows that the decline associated with the share of women in a given field is steeper among men than among women. Thus, highly educated women in Germany do not experience similar wage gains as their male counterparts, when graduating from male-dominated fields, but instead earn wages similar to women graduating from integrated or female-dominated fields.[13] In Finland, in turn, the sex composition does not have a disparate effect on the hourly wages of men and women, a pattern confirmed by the cohort-specific models (see Table 9.6, appendix). Taken together, the results suggest that highly qualified women graduating from male-dominated fields seem to experience stronger difficulties recouping their investments in an occupationalised system, as assumed in hypthesis *1b*. In contrast, the findings do not support the assumption, that employers are incentivized to favour men graduating from female-dominated fields of study (*H1c*).

Finally, field-specific education-employment linkages also seem to influence wages of men and women differently. In Germany, the interaction effect is not statistically significant, although the positive effect of field-specific education employment linkages, now referring to men, seems to increase wages. The opposite pattern prevails in Finland. As indicated by the steeper wage increase of the local linkage score among women, strongly linked fields seem to protect women from lower remunerated positions, while influencing the wages of men to a somewhat lower extent.[14] This pattern is consistent throughout the cohorts, also in the later years (see Table 9.6, appendix). Thus, for Finland, the findings are in line with the hypothesized benefits of strongly linked fields for women's wages in a country setting, where employers' incentive to invest in women is lower (*H2b*). Put differently, women experience the lowest wages in weakly linked fields, where employers' investment in promotions or firm-specific skill might be less important (Estévez-Abe 2005).

9.5 Discussion and conclusion

This study investigated whether gender-specific fields of study choices transform into gender-based wage disparities similarly in Finland and Germany. Previous research has repeatedly highlighted that differences in fields of study are an important source of earnings differentials between highly educated men and women in several countries. Yet the effect of field of study choices on the gender wage gap could be conditional on institutions structuring early career

13 For Germany, gender specific models confirm that the sex composition of majors is only significantly associated with the wages of men.
14 The cross-level interaction effect takes the variation in the effect of field-specific education employment linkages over time into consideration.

patterns. This study focused on one such institutional feature, namely the coupling between the educational system and the labour market, and suggested two possible patterns. Skill-regimes could allocate graduates from a given field of study to a corresponding position in a gender-neutral manner, and thereby generate gender differences in remunerations. On the other hand, if the effect of education-employment linkages is moderated by gender inequality in the labour market, fields of study choices should predict the wages of men and women differently. To examine these two mechanisms, the study took both differences *between* and *within* countries in education-employment linkages into consideration and analysed the gender wage gap during the first ten years after graduation in two different institutional contexts.

This investigation yields several important findings. First, estimates obtained by longitudinal analyses largely comply with previous cross-sectional findings on Germany: Thus, the gender wage gap can be attributed to the lower remunerations associated with a higher share of women in a given field of study. Second, when assessing the linkage as a *between-country characteristic*, the sex composition of majors seem to link graduates to lower remunerated positions according to a country pattern predicted by previous literature. Thus, the association between the sex composition of majors and hourly earnings is more pronounced in Germany, frequently described as a strongly coupled system. In contrast, the study did not detect a consistent effect of the sex composition in Finland, though it is worth noting that adjusting for the variance structure of fields substantially reduces the gender-wage gap. As such, the latter finding is in line with research on the US and the UK, showing that a higher share of women does not predict wage disadvantages in high-skilled or highly remunerated occupations (Brynin and Perales 2016, Busch 2017). However, given that Finland represents a moderately coupled system, where the horizontal sex segregation in the tertiary system and labour market is high (Charles and Bradley 2009; Grönlund, Halldén and Magnusson 2017), not detecting an effect of the sex composition *per se* raises further questions. Including graduates from universities of applied sciences, where BA-degrees tend to be more vocationally oriented, could result in a stronger importance of horizontal sex segregation.

Third, results on field-specific education-linkages, which were assessed as a *within-country* characteristic by means of a new measure (DiPrete et al. 2017), show that strongly linked fields of study yield higher wages, particularly in Germany, whereas the effect in Finland varied over time. But most importantly, the local linkage score revealed that women, on average, graduate from fields with stronger links to occupations, particularly in Finland. The finding is at odds with the assumption that women refrain from acquiring occupation-specific human capital due to anticipated interruptions (see e.g. Tam 1997). It is important to keep in mind that the measure captures occupational pathways, rather than firm-specific training, and that the analysis is restricted to the tertiary-educated workers. Thus, fields

preferred by women in the higher education system might be more strongly linked to specific occupations or professions than in other educational levels. Finally, and most importantly, fields of study choices do not allocate graduates to labour market positions in a gender-neutral manner, as skill investments predicts the wages of highly qualified men and women differently. In Germany, women graduating from male-dominated fields cannot recoup their investment to the same extent as men, as visible in the stronger association between a major's sex composition and the wages of men. This raises the question, whether women opt out from male-dominated domains, or whether working culture or working-time arrangements in these fields hamper their opportunities. Further analyses should consider the role of occupations in this process more thoroughly. In Finland, in turn, women gain more from fields with strong linkages to occupational pathways. Following Estévez-Abe (2005), highly qualified women in labour markets with extensive family policies seem to profit from occupation-specific careers with low employer involvement. This suggests that men might experience wage progressions through promotion prospects in skill-intense internal labour markets, whereas women encounter difficulties in accessing these positions. The analysis cannot disentangle whether the lower remunerations of weakly linked fields, more pronounced among women, are the result employer discrimination or restricted access to firm-specific training, or whether women graduating from these fields, in fact, opt for positions with, e.g. more family friendly working arrangements. Further research for Finland is warranted to disentangle how career ladders, and access to firm-specific training, differ both cross and within strongly and weakly linked fields, and the extent to which education-employment linkages vary over time.

Overall, the results emphasize the need to take gender-specific effects of institutions into consideration, when analysing higher education graduates' early labour market patterns and the field-specific allocation of men and women into labour market positions. Although the gender-specific effect of family formation might increase in course of employment (Braakmann 2013, Brandt 2016), differences in earnings trajectories by fields of study also grow over the career (Kim, Tamborini and Sakamoto 2015). Thus, field-specific earnings profiles, and gender differences therein, seem to have long-term consequences for wage inequality between men and women.

9.6 References

Aisenbrey, Silke and Hannah Brückner. 2008. "Occupational Aspirations and the Gender Gap in Wages." *European Sociological Review* 24(5):633-49. doi: 10.1093/esr/jcn024.

Allmendinger, Jutta and Thomas Hinz. 1997. "Mobilität Und Lebensverlauf: Deutschland, Großbritannien Und Schweden Im Vergleich." Pp. 247-85 in *Die Westeuropäischen Gesellschaften Im Vergleich*, edited by S. Hradil and S. Immerfall. Wiesbaden: VS Verlag für Sozialwissenschaften.

Barone, Carlo. 2011. "Some Things Never Change: Gender Segregation in Higher Education across Eight Nations and Three Decades." *Sociology of Education* 84(2):157-76. doi: 10.1177/0038040711402099.

Becker, Gary S. 1962. "Investment in Human Capital: A Theoretical Analysis." *Journal of Political Economy* 70(5):9-49.

Bol, Thijs and Herman G. van de Werfhorst. 2011. "Signals and Closure by Degrees: The Education Effect across 15 European Countries." *Research in Social Stratification and Mobility* 29(1):119-32. doi: http://dx.doi.org/10.1016/j.rssm.2010.12.002.

Bol, Thijs and Kim A. Weeden. 2015. "Occupational Closure and Wage Inequality in Germany and the United Kingdom." *European Sociological Review* 31(3):354-69. doi: 10.1093/esr/jcu095.

Braakmann, Nils 2013. "What Determines Wage Inequality among Young German University Graduates." *Jahrbücher für Nationalökonomie und Statistik* 233(2):130-58.

Brandt, Gesche. 2016. "Einkommensunterschiede Von Akademikerinnen Und Akademikern Im Erwerbsverlauf." *Beiträge zur Hochschulforschung* 4:40-61.

Brynin, Malcolm and Francisco Perales. 2016. "Gender Wage Inequality: The De-Gendering of the Occupational Structure." *European Sociological Review* 32(1):162-74. doi: 10.1093/esr/jcv092.

Buchmann, Claudia, Thomas A. DiPrete and Anne McDaniel. 2008. "Gender Inequalities in Education." *Annual Review of Sociology* 34:319-37.

Busch, Anne. 2013. "Der Einfluss Der Beruflichen Geschlechtersegregation Auf Den „Gender Pay Gap“." *Kölner Zeitschrift für Soziologie und Sozialpsychologie* 65(2):301-38. doi: 10.1007/s11577-013-0201-1.

Busch, Felix. 2017. "Occupational Devaluation Due to Feminization? Causal Mechanics, Effect Heterogeneity, and Evidence from the United States, 1960 to 2010." *Social Forces*. doi: 10.1093/sf/sox077.

Cha, Youngjoo and Kim A. Weeden. 2014. "Overwork and the Slow Convergence in the Gender Gap in Wages." *American Sociological Review* 79(3):457-84. doi: 10.1177/0003122414528936.

Charles, Maria and Karen Bradley. 2009. "Indulging Our Gendered Selves? Sex Segregation by Field of Study in 44 Countries ". *American Journal of Sociology* 114(4):924-76.

Di Stasio, Valentina, Thijs Bol and Herman G. Van de Werfhorst. 2016. "What Makes Education Positional? Institutions, Overeducation and the Competition for Jobs." *Research in Social Stratification and Mobility* 43:53-63. doi: http://dx.doi.org/10.1016/j.rssm.2015.09.005.

Di Stasio, Valentina and Herman G. van de Werfhorst. 2016. "Why Does Education Matter to Employers in Different Institutional Contexts? A Vignette Study in England and the Netherlands." *Social Forces* 95(1):77-106. doi: 10.1093/sf/sow027.

DiPrete, Thomas A., Thijs Bol, Christina Ciocca Eller and Herman G. van de Werfhorst. 2017. "School-to-Work Linkages in the United States, Germany, and France." *American Journal of Sociology* 122(6):1869-938. doi: 10.1086/691327.

Drasch, Katrin. 2013. "Educational Attainment and Family-Related Employment Interruptions in Germany: Do Changing Institutional Settings Matter?". *European Sociological Review* 29(5):981-95. doi: 10.1093/esr/jcs076.

England, Paula, Melissa S. Herbert, Barbara Stanek Kilbourne, Lori L. Reid and Lori McCreary Megdal. 1994. "The Gendered Valuation of Occupations and Skills: Earnings in 1980 Census Occupations." *Social Forces* 73(1):65-100. doi: 10.1093/sf/73.1.65.

Estevez-Abe, Margarita, Torben Iversen and David Soskice. 2001. "Social Protection and the Formation of Skills: A Reinterpretation of the Welfare State." Pp. 145-83 in *Varieties of Capitalism. The Institutional Foundations of Comparative Advantage*, edited by P. A. Hall and D. Soskice. Oxford: Oxford University Press.

Estévez-Abe, Margarita. 2005. "Gender Bias in Skills and Social Policies: The Varieties of Capitalism Perspective on Sex Segregation." *Social Politics: International Studies in Gender, State & Society* 12(2):180-215. doi: 10.1093/sp/jxi011.

Estévez-Abe, Margarita. 2006. "Gendering the Varieties of Capitalism. A Study of Occupational Segregation by Sex in Advanced Industrial Societies." *World Politics* 59(1):142 - 75

Evertsson, Marie, Paula England, Irma Mooi-Reci, Joan Hermsen, Jeanne de Bruijn and David Cotter. 2009. "Is Gender Inequality Greater at Lower or Higher Educational Levels? Common Patterns in the Netherlands, Sweden, and the United States." *Social Politics: International Studies in Gender, State & Society* 16(2):210-41. doi: 10.1093/sp/jxp008.

Evertsson, Marie, Daniela Grunow and Silke Aisenbrey. 2016. "Work Interruptions and Young Women's Career Prospects in Germany, Sweden and the Us." *Work, Employment & Society* 30(2):291-308. doi: 10.1177/0950017015598283.

Forster, Andrea G. and Thijs Bol. 2018. "Vocational Education and Employment over the Life Course Using a New Measure of Occupational Specificity." *Social Science Research* 70:176-97. doi: https://doi.org/10.1016/j.ssresearch.2017.11.004.

Gangl, Markus. 2001. "European Patterns of Labour Market Entry. A Dichotomy of Occupationalized Vs. Non-Occupationalized Systems?". *European Societies* 3(4):471-94. doi: 10.1080/14616690120112226.

Gangl, Markus. 2004. "Institutions and the Structure of Labour Market Matching in the United States and West Germany." *European Sociological Review* 20(3):171-87.

Gerstorf, Sandra and Jürgen Schupp. 2016. "Soep Wave Report 2015." Vol. Berlin.

Giesecke, Johannes and Steffen Schindler. 2008. "Field of Study and Flexible Work: A Comparison between Germany and the Uk." *International Journal of Comparative Sociology* 49(4-5):283-304. doi: 10.1177/0020715208093078.

Glass, Jennifer L., Sharon Sassler, Yael Levitte and Katherine M. Michelmore. 2013. "What's So Special About Stem? A Comparison of Women's Retention in Stem and Professional Occupations." *Social Forces* 92(2):723-56.

Grönlund, Anne and Charlotta Magnusson. 2016. "Family-Friendly Policies and Women's Wages – Is There a Trade-Off? Skill Investments, Occupational Segregation and the Gender Pay Gap in Germany, Sweden and the Uk." *European Societies* 18(1):91-113. doi: 10.1080/14616696.2015.1124904.

Grönlund, Anne, Karin Halldén, and Charlotta Magnusson. 2017. "A Scandinavian success story? Women's labour market outcomes in Denmark, Finland, Norway and Sweden. " *Acta Sociologica* 60(2): 97-119. doi: 10.1177/0001699316660595.

Hakim, Catherine. 2002. "Lifestyle Preferences as Determinants of Women's Differentiated Labor Market Careers." *Work and Occupations* 29(4):428-59. doi: 10.1177/0730888402029004003.

Hannan, Damian, Emer Smyth and Selina McCoy. 1999. "A Comparative Analysis of Transitions from Education to Work in Europe (Catewe) - a Conceptual Framework." Vol. *ESRI Working Paper*. Dublin European Studies Research Insitute.

Kalmijn, Mattbijs and Tanja van der Lippe. 1997. "Type of Schooling and Sex Differences in Earnings in the Netherlands." *European Sociological Review* 13(1):1-15. doi: 10.1093/oxfordjournals.esr.a018198.

Kanter, Rosabeth Moss. 1977. "Some Effects of Proportions on Group Life: Skewed Sex Ratios and Responses to Token Women." *American Journal of Sociology* 82(5):965-90. doi: 10.1086/226425.

Kim, ChangHwan, Christopher R. Tamborini and Arthur Sakamoto. 2015. "Field of Study in College and Lifetime Earnings in the United States." *Sociology of Education* 88(4):320-39. doi: 10.1177/0038040715602132.

Klein, Markus. 2011. "Higher Education and Non-Pecuniary Returns in Germany: Tracing the Mechanisms Behind Field of Study Effects at the Start of the Career." *Irish Educational Studies* 30(2):253-70. doi: 10.1080/03323315.2011.569144.

Leuze, Kathrin. 2007. "What Makes for a Good Start? Consequences of Occupation-Specific Higher Education for Career Mobility: Germany and Great Britain Compared." *International Journal of Sociology* 37(2):29-53. doi: 10.2753/IJS0020-7659370202.

Leuze, Kathrin and Susanne Strauß. 2009. "Lohnungleichheiten Zwischen Akademikerinnen Und Akademikern. Der Einfluss Von Fachlicher Spezialisierung, Frauendominierten Fächern Und Beruflicher Segregation." *Zeitschrift für Soziologie* 38(4):262-81.

Leuze, Kathrin. 2011. "How Structure Signals Status: Institutional Stratification and the Transition from Higher Education to Work in Germany and Britain." *Journal of Education and Work* 24(5):449-75. doi: 10.1080/13639080.2011.596524.

Leuze, Kathrin and Susanne Strauß. 2014. "Female-Typical Subjects and Their Effect on Wage Inequalities among Higher Education Graduates in Germany." *European Societies* 16(2):275-98. doi: 10.1080/14616696.2012.748929.

Leuze, Kathrin and Susanne Strauß. 2016. "Why Do Occupations Dominated by Women Pay Less? How 'Female-Typical' Work Tasks and Working-Time Arrangements Affect the Gender Wage Gap among Higher Education Graduates." *Work, employment and society* 30(5):802-20. doi: 10.1177/0950017015624402.

Lindberg, Matti E. 2009. "Student and Early Career Mobility Patterns among Highly Educated People in Germany, Finland, Italy, and the United Kingdom." *Higher Education* 58(3):339-58. doi: 10.1007/s10734-009-9198-9.

Machin, Stephen and Patrick A. Puhani. 2003. "Subject of Degree and the Gender Wage Differential: Evidence from the Uk and Germany." *Economics Letters* 79(3):393-400. doi: http://dx.doi.org/10.1016/S0165-1765(03)00027-2.

Magnusson, Charlotta and Magnus Nermo. 2017. "Gender, Parenthood and Wage Differences: The Importance of Time-Consuming Job Characteristics." *Social Indicators Research* 131(2):797-816. doi: 10.1007/s11205-016-1271-z.

Mandel, Hadas and Moshe Semyonov. 2005. "Family Policies, Wage Structures, and Gender Gaps: Sources of Earnings Inequality in 20 Countries." *American Sociological Review* 70(6):949-67. doi: 10.1177/000312240507000604.

Mandel, Hadas and Moshe Semyonov. 2006. "A Welfare State Paradox: State Interventions and Women's Employment Opportunities in 22 Countries." *American Journal of Sociology* 111(6):1910-49. doi: doi:10.1086/499912.

Mandel, Hadas. 2012. "Winners and Losers: The Consequences of Welfare State Policies for Gender Wage Inequality." *European Sociological Review* 28(2):241-62. doi: 10.1093/esr/jcq061.

Mann, Allison and Thomas A. DiPrete. 2013. "Trends in Gender Segregation in the Choice of Science and Engineering Majors." *Social Science Research* 42(6):1519-41. doi: http://dx.doi.org/10.1016/j.ssresearch.2013.07.002.

Manzoni, Anna, Juho Härkönen and Karl Ulrich Mayer. 2014. "Moving On? A Growth-Curve Analysis of Occupational Attainment and Career Progression Patterns in West Germany." *Social Forces* 92(4):1285-312.

Marsden, David. 1990. "Institutions and Labour Mobility: Occupational and Internal Labour Markets in Britain, France, Italy and West Germany." Pp. 414-38 in *Labour Relations and Economic Performance: Proceedings of a Conference Held by the International Economic Association in Venice, Italy*, edited by R. Brunetta and C. Dell'Aringa. London: Palgrave Macmillan UK.

Mincer, Jacob and Solomon Polachek. 1974. "Family Investments in Human Capital: Earnings of Women." *Journal of Political Economy* 82(2):S76-S108.
Müller, Walter and Yossi Shavit. 1998. "The Institutional Embeddedness of the Stratification Process. A Comparative Study of Occupations in Thirteen Countries." Pp. 1-48 in *From School to Work. A Comparative Study of Educational Qualifications and Occupational Destinations*, edited by Y. Shavit and W. Müller. Oxford: Clarendon Press.
Murphy, Emily and Daniel Oesch. 2016. "The Feminization of Occupations and Change in Wages: A Panel Analysis of Britain, Germany, and Switzerland." *Social Forces* 94(3):1221-55. doi: 10.1093/sf/sov099.
Napari, Sami. 2008. "The Early-Career Gender Wage Gap among University Graduates in the Finnish Private Sector." *Labor* 22(4):697-733. doi: 10.1111/j.1467-9914.2008.00429.x.
Noelke, Clemens, Michael Gebel and Irena Kogan. 2012. "Uniform Inequalities: Institutional Differentiation and the Transition from Higher Education to Work in Post-Socialist Central and Eastern Europe." *European Sociological Review* 28(6):704-16. doi: 10.1093/esr/jcs008.
Ochsenfeld, Fabian. 2014. "Why Do Women's Fields of Study Pay Less? A Test of Devaluation, Human Capital, and Gender Role Theory." *European Sociological Review* 30(4):536-48. doi: 10.1093/esr/jcu060.
OECD. 2017. *Education at a Glance 2017. Oecd Indicators*, Edited by O. Publishing. Paris.
Olitsky, Neal H. 2014. "How Do Academic Achievement and Gender Affect the Earnings of Stem Majors? A Propensity Score Matching Approach." *Research in Higher Education* 55(3):245-71. doi: 10.1007/s11162-013-9310-y.
Perales, Francisco. 2013. "Occupational Sex-Segregation, Specialized Human Capital and Wages: Evidence from Britain." *Work, employment and society* 27(4):600-20. doi: 10.1177/0950017012460305.
Polachek, Solomon W. 1981. "Occupational Self-Selection: A Human Capital Approach to Sex Differences in Occupational Structure." *The Review of Economics and Statistics* 63(1):60-69.
Polavieja, Javier G. 2008. "The Effect of Occupational Sex-Composition on Earnings: Job-Specialization, Sex-Role Attitudes and the Division of Domestic Labour in Spain." *European Sociological Review* 24(2):199-213. doi: 10.1093/esr/jcm043.
Prix, Irene. 2009. "Gender and Recent Graduates' Occupational Stratification: The Interactive Role of the Educational and Employment Sectors in Four Countries." *Comparative Education* 45(4):545-68. doi: 10.1080/03050060903391602.
Prix, Irene. 2013. "More or Different Education? The Joint Impact of Educational Level and Fields of Study on Earnings Stratification in Finland, 1985–2005." *Acta Sociologica* 56(3):265-84. doi: 10.1177/0001699312474381.
Rabe-Hesketh, Sofia and Andreas Skrondal. 2012. *Multilevel and Longitudinal Modeling Using Stata. Volume I: Continuous Responses*. Texas: StataPress.
Ray, Rebecca, Janet C. Gornick and John Schmitt. 2010. "Who Cares? Assessing Generosity and Gender Equality in Parental Leave Policy Designs in 21 Countries." *Journal of European Social Policy* 20(3):196-216. doi: 10.1177/0958928710364434.
Reimer, David, Clemens Noelke and Aleksander Kucel. 2008. "Labor Market Effects of Field of Study in Comparative Perspective: An Analysis of 22 European Countries." *International Journal of Comparative Sociology* 49(4-5):233-56. doi: 10.1177/0020715208093076.
Reimer, David and Stephanie Steinmetz. 2009. "Highly Educated but in the Wrong Field?". *European Societies* 11(5):723-46. doi: 10.1080/14616690802326400.
Ridgeway, Cecilia L. and Shelley J. Correll. 2004. "Unpacking the Gender System." *Gender & Society* 18(4):510-31. doi: doi:10.1177/0891243204265269.
Ridgeway, Cecilia L. 2014. "Why Status Matters for Inequality." *American Sociological Review* 79(1):1-16. doi: 10.1177/0003122413515997.

Roksa, Josipa. 2005. "Double Disadvantage or Blessing in Disguise? Understanding the Relationship between College Major and Employment Sector." *Sociology of Education* 78(3):207-32. doi: 10.1177/003804070507800302.

Sacchi, Stefan, Irene Kriesi and Marlis Buchmann. 2016. "Occupational Mobility Chains and the Role of Job Opportunities for Upward, Lateral and Downward Mobility in Switzerland." *Research in Social Stratification and Mobility* 44:10-21. doi: http://dx.doi.org/10.1016/j.rssm.2015.12.001.

Salmi, Minna and Johanna Närvi Lammi-Taskula. 2009. "Perhevapaat Ja Työelämän Tasa-Arvo " Vol. 24/2009. Helsinki: Työ- ja elinkeinoministeriö.

Shauman, Kimberlee A. 2006. "Occupational Sex Segregation and the Earnings of Occupations: What Causes the Link among College-Educated Workers?". *Social Science Research* 35(3):577-619. doi: http://dx.doi.org/10.1016/j.ssresearch.2004.12.001.

Sirniö, Outi, Timo M. Kauppinen and Pekka Martikainen. 2016. "Income Trajectories after Graduation: An Intergenerational Approach." *Advances in Life Course Research* 30:72-83. doi: http://dx.doi.org/10.1016/j.alcr.2016.04.001.

Smyth, Emer. 2005. "Gender Differentiation and Early Labour Market Integration across Europe." *European Societies* 7(3):451-79. doi: 10.1080/14616690500194084.

Solga, Heike and Lisa Pfahl. 2009. "Doing Gender Im Technisch-Naturwissen-Schaftlichen Bereich." Pp. 155-218 in *Förderung Des Nachwuchses in Technik Und Naturwissenschaft: Beiträge Zu Den Zentralen Handlungsfeldern*, edited by J. Milberg. Berlin, Heidelberg: Springer Berlin Heidelberg.

Spence, Michael. 1973. "Job Market Signaling." *The Quarterly Journal of Economics* 87(3):355-74.

Steinmetz, Stephanie. 2012. *The Contextual Challenges of Occupational Sex Segregation. Deciphering Cross-National Differences in Europe*. Wiesbaden: VS Verlag für Sozialwissenschaften.

Tam, Tony. 1997. "Sex Segregation and Occupational Gender Inequality in the United States: Devaluation or Specialized Training?". *American Journal of Sociology* 102(6):1652-92.

Triventi, Moris. 2013. "The Gender Wage Gap and Its Institutional Context: A Comparative Analysis of European Graduates." *Work, Employment & Society* 27(4):563-80. doi: 10.1177/0950017012460322.

Uusitalo, Roope and Juhana Vartiainen. 2008. "Finland: Firm Factors in Wages and Wage Changes." Pp. 149-78 in *The Structure of Wages: An International Comparison*, edited by E. P. Lazear and K. L. Shaw. University of Chicago Press: Chicago.

van de Werfhorst, Herman G. and Gerbert Kraaykamp. 2001. "Four Field-Related Educational Resources and Their Impact on Labor, Consumption, and Sociopolitical Orientation." *Sociology of Education* 74(4):296-317. doi: 10.2307/2673137.

van de Werfhorst, Herman G. 2004. "Systems of Educational Specialization and Labor Market Outcomes in Norway, Australia, and the Netherlands." *International Journal of Comparative Sociology* 45(5):315-35. doi: 10.1177/0020715204054154.

van de Werfhorst, Herman G. 2011. "Skill and Education Effects on Earnings in 18 Countries: The Role of National Educational Institutions." *Social Science Research* 40(4):1078-90. doi: http://dx.doi.org/10.1016/j.ssresearch.2011.03.004.

Wagner, Gert G, Joachim R Frick and Jürgen Schupp. 2007. "The German Socio-Economic Panel Study (Soep): Scope, Evolution and Enhancement." Vol. *SOEPpapers on Multidisciplinary Panel Data Research, No. 1*. Berlin.

Weeden, Kim. 2002. "Why Do Some Occupations Pay More Than Others? Social Closure and Earnings Inequality in the United States." *The American Journal of Sociology* 108(1):55-101. doi: citeulike-article-id:6176092.

Williams, C. L. 1995. *Still a Man's World: Men Who Do 'Women'S Work'*. Berkeley, CA.

9.7 Appendix

Table 9.3 Descriptive statistics for fields of study.

Fields of study	Germany				Finland			
	% women	SD	Local linkage	SD	% women	SD	Local linkage	SD
Education science	76.84	2.37	1.84	0.15	90.14	1.94	1.61	0.09
Primary and special education,	84.98	2.56	2.90	0.12	76.86	4.16	2.90	0.07
Secondary education	72.50	1.27	2.40	0.09	71.25	3.88	3.13	0.05
Pre-school education					93.95	1.02	2.75	0.11
Audio-visual techniques, media					65.37	0.76	1.67	0.28
Fine Arts (incl. history of art)	66.95	6.85	1.94	0.07	69.42	1.42	1.60	0.19
Music and performing arts	56.79	4.40	2.78	0.08	63.93	2.18	2.49	0.19
History and archelogy	48.81	7.63	1.41	0.27	54.87	3.55	1.56	0.09
Philosophy					41.68	6.73	1.52	0.18
Theology, religion	50.91	3.60	3.99	0.14	56.60	5.27	3.52	0.12
Humanities, general					61.85	4.17	1.30	0.17
Languages (foreign)	77.77	7.31	1.50	0.19	89.42	1.75	1.11	0.17
Languages (native, literature)	79.30	2.32	1.52	0.14	85.53	2.20	1.41	0.09
Economics					43.04	3.04	1.42	0.08
Political/ Civic Science	62.90	0.00	1.41	0.00	62.10	6.23	1.62	0.15
Psychology	79.62	5.03	2.37	0.16	85.35	2.41	2.93	0.10
Sociology, cultural studies, social work	74.37	3.06	2.10	0.05	79.85	3.99	1.81	0.05
Journalism, library studies	77.25	8.91	3.13	0.29	76.52	4.40	2.49	0.34
Administration	53.74	2.87	2.14	0.20	61.83	3.32	1.43	0.10
Law	48.41	4.03	3.25	0.10	53.11	3.74	2.59	0.13
Business	44.43	3.97	1.04	0.04	51.00	1.64	1.34	0.07
Biology and biochemistry	60.42	6.86	1.96	0.09	72.00	6.42	2.07	0.19
Environment	46.75	10.22	2.05	0.31	72.11	4.97	2.34	0.35
Chemistry	41.41	2.96	2.00	0.12	54.29	4.50	1.97	0.06
Earth sciences, general nat. sciences	37.78	11.97	1.39	0.16	51.66	6.45	1.97	0.27
Physics	18.10	5.74	2.18	0.07	22.70	3.65	2.01	0.16
Mathematics	39.50	2.49	1.95	0.13	44.62	3.48	1.71	0.16
Statistics					49.13	8.84	1.91	0.21
Computing	16.49	1.28	2.34	0.17	17.69	1.95	1.80	0.15
Chemical and mechanical engineering	14.25	3.11	1.48	0.04	21.06	2.19	1.56	0.11
Energy, electrical engineering	8.30	1.27	1.59	0.02	13.40	3.22	1.57	0.06
Motor, vehicles, and aircrafts					44.55	7.10	1.51	0.04
Manufacturing and processing	33.43	0.00	1.16	0.00	36.35	6.42	1.62	0.10
Architecture, town planning, interior decoration	49.27	5.54	2.22	0.17	49.35	4.39	2.68	0.42
Building, civil engineering	21.99	2.42	1.94	0.11	27.78	4.81	2.20	0.38
Engineering (general)	18.52	5.54	1.53	0.08	40.02	14.84	1.37	0.29
Crop, horticulture, food, beverages, animals	41.50	3.19	1.08	0.11	59.98	4.38	1.60	0.18
Forestry	41.21	1.37	2.83	0.32	34.40	6.49	1.95	0.21
Veterinary	49.37	12.60	3.13	0.18	88.08	5.45	3.31	0.12
Dental Studies	53.21	6.43	4.01	0.06	73.41	1.56	3.84	0.12
Human Medicine	52.51	3.54	3.75	0.05	64.05	2.24	3.64	0.05
Pharmacy	75.37	1.14	3.14	0.48	88.74	1.43	3.10	0.22
Health Science, Nursing	78.38	0.52	1.95	0.00	90.89	4.07	1.78	0.08
Personal Services	80.17	7.92	0.85	0.07	77.20	14.37	1.31	0.15
Sports	68.20	12.07	1.42	0.69	61.39	3.92	1.64	0.15
Total linkage score (higher education)	*1.962*				*2.093*			
Correlation: sex composition and education-employment linkage	0.196				0.294			

Notes: The correlation is calculated on the level of fields of study by drawing on the field-specific mean value.
Source: FLEED merged with Structure of Earnings, GSOEP (v33.1 1991-2014) merged with Microcensus

Table 9.4 Change in composition and education-employment linkages over time in Finland.

	WOMEN		MEN		
	Education-employment linkages		Education-employment linkages		
Graduation cohort	mean	median	mean	median	Share of women among graduates
1995	2.317	2.034	2.119	1.873	0.554
1996	2.274	1.971	2.09	1.798	0.578
1997	2.3	2.26	2.052	1.89	0.565
1998	2.292	2.251	2.048	1.732	0.573
1999	2.196	1.97	2.01	1.731	0.57
2000	2.124	1.878	1.874	1.529	0.59
2001	2.156	1.939	1.909	1.592	0.584
2002	2.122	1.878	1.879	1.592	0.58
2003	2.112	1.847	1.855	1.649	0.601
2004	2.092	1.847	1.872	1.61	0.613
2005	1.989	1.692	1.72	1.477	0.603
2006	2.094	1.838	1.802	1.573	0.606
2007	2.078	1.833	1.806	1.573	0.602
2008	1.955	1.714	1.777	1.573	0.619

Source: FLEED merged with Structure of Earnings (1995-2008)

Table 9.5 Descriptive statistics of samples by gender (person-years).

	Germany				Finland			
	Women		Men		Women		Men	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Hourly wage (deflated, €)	18.168	9.402	22.069	10.620	22.501	116.623	25.722	60.574
Share of women in fields of study (%)	58.827	18.971	40.936	21.582	67.144	19.589	43.366	23.118
Sex composition of fields of study, categorical								
Male-dominated field	0.073		0.358		0.068		0.394	
Integrated field	0.523		0.498		0.394		0.437	
female-dominated field	0.403		0.144		0.538		0.169	
Local linkage strength	2.087	0.828	1.874	0.772	2.245	0.790	1.964	0.674
Public sector, size of firm (in private sector)								
Public sector	0.439		0.281		0.544		0.344	
< 20	0.156		0.180		0.109		0.108	
20 -199	0.156		0.171		0.176		0.251	
200 - 1999	0.108		0.153		0.110		0.210	
>=2000	0.141		0.215		0.018		0.040	
Missing					0.044		0.046	
Level of tertiary degree								
Germany								
BA university	0.016		0.009					
MA and BA applied sciences	0.301		0.342					
MA, Diplom (university)	0.592		0.563					
PhD	0.017		0.042					
Other	0.019		0.019					
Missing	0.056		0.068					
Finland								
BA					0.082		0.023	
Master					0.883		0.910	
PhD					0.035		0.066	
Years of experience	3.756	2.530	4.175	2.651	3.439	2.391	4.325	2.716
Age of Youngest Child								
Child below 4	0.088		0.181		0.293		0.364	
Child between 4 and 6	0.044		0.048		0.097		0.073	
Child between 7 and 16	0.039		0.031		0.057		0.036	
No child/child > 16)	0.830		0.740		0.552		0.527	
Partner in household	0.546		0.587		0.751		0.772	
Migration background (*Ref.* no)	0.134		0.156					
Language								
Finnish					0.918		0.912	
Swedish					0.066		0.065	
Other					0.016		0.023	
Age when graduating > 32	0.076		0.125		0.101		0.100	
Region, West (*Ref.* East)	0.853		0.882					
N (individual-years)	3623		4415		172 195		130 369	

Notes: Estimates for both countries are weighed. For Finland, weights are not available for the year 2014.

Source: FLEED merged with Structure of Earnings, GSOEP (v33.1) merged with Microcensus

Table 9.6 Random coefficient models for estimating the logarithm of the hourly wage in Germany.

Germany	M0		M1		M2		M3		M4	
Female (*Ref.* male)	-0.114	***	-0.067	***	-0.062	**	-0.062	**	-0.067	**
	(0.017)		(0.020)		(0.021)		(0.021)		(0.021)	
Share of Women in Field (10%)					-0.015	*	-0.018	*	-0.031	***
					(0.008)		(0.008)		(0.009)	
Education-Employment Linkage							0.036	+	0.065	*
							(0.022)		(0.028)	
Cross-level interactions										
Share of Women in Field x Female									0.019	*
									(0.010)	
Local Education-Employment Linkage x Female									-0.037	
									(0.025)	
Individual-level controls										
Degree (*Ref.* Diplom/MA-degree university)										
BA-degree (university)	-0.27	***	-0.276	***	-0.278	***	-0.276	***	-0.278	***
	(0.058)		(0.059)		(0.059)		(0.059)		(0.059)	
Applied sciences (Diplom, BA, MA)	-0.066	***	-0.067	***	-0.069	***	-0.067	***	-0.069	***
	(0.018)		(0.019)		(0.019)		(0.019)		(0.019)	
PhD	0.136	***	0.113	***	0.115	***	0.115	***	0.116	***
	(0.030)		(0.032)		(0.031)		(0.031)		(0.031)	
Other	-0.069		-0.029		-0.029		-0.028		-0.025	
	(0.053)		(0.053)		(0.053)		(0.053)		(0.053)	
Missing	-0.045		-0.069	+	-0.068	+	-0.071	+	-0.07	+
	(0.037)		(0.037)		(0.037)		(0.037)		(0.037)	
Employment Experience (years)	0.12	***	0.117	***	0.116	***	0.116	***	0.116	***
	(0.006)		(0.006)		(0.006)		(0.006)		(0.006)	
Employment Experience² (years)	-0.007	***	-0.007	***	-0.006	***	-0.006	***	-0.006	***
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)	
Firm size (Ref. 200-1999 employees)										
Public Sector	-0.106	***	-0.083	***	-0.083	***	-0.084	***	-0.084	***
	(0.017)		(0.017)		(0.017)		(0.017)		(0.017)	
< 20	-0.176	***	-0.16	***	-0.16	***	-0.161	***	-0.161	***
	(0.019)		(0.019)		(0.019)		(0.019)		(0.019)	
20-199	-0.08	***	-0.07	***	-0.07	***	-0.07	***	-0.07	***
	(0.018)		(0.018)		(0.018)		(0.018)		(0.018)	
>=2000	0.075	***	0.068	***	0.068	***	0.068	***	0.068	***
	(0.017)		(0.017)		(0.017)		(0.017)		(0.017)	
Family and Partner										
Age of Youngest Child (*Ref.* no child/child > 16)										
Child below 4	0.051	***	0.05	***	0.051	***	0.051	***	0.051	***
	(0.014)		(0.013)		(0.013)		(0.013)		(0.013)	
Child between 4 and 6	0.035	+	0.038	*	0.038	*	0.037	*	0.038	*
	(0.019)		(0.019)		(0.019)		(0.019)		(0.019)	
Child between 8 and 16	-0.006		-0.002		-0.002		-0.002		-0.002	
	(0.026)		(0.026)		(0.026)		(0.026)		(0.026)	
Partner in household (*Ref.* no partner)	0.042	***	0.038	**	0.038	**	0.038	**	0.038	**
	(0.012)		(0.012)		(0.012)		(0.012)		(0.012)	
Migration background (*Ref.* no)	-0.004		-0.021		-0.022		-0.022		-0.023	
	(0.021)		(0.021)		(0.021)		(0.021)		(0.021)	
Older than 32 when graduating	0.029		0.044		0.044		0.043		0.045	
	(0.030)		(0.029)		(0.029)		(0.029)		(0.029)	
Year of graduation (*Ref.* 2003-2006)										
1992-1995	0.162	***	0.148	**	0.146	**	0.144	**	0.139	**
	(0.049)		(0.048)		(0.048)		(0.048)		(0.048)	
1996-1999	0.103	**	0.098	**	0.099	**	0.095	**	0.092	*
	(0.037)		(0.037)		(0.037)		(0.037)		(0.037)	

2000-2002	0.048	+	0.039		0.039		0.036		0.037	
	(0.028)		(0.027)		(0.027)		(0.027)		(0.027)	
2007-2010	-0.008		-0.016		-0.013		-0.013		-0.01	
	(0.026)		(0.025)		(0.025)		(0.025)		(0.025)	
Region, West (*Ref.* East)	0.18	***	0.182	***	0.183	***	0.182	***	0.181	***
	(0.019)		(0.018)		(0.018)		(0.018)		(0.018)	
Source of higher education degree (*Ref.* Transition retrospective)										
Transition observed	-0.08	***	-0.081	***	-0.084	***	-0.086	***	-0.087	***
	(0.020)		(0.019)		(0.019)		(0.019)		(0.019)	
Imputation of wages (Ref. No imputation)										
Monthly earnings imputed	0.042	*	0.033	+	0.033	+	0.033	+	0.033	+
	(0.017)		(0.017)		(0.017)		(0.017)		(0.017)	
Annual bonuses imputed	0.113	***	0.106	***	0.106	***	0.106	***	0.106	***
	(0.026)		(0.025)		(0.025)		(0.025)		(0.025)	
Constant	2.399	***	2.329	***	2.332	***	2.33	***	2.328	***
	(0.061)		(0.066)		(0.065)		(0.064)		(0.064)	
N (individuals)	1800		1800		1800		1800		1800	
n (individual-years)	8148		8148		8148		8148		8148	

+ p< 0.10, * p<0.05, ** p<0.01, *** p<0.001, standard errors in parenthesis

Notes: Restricted maximum likelihood estimation. Models adjust for time-fixed effects (not displayed)

Source: GSOEP (v33.1 1993-2016) merged with Microcensus

Table 9.7 Random-coefficient models for estimating the logarithm of the hourly wage in Finland.

Finland	M0		M1		M2		M3		M4	
Female (Ref. male)	-0.093	***	-0.053	***	-0.053	***	-0.056	***	-0.053	***
	(0.003)		(0.007)		(0.007)		(0.008)		(0.007)	
Share of Women in Field (10%)					-0.005		0.004		0.008	*
					(0.003)		(0.003)		(0.004)	
Education-Employment Linkage							0.06	***	0.047	***
							(0.01)		(0.011)	
Cross-level Interactions										
Share of Women in Field of Study x Female									-0.005	
									(0.003)	
Education-Employment Linkage x Female									0.026	**
									(0.008)	
Individual-level controls										
Degree (Ref. MA-degree)										
BA-degree	-0.257	***	-0.162	***	-0.162	***	-0.168	***	-0.169	***
	(0.006)		(0.007)		(0.007)		(0.007)		(0.007)	
PhD	0.12	***	0.097	***	0.097	***	0.098	***	0.098	***
	(0.004)		(0.004)		(0.004)		(0.004)		(0.004)	
Employment Experience (years)	0.039	***	0.034	***	0.034	***	0.037	***	0.037	***
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)	
Employment Experience² (years)	0	***	0	***	0	***	0		0	
	(0.000)		(0.000)		(0.000)		(0.004)		(0.000)	
Firm size (*Ref.* 200-1999 employees)										
Public Sector	-0.142	***	-0.149	***	-0.149	***	-0.147	***	-0.147	***
	(0.003)		(0.003)		(0.003)		(0.003)		(0.003)	
< 20	-0.073	***	-0.07	***	-0.07	***	-0.074	***	-0.074	***
	(0.004)		(0.003)		(0.003)		(0.003)		(0.003)	
20-199	-0.024	***	-0.022	***	-0.022	***	-0.025	***	-0.025	***
	(0.003)		(0.002)		(0.002)		(0.002)		(0.002)	
>=2000	0.01	*	0.012	**	0.012	**	0.012	**	0.012	**
	(0.004)		(0.004)		(0.004)		(0.004)		(0.004)	
Missing	-0.06	***	-0.051	***	-0.051	***	-0.07	***	-0.07	***
	(0.003)		(0.003)		(0.003)		(0.003)		(0.003)	
Family and Partner										
Age of Youngest Child (Ref. No child/child > 16)										
Child below 4	0.019	***	0.015	***	0.015	***	0.013	***	0.013	***
	(0.002)		(0.002)		(0.002)		(0.002)		(0.002)	
Child between 4 and 6	0.03	***	0.028	***	0.028	***	0.028	***	0.028	***
	(0.003)		(0.003)		(0.003)		(0.003)		(0.003)	
Child between 8 and 16	0.009	*	0.009	**	0.009	**	0.012	***	0.012	***
	(0.004)		(0.004)		(0.004)		(0.003)		(0.003)	
Partner in household (*Ref.* No partner)	0.013	***	0.012	***	0.012	***	0.011	***	0.011	***
	(0.002)		(0.002)		(0.002)		(0.002)		(0.002)	
Language (Ref. Finnish)										
Swedish	0.01	*	0.006		0.006		0.007		0.007	
	(0.005)		(0.005)		(0.005)		(0.005)		(0.005)	
Other	-0.027	**	-0.063	***	-0.063	***	-0.062	***	-0.062	***
	(0.009)		(0.008)		(0.008)		(0.008)		(0.008)	
Older than 32 when graduating (*Ref.* 31 or younger)	0.007		0.03	***	0.03	***	0.026	***	0.025	***
	(0.004)		(0.004)		(0.004)		(0.004)		(0.004)	
Year of labour market entry (*Ref. 2002*-2005)										
1998-2001	0.03	***	0.044	***	0.043	***	0.053	***	0.053	***
	(0.006)		(0.005)		(0.005)		(0.005)		(0.005)	
2002-2005	-0.007		0.01	*	0.009	*	0.021	***	0.021	***
	(0.004)		(0.004)		(0.003)		(0.004)		(0.004)	

2006-2009	0.027	***	0.012	***	0.013	***	-0.009	*	-0.008	*
	(0.004)		(0.004)		(0.004)		(0.004)		(0.004)	
Interaction effect: Year (*Ref.* 2005) x education-employment linkage										
1995 x education employment linkage							0.08	***	0.08	***
							(0.009)		(0.009)	
1998 x education employment linkage							0.037	***	0.037	***
							(0.005)		(0.005)	
2001 x education employment linkage							0.02	***	0.02	***
							(0.004)		(0.004)	
2006 x education employment linkage							-0.095	***	-0.095	***
							(0.003)		(0.003)	
2010 x education employment linkage							-0.18	***	-0.18	***
							(0.004)		(0.004)	
2013 x education employment linkage							-0.18	***	-0.18	***
							(0.004)		(0.004)	
Constant	3.022	***	2.958	***	2.96	***	2.95	***	2.95	***
	(0.005)		(0.019)		(0.019)		(0.02)		(0.021)	
N (individuals	47607		47607		47607		47607		47607	
n (individual-years)	309950		309950		309950		309950		309950	

+ p< 0.10, * p<0.05, ** p<0.01, *** p<0.001, standard errors in parenthesis

Notes: Restricted maximum likelihood estimation. Models adjust for time-fixed effects (not displayed) and interaction effects between the education-employment linkage and years. To obtain an understanding of the pattern over time, models display six years as an example.

Source: FLEED merged with Structure of Earnings (1995-2014)

Table 9.8 Random-coefficient models for estimating the logarithm of the hourly wage in Finland for four selected graduation cohorts.

	M0		M1		M2		M3		M4	
Finland 1997 (n: 20499)										
Female (*Ref.* male)	-0.069 ***	(0.011)	-0.061 ***	(0.014)	-0.060 ***	(0.014)	-0.058 ***	(0.014)	-0.059 ***	(0.014)
Share of Women in Field of Study (10%)					-0.011 **	(0.010)	-0.016	(0.009)	-0.017	(0.010)
Education-Employment Linkage							0.066 *	(0.029)	0.044 *	(0.033)
Interactions										
Share of Women in Field x Female									0.003	(0.007)
Local Education-Employment Linkage									0.034	(0.066)
Constant	2.982 ***	(0.015)	2.888 ***	(0.026)	2.887 ***	(0.026)	2.885 ***	(0.026)	2.882 ***	(0.026)
Individual and period controls	Yes		Yes		Yes		Yes		Yes	

	M0		M1		M2		M3		M4	
Finland 2000 (n: 21365)										
Female (*Ref.* male)	-0.084 ***	(0.010)	-0.047 ***	(0.015)	-0.046 **	(0.015)	-0.045 **	(0.015)	-0.035 **	(0.012)
Share of Women in Field of Study (10%)					-0.021 **	(0.007)	-0.022 **	(0.010)	-0.025 **	(0.009)
Education-Employment Linkage							0.057 *	(0.017)	0.002	(0.030)
Interactions										
Share of Women in Field x Female									0.005	(0.006)
Local Education-Employment Linkage									0.066 ***	(0.087)
Constant	3.006 ***	(0.016)	2.946 ***	(0.027)	2.948 ***	(0.026)	2.953 ***	(0.025)	2.943 ***	(0.026)
Individual and period controls	Yes		Yes		Yes		Yes		Yes	

	M0		M1		M2		M3		M4	
Finland 2003 (n: 22224)										
Female (*Ref.* male)	-0.090 ***	(0.010)	-0.048 ***	(0.014)	-0.048 ***	(0.014)	-0.047 ***	(0.013)	-0.036 **	(0.011)
Share of Women in Field of Study (10%)					0.002	(0.008)	-0.001	(0.008)	0.007	(0.010)
Education-Employment Linkage							0.034	(0.009)	-0.036	(0.036)
Interactions										
Share of Women in Field x Female									-0.008	(0.005)
Local Education-Employment Linkage									0.065 ***	(0.015)
Constant	3.019 ***	(0.016)	2.959 ***	(0.028)	2.958 ***	(0.028)	2.963 ***	(0.028)	2.950 ***	(0.030)
Individual and period controls	Yes		Yes		Yes		Yes		Yes	

	M0		M1		M2		M3		M4	
Finland 2006 (n: 18702)										
Female (*Ref.* male)	-0.107 ***	(0.010)	-0.054 ***	(0.014)	-0.053 ***	(0.014)	-0.054 ***	(0.013)	-0.048 **	(0.013)
Share of Women in Field of Study (10%)					-0.006	(0.008)	-0.012	(0.008)	-0.008	(0.010)
Education-Employment Linkage							0.070 **	(0.026)	0.026	(0.036)
Interactions										
Share of Women in Field x Female									0.006	(0.006)
Local Education-Employment Linkage									0.034 *	(0.034)
Constant	2.936 ***	(0.016)	2.883 ***	(0.030)	2.885 ***	(0.030)	2.901 ***	(0.030)	2.892 ***	(0.030)
Individual and period controls	Yes		Yes		Yes		Yes		Yes	

+ p < 0.10, * p<0.05, ** p<0.01, *** p<0.001, standard errors in parenthesis.

Notes: Restricted maximum likelihood estimation. Models control for labour market experience, firm size and public sector employment, family characteristics, age at graduation, type of degree, and year fixed effects.

Source: FLEED merged with Structure of Earnings (1997-2014)

10 Sub-Study IV: Fast Lane or Down the Drain? Does the Occupation Held Prior to Unemployment shape the Transition Back to Work?

Abstract

In this paper, we analyse transitions from unemployment into re-employment from 1993 to 2010 among German men and women, and ask whether gender differences in unemployment trajectories can be explained by the fact that men and women work in different occupations prior to unemployment. In particular, we focus on whether the sex composition of the pre-unemployment occupation plays a crucial role in structuring unemployment trajectories, or whether other occupational characteristics, such as occupational closure, are more important. We test this framework by means of retrospective life histories drawn from the German National Educational Panel Study. This individual level data is linked to aggregated occupational information, which is constructed from the German Microcensus and the Sample of Integrated Labour Market Biographies. The results of the Cox proportional-hazard models indicate that occupational characteristics predict gender differences in unemployment trajectories. Working in a male-dominated occupation prior to unemployment influences the transition rate into employment positively. At the same time, our analyses reveal that the effects of occupational characteristics differ substantially between men and women.

Keywords

Unemployment, gender, occupation, gender segregation, crowding, occupational closure

Highlights

- We study the role of occupations for transitions out of unemployment in Germany.
- Occupations account for the female disadvantage in re-employment after job loss.
- Male-dominated occupations are associated with higher transition rates into employment.
- The effects of occupational characteristics differ between men and women.
- We combine individual employment trajectories with rich occupational panel data.

DOI

https://doi.org/10.1016/j.rssm.2017.03.005

11 References

Achatz, Juliane, Hermann Gartner, and Timea Glück. 2005. "Bonus or bias?" *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie* 57(3):466-93.

Aisenbrey, Silke, and Hannah Brückner. 2008. "Occupational Aspirations and the Gender Gap in Wages." *European Sociological Review* 24(5):633-49.

Aisenbrey, Silke, and Anette Fasang. 2017. "The Interplay of Work and Family Trajectories over the Life Course: Germany and the United States in Comparison." *American Journal of Sociology* 122(5):1448-84.

Albrecht, James, Anders Björklund, and Susan Vroman. 2003. "Is There a Glass Ceiling in Sweden?" *Journal of Labor Economics* 21(1):145-77.

Allmendinger, Jutta. 1989. "Educational systems and labor market outcomes." *European Sociological Review* 5(3):231-50.

Allmendinger, Jutta, and Thomas Hinz. 1997. "Mobilität und Lebensverlauf: Deutschland, Großbritannien und Schweden im Vergleich." Pp. 247-85 in *Die westeuropäischen Gesellschaften im Vergleich*, edited by Stefan Hradil and Stefan Immerfall. Wiesbaden: VS Verlag für Sozialwissenschaften.

Allmendinger, Jutta, Corinna Kleinert, Manfred Antoni, Bernhard Christoph, Katrin Drasch, Florian Janik, Kathrin Leuze, Britta Matthes, Reinhard Pollak, and Michael Ruland. 2011. "18 Adult education and lifelong learning." *Zeitschrift für Erziehungswissenschaft* 14(0):283-99.

Alon, Sigal, and Thomas A. DiPrete. 2015. "Gender Differences in the Formation of a Field of Study Choice Set." *Sociological Science* 2:50-81.

Arulampalam, Wiji. 2001. "Is Unemployment Really Scarring? Effects of Unemployment Experiences on Wages." *The Economic Journal* 111(475):585-606.

Bächmann, Ann-Christin, and Dörthe Gatermann. 2017. "The duration of family-related employment interruptions – the role of occupational characteristics." *Journal for Labour Market Research* 50(1):143-60.

Baker, David P., and Deborah Perkins Jones. 1993. "Creating Gender Equality: Cross-national Gender Stratification and Mathematical Performance." *Sociology of Education* 66(2):91-103.

Barone, Carlo. 2011. "Some Things Never Change: Gender Segregation in Higher Education across Eight Nations and Three Decades." *Sociology of Education* 84(2):157-76.

Baum, Charles. 2002. "The Effect of Work Interruptions on Women's Wages." *Labour Economics* 16(1):1-36.

Beck, Ulrich, Michael Brater, and Hansjürgen Daheim. 1980. *Soziologie der Arbeit und der Berufe. Grundlagen, Problemfelder, Forschungsergebnisse*. Reinbek bei Hamburg: Rowohlt.

Becker, Gary Stanley. 1993. *Human Capital. A Theoretical and Empirical Analysis with Special Reference to Education (3rd ed.)*. Chicago and London: The University of Chicago Press.

Beede, David, Tiffany Julian, David Langdon, George McKittrick, Beethika Khan, and Mark Doms. 2011. "Women in STEM: A Gender Gap to Innovation." in *ESA Issue Brief*, edited by Economics and Statistics Administration U.S. Department of Commerce.

Berger, Peter A , Dirk Konietzka, and M Michailow. 2001. "Beruf, soziale Ungleichheit und Individualisierung." Pp. 209-38 in *Aspekte des Berufs in der Moderne*, edited by Thomas Kurtz. Opladen: Leske + Budrich.

Bergmann, Barbara R. 1974. "Occupational Segregation, Wages and Profits When Employers Discriminate by Race or Sex." *Eastern Economic Journal* 1(2):103-10.

Black, Sandra E., and Alexandra Spitz-Oener. 2010. "Explaining Women's Success: Technological Change and the Skill Content of Women's Work." *Review of Economics & Statistics* 92(1):187-94.
Blau, Francine D., Marianne A. Ferber, and Anne E. Winkler. 2009. *The economics of women, men and work*. Boston [u.a.]: Prentice Hall.
Blau, Francine D., and Lawrence M. Kahn. 2017. "The Gender Wage Gap: Extent, Trends, and Explanations." *Journal of Economic Literature* 55(3):789-865.
Blossfeld, Hans-Peter. 1987. "Labor-Market Entry and the Sexual Segregation of Careers in the Federal Republic of Germany." *American Journal of Sociology* 93(1):89-118.
Blossfeld, Hans-Peter, Sandra Buchholz, Johanna Dämmrich, Elina Kilpi-Jakonen, Yuliya Kosyakova, and Jan Skopek. 2015. "Gender Differences at Labor Market Entry: The Effect of Changing Educational Pathways and Institutional Structures." Pp. 3-35 in *Gender, Education and Employment. An International Comparison of School-to-Work Transitions*, edited by Hans-Peter Blossfeld, Jan Skopek, Moris Triventi, and Sandra Buchholz. Cheltenham/Northampton, MA: Edward Elgar.
Blossfeld, Hans-Peter, Katrin Golsch, and Götz Rohwer. 2007. *Event history analysis with Stata*. New York, Hove: Psychology Press. Taylor & Francis Group.
Bobbitt-Zeher, Donna. 2007. "The Gender Income Gap and the Role of Education." *Sociology of Education* 80(1):1-22.
Bol, Thijs, and Herman G. van de Werfhorst. 2013. "Educational Systems and the Trade-Off between Labor Market Allocation and Equality of Educational Opportunity." *Comparative Education Review* 57(2):285-308.
Bol, Thijs, and Kim A. Weeden. 2015. "Occupational Closure and Wage Inequality in Germany and the United Kingdom." *European Sociological Review* 31(3):354-69.
Braakmann, Nils 2013. "What determines wage inequality among young German university graduates." *Jahrbücher für Nationalökonomie und Statistik* 233(2):130-58.
Brandt, Gesche. 2016. "Einkommensunterschiede von Akademikerinnen und Akademikern im Erwerbsverlauf." *Beiträge zur Hochschulforschung* 4:40-61.
Breen, Richard, and John H. Goldthorpe. 1997. "Explaining Educational Differentials: Towards a Formal Rational Action Theory." *Rationality and Society* 9(3):275-305.
Brynin, Malcolm, and Francisco Perales. 2016. "Gender Wage Inequality: The De-gendering of the Occupational Structure." *European Sociological Review* 32(1):162-74.
Brzinsky-Fay, Christian. 2007. "Lost in Transition? Labour Market Entry Sequences of School Leavers in Europe." *European Sociological Review* 23(4):409-22.
Buchholz, Sandra, Dirk Hofäcker, Melinda Mills, Hans-Peter Blossfeld, Karin Kurz, and Heather Hofmeister. 2009. "Life Courses in the Globalization Process: The Development of Social Inequalities in Modern Societies." *European Sociological Review* 25(1):53-71.
Buchmann, Claudia, Thomas A. DiPrete, and Anne McDaniel. 2008. "Gender Inequalities in Education." *Annual Review of Sociology* 34:319-37.
Buchmann, Marlis C., and Irene Kriesi. 2011. "Transition to Adulthood in Europe." *Annual Review of Sociology* 37(1):481-503.
Busch-Heizmann, Anne. 2015. "Supply-Side Explanations for Occupational Gender Segregation: Adolescents' Work Values and Gender-(A)Typical Occupational Aspirations." *European Sociological Review* 31(1):48-64.
Busch, Anne. 2013a. "Der Einfluss der beruflichen Geschlechtersegregation auf den „Gender Pay Gap"." *Kölner Zeitschrift für Soziologie und Sozialpsychologie* 65(2):301-38.
—. 2013b. *Die berufliche Geschlechtersegregation in Deutschland*. Wiesbaden: Springer VS.
Busch, Felix. 2017. "Occupational Devaluation Due to Feminization? Causal Mechanics, Effect Heterogeneity, and Evidence from the United States, 1960 to 2010." *Social Forces*.
Cech, Erin. 2015. "Engineers and Engineeresses? Self-conceptions and the Development of Gendered Professional Identities." *Sociological Perspectives* 58(1):56-77.

Cech, Erin, Brian Rubineau, Susan Silbey, and Caroll Seron. 2011. "Professional Role Confidence and Gendered Persistence in Engineering." *American Sociological Review* 76(5):641-66.
Ceci, Stephen J., Wendy M. Williams, and Susan M. Barnett. 2009. "Women's Underrepresentation in Science: Sociocultural and Biological Considerations." *Psychological Bulletin* 135(2):218-61.
Cha, Youngjoo, and Kim A. Weeden. 2014. "Overwork and the Slow Convergence in the Gender Gap in Wages." *American Sociological Review* 79(3):457-84.
Chan, Tak Wing. 1999. "Revolving Doors Reexamined: Occupational Sex Segregation over the Life Course." *American Sociological Review* 64(1):86-96.
Charles, Maria. 1992. "Cross-National Variation in Occupational Sex Segregation." *American Sociological Review* 57(4):483-502.
—. 2005. "National Skill Regimes, Postindustrialism, and Sex Segregation." *Social Politics: International Studies in Gender, State & Society* 12(2):289-316.
—. 2011. "A World of Difference: International Trends in Women's Economic Status." *Annual Review of Sociology* 37(1):355-71.
—. 2017. "Venus, Mars, and Math." *Socius* 3:1-16.
Charles, Maria, and Karen Bradley. 2002. "Equal but Separate? A Cross-National Study of Sex Segregation in Higher Education." *American Sociological Review* 67:573–99.
—. 2009. "Indulging Our Gendered Selves? Sex Segregation by Field of Study in 44 Countries " *American Journal of Sociology* 114(4):924-76.
Charles, Maria, and David B. Grusky. 2004. *Occupational Ghettos: The Worldwide Segregation of Women and Men*. Stanford: Stanford University Press.
Charles, Maria, Bridget Harr, Erin Cech, and Alexandra Hendley. 2014. "Who likes math where? Gender differences in eighth-graders' attitudes around the world." *International Studies in Sociology of Education* 24(1):85-112.
Cohen, Philip N. , and Matt L. Huffman. 2003. "Individuals, Jobs, and Labor Markets: The Devaluation of Women's Work." *American Sociological Review* 68(3):443-63.
Cooke, Lynn Prince. 2014. "Gendered Parenthood Penalties and Premiums across the Earnings Distribution in Australia, the United Kingdom, and the United States." *European Sociological Review* 30(3):360-72.
Correll, Shelley J. 2001. "Gender and the Career Choice Process: The Role of Biased Self-Assessments." *American Journal of Sociology* 106(6):1691-730.
Correll, Shelley J. 2004. "Constraints into Preferences: Gender, Status, and Emerging Career Aspirations." *American Sociological Review* 69(1):93-113.
Cvencek, Dario, Andrew N. Meltzoff, and Anthony G. Greenwald. 2011. "Math–Gender Stereotypes in Elementary School Children." *Child Development* 82(3):766-79.
Damelang , Andreas , Florian Schulz, and Basha Vicari. 2015. "Institutionelle Eigenschaften von Berufen und ihr Einfluss auf berufliche Mobilität in Deutschland " *Schmollers Jahrbuch* 135(3):307-33.
Dechant, Anna, Harald Rost, and Florian Schulz. 2014. "Die Veränderung der Hausarbeitsteilung in Paarbeziehungen : ein Überblick über die Längsschnittforschung und neue empirische Befunde auf Basis der pairfam-Daten " *Zeitschrift für Familienforschung* 26(2):144-68.
Destatis. 2018. "Verdienstunterschied zwischen Frauen und Männern in Deutschland 2017 bei 21 %." in *https://www.destatis.de/DE/PresseService/Presse/Pressemitteilungen/2018/03/PD18_099_621.html*, edited by Statistisches Bundesamt.
Di Stasio, Valentina, Thijs Bol, and Herman G. Van de Werfhorst. 2016. "What makes education positional? Institutions, overeducation and the competition for jobs." *Research in Social Stratification and Mobility* 43:53-63.
Di Stasio, Valentina, and Herman G. van de Werfhorst. 2016. "Why Does Education Matter to Employers in Different Institutional Contexts? A Vignette Study in England and the Netherlands." *Social Forces* 95(1):77-106.

DiPrete, Thomas A., Thijs Bol, Christina Ciocca Eller, and Herman G. van de Werfhorst. 2017. "School-to-Work Linkages in the United States, Germany, and France." *American Journal of Sociology* 122(6):1869-938.

DiPrete, Thomas A., and Gregory M. Eirich. 2006. "Cumulative Advantage as a Mechanism for Inequality: A Review of Theoretical and Empirical Developments." *Annual Review of Sociology* 32(1):271-97.

Diprete, ThomasA, and Claudia Buchmann. 2006. "Gender-specific trends in the value of education and the emerging gender gap in college completion." *Demography* 43(1):1-24.

Dombrowski, Rosine. 2015. *Berufswünsche benachteiligter Jugendlicher*. Bielefeld: Bertelsmann Verlag.

Dostal, Werner. 2002. "Der Berufsbegriff in der Berufsforschung des IAB." Pp. 463–74 in *IAB-Kompendium Arbeitsmarkt- und Berufsforschung. Beiträge zur Arbeitsmarkt- und Berufsforschung, BeitrAB 250*, edited by Gerhard Kleinhenz. Nurnberg: Institut fur Arbeitsmarkt- und Berufsforschung.

Drasch, Katrin. 2013. "Educational Attainment and Family-Related Employment Interruptions in Germany: Do Changing Institutional Settings Matter?" *European Sociological Review* 29(5):981-95.

Drasch, Katrin, Corinna Kleinert, Britta Matthes, and Michael Ruland. 2016. "Why Do We Collect Data on Educational Histories Over the Life Course the Way We Do ? Core Questionnaire Design Decisions in Starting Cohort 6—Adults." Pp. 331-47 in *Methodological Issues of Longitudinal Surveys: The Example of the National Educational Panel Study*, edited by Hans-Peter Blossfeld, Jutta von Maurice, Michael Bayer, and Jan Skopek. Wiesbaden: Springer Fachmedien Wiesbaden.

Drobnič, Sonja , Hans-Peter Blossfeld, and Götz Rohwer. 1999. "Dynamics of Women's Employment Patterns over the Family Life Course: A Comparison of the United States and Germany." *Journal of Marriage and Family* (1):133.

Eccles, Jacquelynne S. 1994. "Understanding Women's Educational And Occupational Choices: Applying the Eccles et al. Model of Achievement-Related Choices." *Psychology of Women Quarterly* 18(4):585-609.

—. 2007. "Where Are All the Women? Gender Differences in Participation in Physical Science and Engineering." Pp. 199-210 in *Why aren't more women in science?: Top researchers debate the evidence* edited by Stephen J. Ceci and Wendy M. Williams. Washington, DC: American Psychological Association.

Eccles, Jacquelynne S. & Allan Wigfield. 2002. "Motivational Beliefs, Values, and Goals. " *Annual Review of Psychology* 53: 109-132.

EIGE. 2018. "Time to get more women in tech." http://eige.europa.eu/news-and-events/news/time-get-more-women-tech: European Institute for Gender Equality.

Elder, Glen H, Monica KirkPatrick Johnson, and Robert Crosnoe. 2003. "The Emergence and Development of Life Course Theory." Pp. 3-19 in *Handbook of the Life Course*, edited by Jeylan T Mortimer and Michael J Shanahan: Springer US.

Else-Quest, Nicole M., Janet Shibley Hyde, and Marcia C. Linn. 2010. "Cross-national patterns of gender differences in mathematics: A meta-analysis." *Psychological Bulletin* 136(1):103-27.

England, Paula. 2005. "Gender Inequality in Labor Markets: The Role of Motherhood and Segregation." *Social Politics: International Studies in Gender, State & Society* 12(2):264-88.

—. 2010. "The Gender Revolution: Uneven and Stalled." *Gender & Society* 24(2):149-66.

England, Paula, Melissa S. Herbert, Barbara Stanek Kilbourne, Lori L. Reid, and Lori McCreary Megdal. 1994. "The Gendered Valuation of Occupations and Skills: Earnings in 1980 Census Occupations." *Social Forces* 73(1):65-100.

England, Paula, and Su Li. 2006. "Desegregation Stalled. The Changing Gender Composition of College Majors, 1971-2002." *Gender & Society* 20(5):657-77.

Erikson, Robert, and Jan O Jonsson. 1996. "Introduction: Explaining Class Inequaity in Education: The Swedish Test Case." Pp. 1-63 in *Can Education Be Equalized*, edited by Robert Erikson and Jan O Jonsson. Boulder, Colo: Westview Press.

Esping-Andersen, Gosta. 1990. *The three worlds of welfare capitalism*. Cambridge: Polity Press.

Estévez-Abe, Margarita. 2005. "Gender Bias in Skills and Social Policies: The Varieties of Capitalism Perspective on Sex Segregation." *Social Politics: International Studies in Gender, State & Society* 12(2):180-215.

Estevez-Abe, Margarita, Torben Iversen, and David Soskice. 2001. "Social Protection and the Formation of Skills: A Reinterpretation of the Welfare State." Pp. 145-83 in *Varieties of capitalism. The institutional foundations of comparative advantage*, edited by Peter A. Hall and David Soskice. Oxford: Oxford University Press.

Evertsson, Marie. 2016. "Parental leave and careers: Women's and men's wages after parental leave in Sweden." *Advances in Life Course Research* 29:26-40.

Evertsson, Marie, Paula England, Irma Mooi-Reci, Joan Hermsen, Jeanne de Bruijn, and David Cotter. 2009. "Is Gender Inequality Greater at Lower or Higher Educational Levels? Common Patterns in the Netherlands, Sweden, and the United States." *Social Politics: International Studies in Gender, State & Society* 16(2):210-41.

Evertsson, Marie, and Daniela Grunow. 2012. "Women's Work Interruptions and Career Prospects in Germany and Sweden." *International Journal of Sociology and Social Policy* 32(9/10):561-75.

Evertsson, Marie, Daniela Grunow, and Silke Aisenbrey. 2016. "Work interruptions and young women's career prospects in Germany, Sweden and the US." *Work, Employment & Society* 30(2):291-308.

Fabian, Gregor, Torsten Rehn, Gesche Brandt, and Kolja Briedis. 2013. "Karriere mit Hochschulabschluss? Hochschulabsolventinnen und -absolventen des Prüfungsjahrgangs 2001 zehn Jahre nach dem Studienabschluss." Pp. 1-144 in *HIS: Forum Hochschule*. Hannover: DZHW.

Fairlie, Robert W. 2005. "An extension of the Blinder-Oaxaca decomposition technique to logit and probit models." *Journal of Economic and Social Measurement* 30(4):305-16.

Falk, Susanne. 2005. *Geschlechtspezifische Ungleichheit im Erwerbsverlauf. Analysen für den deutschen Arbeitsmarkt*. Wiesbaden: VS Verlag für Sozialwissenschaften.

Gabay-Egozi, Limor, Yossi Shavit, and Meir Yaish. 2015. "Gender Differences in Fields of Study: The Role of Significant Others and Rational Choice Motivations." *European Sociological Review* 31(3):284-97.

Gangl, Markus. 2001. "European patterns of labour market entry. A dichotomy of occupationalized vs. non-occupationalized systems?" *European Societies* 3(4):471-94.

—. 2004. "Institutions and the Structure of Labour Market Matching in the United States and West Germany." *European Sociological Review* 20(3):171-87.

—. 2006. "Scar Effects of Unemployment: An Assessment of Institutional Complementarities." *American Sociological Review* 71(6):986-1013.

Gangl, Markus, and Andrea Ziefle. 2009. "Motherhood, Labor Force Behavior, and Women's Careers: An Empirical Assessment of the Wage Penalty for Motherhood in Britain, Germany, and the United States." *Demography* 46(2):341-69.

Gash, Vanessa. 2008. "Bridge or Trap? Temporary Workers' Transitions to Unemployment and to the Standard Employment Contract." *European Sociological Review* 24(5):651-68.

Gerber, Theodore P, and Sin Yi Cheung. 2008. "Horizontal Stratification in Postsecondary Education: Forms, Explanations, and Implications." *Annual Review of Sociology* 34(1):299-318.

Gerstorf, Sandra, and Jürgen Schupp. 2016. "SOEP wave report 2015." edited by Deutsches Institut für Wirtschaftsforschung (DIW). Berlin.

Giesecke, Johannes, and Steffen Schindler. 2008. "Field of Study and Flexible Work: A Comparison between Germany and the UK." *International Journal of Comparative Sociology* 49(4-5):283-304.
Gottfredson, Linda S., and Richard T. Lapan. 1996. "Assessing gender-based circumscription of occupational aspirations." *Journal of Carreer Assessment* 5(4):419-41.
—. 1997. "Assessing Gender-Based Circumscription of Occupational Aspirations." *Journal of Career Assessment* 5(4):419-41.
Grönlund, Anne. 2012. "On-the-Job Training—A Mechanism for Segregation? Examining the Relationship between Gender, Occupation, and On-the-Job Training Investments." *European Sociological Review* 28(3):408-20.
Grönlund, Anne, Karin Halldén, and Charlotta Magnusson. 2017. "A Scandinavian success story? Women's labour market outcomes in Denmark, Finland, Norway and Sweden." *Acta Sociologica* 60(2):97-119.
Grönlund, Anne, and Charlotta Magnusson. 2013. "Devaluation, crowding or skill specificity? Exploring the mechanisms behind the lower wages in female professions." *Social Science Research* 42(4):1006-17.
—. 2016. "Family-friendly policies and women's wages – is there a trade-off? Skill investments, occupational segregation and the gender pay gap in Germany, Sweden and the UK." *European Societies* 18(1):91-113.
Grunow, Daniela, Silke Aisenbrey, and Marie Evertsson. 2011. "Familienpolitik, Bildung und Berufskarrieren von Müttern in Deutschland, USA und Schweden." *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie* 63(3):395-430.
Hakim, Catherine. 2002. "Lifestyle Preferences as Determinants of Women's Differentiated Labor Market Careers." *Work and Occupations* 29(4):428-59.
Hall, Anja. 2012. "Lohnen sich schulische und duale Ausbildung gleichermaßen? Bildungserträge von Frauen und Männern im Vergleich." Pp. 281-301 in *Soziologische Bildungsforschung*, edited by Rolf Becker and Heike Solga. Wiesbaden: Springer Fachmedien Wiesbaden.
Hall, Peter A, and Rosemary C R Taylor. 1996. "Political Science and the Three New Institutionalisms*." *Political Studies* 44(5):936-57.
Hall, Peter A., and David Soskice. 2001. *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage*. Oxford: Oxford University Press.
Han, S. W. 2015. "Curriculum standardization, stratification, and students' STEM-related occupational expectations: Evidence from PISA 2006." *International Journal of Educational Research* 72:103-15.
Hannan, Damian, Emer Smyth, and Selina McCoy. 1999. "A Comparative Analysis of Transitions from Education to Work in Europe (CATEWE) - A Conceptual Framework." in *ESRI Working Paper*. Dublin European Studies Research Insitute.
Härkönen, Juho, Anna Manzoni, and Erik Bihagen. 2016. "Gender inequalities in occupational prestige across the working life: An analysis of the careers of West Germans and Swedes born from the 1920s to the 1970s." *Advances in Life Course Research* 29: 41-51.
Haupt, Andreas. 2012. "(Un)equal through social closure." *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie* 64(4):729-53.
Hausmann, Ann-Christin, and Corinna Kleinert. 2014. "Berufliche Segregation auf dem Arbeitsmarkt. Männer- und Frauendomänen kaum verändert." Pp. 1-8 in *IAB-Kurzbericht*. Nürnberg: Institut für Arbeitsmarkt- und Berufsforschung.
Hausmann, Ann-Christin, Aline Zucco, and Corinna Kleinert. 2015. "Berufspanel für Westdeutschland 1976-2010 (OccPan). Dokumentation zur Erstellung und Anonymisierung " in *FDZ-Methodenreport*. Nürnberg: Forschungsdatenzentrum der Bundesagentur für Arbeit im Institut für Arbeitsmarkt- und Berufsforschung.
Heisig, Jan Paul, Merlin Schaeffer, and Johannes Giesecke. 2017. "The Costs of Simplicity: Why Multilevel Models May Benefit from Accounting for Cross-Cluster

Differences in the Effects of Controls." *American Sociological Review* 82(4):796-827.
Helbig, Marcel. 2012a. "Die Umkehrung – Geschlechterungleichgheiten beim Erwerb des Abiturs im Wandel." Pp. 374-92 in *Soziologische Bildungsforschung*, edited by Rolf Becker and Heike Solga: Springer Fachmedien Wiesbaden.
—. 2012b. *Sind Mädchen besser? Der Wandel geschlechtsspezifischen Bildungserfolgs in Deutschland*. Frankfurt/New York: Campus.
Helbig, Marcel, and Kathrin Leuze. 2012. "Ich will Feuerwehrmann werden!" *Kölner Zeitschrift für Soziologie und Sozialpsychologie* 64(1):91-122.
Hillmert, Steffen. 2011. "Occupational Mobility and Developments of Inequality along the Life Course. The German case." *European Societies* 13(3):401-23.
—. 2015. "Gender Segregation in Occupational Expectations and in the Labour Market: International Variation and the Role of Education and Training Systems." Pp. 123-48 in *Gender Segregation in Vocational Education (Comparative Social Research)* edited by Christian Imdorf, Kristinn Hegna, and Liza Reisel: Emerald Group Publishing Limited.
Hinz, Thomas, and Martin Abraham. 2008. "Theorien des Arbeitsmarktes: Ein Überblick." Pp. 17-67 in *Arbeitsmarktsoziologie. Probleme, Theorien, empirische Befunde*, edited by Martin Abraham and Thomas Hinz. Wiesbaden: VS Verlag fur Sozialwissenschaften / GWV Fachverlage GmbH, Wiesbaden.
Hoffmann, Jana , Andreas Damelang, and Florian Schulz. 2011. "Strukturmerkmale von Berufen. Einfluss auf die berufliche Mobilität von Ausbildungsabsolventen." Pp. 1-57 in *IAB Forschungsbericht*. Nuremberg: IAB.
Holland, John L. 1973. *Making vocational choices: a theory of careers*. New Jersey: Prentice-Hall.
Hook, Jennifer L. 2010. "Gender Inequality in the Welfare State: Sex Segregation in Housework, 1965--2003." *American Journal of Sociology* 115(5):1480-523.
Hyde, Janet S., Sara M. Lindberg, Marcia C. Linn, Amy B. Ellis, and Caroline C. Williams. 2008. "Gender Similarities Characterize Math Performance." *Science* 321(5888):494-95.
Jonsson, Jan O. 1999. "Explaining Sex Differences in Educational Choice An Empirical Assessment of a Rational Choice Model." *European Sociological Review* 15(4):391-404.
Kalleberg, Arne L., and Aage B. Sorensen. 1979. "The Sociology of Labor Markets." *Annual Review of Sociology* 5(ArticleType: research-article / Full publication date: 1979 / Copyright © 1979 Annual Reviews):351-79.
Kalmijn, Mattbijs, and Tanja van der Lippe. 1997. "Type of Schooling and Sex Differences in Earnings in the Netherlands." *European Sociological Review* 13(1):1-15.
Kanter, Rosabeth Moss. 1977. "Some Effects of Proportions on Group Life: Skewed Sex Ratios and Responses to Token Women." *American Journal of Sociology* 82(5):965-90.
Kerckhoff, Alan C. 2001. "Education and Social Stratification Processes in Comparative Perspective." *Sociology of Education* 74:3-18.
Kessels, Ursula, Anke Heyder, Martin Latsch, and Bettina Hannover. 2014. "How gender differences in academic engagement relate to students' gender identity." *Educational Research* 56(2):220-29.
Kilbourne, Barbara Stanek, Paula England, George Farkas, Kurt Beron, and Dorothea Weir. 1994. "Returns to Skill, Compensating Differentials, and Gender Bias: Effects of Occupational Characteristics on the Wages of White Women and Men." *American Journal of Sociology* 100(3):689-719.
Killewald, Alexandra. 2013. "A Reconsideration of the Fatherhood Premium:Marriage, Coresidence, Biology, and Fathers' Wages." *American Sociological Review* 78(1):96-116.

Kim, ChangHwan, Christopher R. Tamborini, and Arthur Sakamoto. 2015. "Field of Study in College and Lifetime Earnings in the United States." *Sociology of Education* 88(4):320-39.
Klein, Markus. 2011. "Higher education and non-pecuniary returns in Germany: tracing the mechanisms behind field of study effects at the start of the career." *Irish Educational Studies* 30(2):253-70.
Kleinert, Corinna, and Marita Jacob. 2013. "Demographic changes, labor markets and their consequences on post-school-transitions in West Germany 1975–2005." *Research in Social Stratification and Mobility* 32:65-83.
Kohlberg, Lawrence. 1966. "A cognitive-developmental analysis of children's sex role concepts and attitudes." Pp. 82-172 in *The development of sex differences*, edited by Eleanor E. MacCoby. Stanford: Stanford Univ. Press.
Kohli, Martin. 2007. "The Institutionalization of the Life Course: Looking Back to Look Ahead." *Research in Human Development* 4(3-4):253-71.
Konietzka, Dirk, and Michaela Kreyenfeld. 2010. "The growing educational divide in mothers' employment: an investigation based on the German micro-censuses 1976-2004." *Work, Employment & Society* 24(2):260-78.
Krüger, Helga. 1995. "Dominanzen im Geschlechterverhältnis: Zur Institutionalisierung von Lebensläufen." Pp. 195-219 in *Das Geschlechterverhältnis als Gegenstand der Sozialwissenschaften*, edited by Regina Becker-Schmidt and Gudrun-Axeli Knapp. Frankfurt: Campus.
—. 1996. "Die andere Bildungsegmentation: Berufssysteme und soziale Integration zwischen den Geschlechtern am Beispiel der Umstrukturierung in Pflegeberufen." Pp. 252-74 in *Die Wiederentdeckung der Ungleichheit. Aktuelle Tendenzen in Bildung fur Arbeit*, edited by Axel Bolder. Opladen: Leske + Budrich.
—. 2003. "Berufliche Bildung. Der deutsche Sonderweg und die Geschlechterfrage." *Berliner Journal für Soziologie* 13:497-510.
Krüger, Helga, and René Levy. 2000. "Masterstatus, Familie und Geschlecht." *Berliner Journal für Soziologie* 10(3):379-401.
—. 2001. "Linking Life Courses, Work, and the Family: Theorizing a Not So Visible Nexus between Women and Men." *The Canadian Journal of Sociology* 26(2):145-66.
Law, Helen. 2018. "Gender and Mathematics: Pathways to Mathematically Intensive Fields of Study in Australia". *Advances in Life Course Research* 37: 42-56.
Legewie, Joscha, and Thomas A. DiPrete. 2014. "Pathways to Science and Engineering Bachelor's Degrees for Men and Women." *Sociological Science* 1:41-48.
Leuze, Kathrin. 2007. "What Makes for a Good Start? Consequences of Occupation-Specific Higher Education for Career Mobility: Germany and Great Britain Compared." *International Journal of Sociology* 37(2):29-53.
—. 2010. *Smooth path or long and winding road? How institutions shape the transition from higher education to work*. Opladen/Farmington Hills, MI: Budrich UniPress.
Leuze, Kathrin, and Susanne Strauß. 2009. "Lohnungleichheiten zwischen Akademikerinnen und Akademikern. Der Einfluss von fachlicher Spezialisierung, frauendominierten Fächern und beruflicher Segregation." *Zeitschrift für Soziologie* 38(4):262-81.
—. 2014. "Female-typical Subjects and their Effect on Wage Inequalities among Higher Education Graduates in Germany." *European Societies* 16(2):275-98.
—. 2016. "Why do occupations dominated by women pay less? How 'female-typical' work tasks and working-time arrangements affect the gender wage gap among higher education graduates." *Work, employment and society* 30(5):802-20.
Lewis, Jeffrey B., and Drew A. Linzer. 2005. "Estimating Regression Models in Which the Dependent Variable Is Based on Estimates." *Political Analysis* 13(4):345-64.
Liebeskind, Uta. 2004. "Arbeitsmarktsegregation und Einkommen." *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie* 56(4):630-52.
Lindberg, Matti E. 2009. "Student and early career mobility patterns among highly educated people in Germany, Finland, Italy, and the United Kingdom." *Higher Education* 58(3):339-58.

Lindberg, Sara M., Janet S. Hyde, Jennifer L. Petersen, and Marcia C. Linn. 2010. "New trends in gender and mathematics performance: A meta-analysis." *Psychological Bulletin* 136(6):1123-35.
Lörz, Markus, Heiko Quast, and Andreas Woisch. 2012. "Erwartungen, Entscheidungen und Bildungswege. Studienberechtigte 2010 ein halbes Jahr nach Schulabgang." Pp. 1-134 in *HIS Forum Hochschule*.
Lörz, Markus, Steffen Schindler, and Jessica G. Walter. 2011. "Gender inequalities in higher education: extent, development and mechanisms of gender differences in enrolment and field of study choice." *Irish Educational Studies* 30(2):179-98.
Machin, Stephen, and Patrick A. Puhani. 2003. "Subject of degree and the gender wage differential: evidence from the UK and Germany." *Economics Letters* 79(3):393-400.
Madero-Cabib, Ignacio, and Anette Eva Fasang. 2016. "Gendered work–family life courses and financial well-being in retirement." *Advances in Life Course Research* 27:43-60.
Magnusson, Charlotta. 2009. "Gender, Occupational Prestige, and Wages: A Test of Devaluation Theory." *European Sociological Review* 25(1):87-101.
—. 2013. "More women, lower pay? Occupational sex composition, wages and wage growth." *Acta Sociologica* 56(3):227-45.
Mandel, Hadas. 2012. "Winners and Losers: The Consequences of Welfare State Policies for Gender Wage Inequality." *European Sociological Review* 28(2):241-62.
Mann, Allison, and Thomas A. DiPrete. 2013. "Trends in gender segregation in the choice of science and engineering majors." *Social Science Research* 42(6):1519-41.
—. 2016. "The Consequences of the National Math and Science Performance Environment for Gender Differences in STEM Aspirations." *Sociological Science* 3:568-603.
Mann, Allison, Joscha Legewie, and Thomas A DiPrete. 2015. "The Role of School Performance in Narrowing Gender Gaps in the Formation of STEM Aspirations: A Cross-National Study." *Frontiers in Psychology* 6:1-11.
Manzoni, Anna. 2012. "In and out of employment: Effects in panel and life-history data." *Advances in Life Course Research* 17(1):11-24.
Manzoni, Anna, Juho Härkönen, and Karl Ulrich Mayer. 2014. "Moving On? A Growth-Curve Analysis of Occupational Attainment and Career Progression Patterns in West Germany." *Social Forces* 92(4):1285-312.
Mare, Robert D. 1980. "Social Background and School Continuation Decisions." *Journal of the American Statistical Association* 75(370):295-305.
Matthes, Britta, Carola Burkert, and Wolfgang Biersack. 2008. "Berufssegmente. Eine empirisch fundierte Neuabgreunzung vergleichbarer beruflicher Einheiten." Pp. 1-40 in *IAB-Discussion Paper 35*: IAB.
Mavromaras, Kostas G. 2003. "Indirect Re–employment Wage Discrimination." *Bulletin of Economic Research* 55(1):53-89.
Mayer, Karl Ulrich. 2003. "The Sociology of the Life Course and Lifespan Psychology: Diverging or Converging Pathways?" Pp. 463-81 in *Understanding Human Development: Dialogues with Lifespan Psychology*, edited by Ursula M. Staudinger and Ulman Lindenberger. Boston, MA: Springer US.
—. 2004. "Whose Lives? How History, Societies, and Institutions Define and Shape Life Courses." *Research in Human Development* 1(3):161-87.
—. 2009. "New Directions in Life Course Research." *Annual Review of Sociology* 35(1):413-33.
Mayer, Karl Ulrich, Daniela Grunow, and Natalie Nitsche. 2010. "Mythos der Flexibilisierung? Wie instabil sind Berufsbiographien wirklich und als wie instabil werden sie wahrgenommen?" *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie* 62:369-402.
McDaniel, Anne. 2010. "Cross-National Gender Gaps in Educational Expectations: The Influence of National-Level Gender Ideology and Educational Systems." *Comparative Education Review* 54(1):27-50.

—. 2016. "The Role of Cultural Contexts in Explaining Cross-National Gender Gaps in STEM Expectations." *European Sociological Review* 32(1):122-33.
Menze, Laura. 2017. "Horizontale und vertikale Adäquanz im Anschluss an die betriebliche Ausbildung in Deutschland." *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie*:1-29.
Mincer, Jacob, and Solomon Polachek. 1974. "Family Investments in Human Capital: Earnings of Women." *Journal of Political Economy* 82(2):S76-S108.
Morgan, Stephen L. . 2006. "Expectations and aspriations." Pp. 1528-31 in *The Blackwell Encyclopedia of Sociology*, edited by G. Ritzer. Malden: Blackwell.
Morgan, Stephen L., Dafna Gelbgiser, and Kim A. Weeden. 2013. "Feeding the pipeline: Gender, occupational plans, and college major selection." *Social Science Research* 42(4):989-1005.
Müller, Walter, and Yossi Shavit. 1998. "The Institutional Embeddedness of the Stratification Process. A Comparative Study of Occupations in Thirteen Countries." Pp. 1-48 in *From School to Work. A Comparative Study of Educational Qualifications and Occupational Destinations*, edited by Yossi Shavit and Walter Müller. Oxford: Clarendon Press.
Murphy, Emily, and Daniel Oesch. 2016. "The Feminization of Occupations and Change in Wages: A Panel Analysis of Britain, Germany, and Switzerland." *Social Forces* 94(3):1221-55.
Nagy, Gabriel. 2006. "Berufliche Interessen, kognitive und fachgebundene Kompetenzen: Ihre Bedeutung für die Studienfachwahl und die Bewährung im Studium." in *Dissertation. Berlin. www.diss.fu-berlin.de/2007/109/*.
Nagy, Gabriel, Jessica Garrett, Ulrich Trautwein, Kai S. Cortina, Jürgen Baumert, and Jacquelynne S. Eccles. 2008. "Gendered high school course selection as a precursor of gendered careers: The mediating role of self-concept and intrinsic value." Pp. 115-43 in *Gender and occupational outcomes: Longitudinal assessments of individual, social, and cultural influences.*, edited by Helen M. G. Watt and Jacquelynne S. Eccles. Washington, DC, US: American Psychological Association.
Nagy, Gabriel, Ulrich Trautwein, Jürgen Baumert, Olaf Köller, and Jessica Garrett. 2006. "Gender and course selection in upper secondary education: Effects of academic self-concept and intrinsic value." *Educational Research and Evaluation* 12(4):323-45.
Nagy, Gabriel, Helen M. G. Watt, Jacquelynne S. Eccles, Ulrich Trautwein, Oliver Lüdtke, and Jürgen Baumert. 2010. "The Development of Students' Mathematics Self-Concept in Relation to Gender: Different Countries, Different Trajectories?" *Journal of Research on Adolescence* 20(2):482-506.
Napari, Sami. 2008. "The Early-career Gender Wage Gap among University Graduates in the Finnish Private Sector." *Labor* 22(4):697-733.
Nieuwenhuis, Rense, Ariana Need, and Henk Van Der Kolk. 2012. "Institutional and Demographic Explanations of Women's Employment in 18 OECD Countries, 1975–1999." *Journal of Marriage and Family* 74(3):614-30.
Nitsche, Natalie, and Daniela Grunow. 2016. "Housework over the course of relationships: Gender ideology, resources, and the division of housework from a growth curve perspective." *Advances in Life Course Research* 29:80-94.
Noelke, Clemens, Michael Gebel, and Irena Kogan. 2012. "Uniform Inequalities: Institutional Differentiation and the Transition from Higher Education to Work in Post-socialist Central and Eastern Europe." *European Sociological Review* 28(6):704-16.
Ochsenfeld, Fabian. 2012. "Gläserne Decke oder goldener Käfig: Scheitert der Aufstieg von Frauen in erste Managementpositionen an betrieblicher Diskriminierung oder an familiären Pflichten?" *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie* 64(3):507-34.
—. 2014. "Why Do Women's Fields of Study Pay Less? A Test of Devaluation, Human Capital, and Gender Role Theory." *European Sociological Review* 30(4):536-48.

—. 2016. "Preferences, constraints, and the process of sex segregation in college majors: A choice analysis." *Social Science Research* 56:117–32.
—. 2017. "The gender income gap and the role of family formation revisited." *Journal for Labour Market Research* 50(1):131-41.
OECD. 2007. "PISA 2006: Science Competencies for Tomorrow's World. Volume I: Analysis." edited by OECD Publishing. Paris.
—. 2009. "PISA Data Analysis Manual SPSS." Paris: OECD.
—. 2014. "PISA 2012 Results: What Students Know and Can Do – Student Performance in Mathematics, Reading and Science." in *Volume I, Revised edition, February 2014*: PISA, OECD Publishing http://dx.doi.org/10.1787/9789264201118-en.
Okamoto, Dina, and Paula England. 1999. "Is There a Supply Side to Occupational Sex Segregation?" *Sociological Perspectives* 42(4):557-82.
OSF, Official Statistics of Finland. 2018. "Structure of Earnings." edited by Statistics Finland. Helsinki.
Penner, Andrew. 2008. "Gender Differences in Extreme Mathematical Achievement: An International Perspective on Biological and Social Factors." *American Journal of Sociology* 114(S1):S138-S70.
Perales, Francisco. 2013. "Occupational sex-segregation, specialized human capital and wages: evidence from Britain." *Work, employment and society* 27(4):600-20.
Pfau-Effinger, Birgit. 2004. "Socio-historical paths of the male breadwinner model – an explanation of cross-national differences." *British Journal of Sociology* 55(3):377-99.
Polachek, Solomon W. 1981. "Occupational Self-Selection: A Human Capital Approach to Sex Differences in Occupational Structure." *The Review of Economics and Statistics* 63(1):60-69.
Polavieja, Javier G. 2008. "The Effect of Occupational Sex-Composition on Earnings: Job-Specialization, Sex-Role Attitudes and the Division of Domestic Labour in Spain." *European Sociological Review* 24(2):199-213.
Polavieja, Javier G., and Lucinda Platt. 2014. "Nurse or Mechanic? The Role of Parental Socialization and Children's Personality in the Formation of Sex-Typed Occupational Aspirations." *Social Forces* 93(1):31-61.
Rabe-Hesketh, Sofia, and Andreas Skrondal. 2012. *Multilevel and Longitudinal Modeling Using Stata. Volume I: Continuous Responses*. Texas: StataPress.
Reimer, David, Clemens Noelke, and Aleksander Kucel. 2008. "Labor Market Effects of Field of Study in Comparative Perspective: An Analysis of 22 European Countries." *International Journal of Comparative Sociology* 49(4-5):233-56.
Reimer, David, and Stephanie Steinmetz. 2009. "Highly Educated but in the Wrong Field?" *European Societies* 11(5):723-46.
Ridgeway, Cecilia L. 2009. "Framed Before We Know It." *Gender & Society* 23(2):145-60.
Ridgeway, Cecilia L., and Shelley J. Correll. 2004. "Unpacking the Gender System." *Gender & Society* 18(4):510-31.
Riegle-Crumb, Catherine, and Barbara King. 2010. "Questioning a White Male Advantage in STEM." *Educational Researcher* 39(9):656-64.
Riegle-Crumb, Catherine, Barbara King, Eric Grodsky, and Chandra Muller. 2012. "The More Things Change, the More They Stay the Same? Prior Achievement Fails to Explain Gender Inequality in Entry Into STEM College Majors Over Time." *American Educational Research Journal*.
Roksa, Josipa. 2005. "Double Disadvantage or Blessing in Disguise? Understanding the Relationship Between College Major and Employment Sector." *Sociology of Education* 78(3):207-32.
Roksa, Josipa, and Tania Levey. 2010. "What Can You Do with That Degree? College Major and Occupational Status of College Graduates over Time." *Social Forces* 89(2):389-415.

Ruble, Diane N, Carol L Martin, and Sheri A Berenbaum. 2006. "Gender Development." Pp. 858-932 in *Handbook of Child Psychology*, edited by W Damon and Lerner. R. M. Hoboken, N.J.: John Wiley & Sons.

Ruland, Michael, Katrin Drasch, Ralf Künster, Britta Matthes, and Angelika Steinwede. 2016. "Data-Revision Module—A Beneficial Tool to Support Autobiographical Memory in Life-Course Studies." Pp. 367-84 in *Methodological Issues of Longitudinal Surveys: The Example of the National Educational Panel Study*, edited by Hans-Peter Blossfeld, Jutta von Maurice, Michael Bayer, and Jan Skopek. Wiesbaden: Springer Fachmedien Wiesbaden.

Sacchi, Stefan, Irene Kriesi, and Marlis Buchmann. 2016. "Occupational mobility chains and the role of job opportunities for upward, lateral and downward mobility in Switzerland." *Research in Social Stratification and Mobility* 44 (1):10-21.

Salikutluk, Zerrin, and Stefanie Heyne. 2017. "Do Gender Roles and Norms Affect Performance in Maths? The Impact of Adolescents' and their Peers' Gender Conceptions on Maths Grades." *European Sociological Review* 33(3):368-81.

Scheeren, Lotte, Herman G. van de Werfhorst, and Thijs Bol. 2018. "The Gender Revolution in Context: How Later Tracking in Education Benefits Girls." *Social Forces*.

Schmelzer, Paul. 2012. "The Consequences of Job Mobility for Future Earnings in Early Working Life in Germany—Placing Indirect and Direct Job Mobility into Institutional Context." *European Sociological Review* 28(1):82-95.

Schmid, Günther. 2001. "Arbeitsmarkt und Beschäftigung." Pp. 21-36 in *Handwörterbuch zur Gesellschaft Deutschlands*, edited by Bernhard Schäfers and Wolfgang Zapf. Wiesbaden: VS Verlag für Sozialwissenschaften.

Schnabel, Kai, and Sabine Gruehn. 2000. "Studienfachwünsche und Berufsorientierungen in der gymnasialen Oberstufe." Pp. 405-43 in *TIMSS-III. Dritte Internationale Mathematik- und Naturwissenschaftsstudie. Mathematische und naturwissenschaftliche Bildung am Ende der Schullaufbahn. 2. Mathematische und physikalische Kompetenzen am Ende der gymnasialen Oberstufe*, edited by J Baumert, W Bos, and R Lehmann. Opladen: Leske u. Budrich.

Schoon, Ingrid, and Elzbieta Polek. 2011. "Teenage career aspirations and adult career attainment: The role of gender, social background and general cognitive ability." *International Journal of Behavioral Development* 35(3):210-17.

Scott, R. W. 2001. *Institutions and Organizations.* Beverly Hills, London: Sage Publications.

Settersten, Richard A., and Lynn Gannon. 2005. "Structure, Agency, and the Space Between: On the Challenges and Contradictions of a Blended View of the Life Course." *Advances in Life Course Research* 10:35-55.

Seymour, Elaine. 1995. "The loss of women from science, mathematics, and engineering undergraduate majors: An explanatory account." *Science Education* 79(4):437-73.

Shauman, Kimberlee A. 2006. "Occupational sex segregation and the earnings of occupations: What causes the link among college-educated workers?" *Social Science Research* 35(3):577-619.

Sikora, Joanna, and Artur Pokropek. 2012. "Gender segregation of adolescent science career plans in 50 countries." *Science Education* 96(2):234-64.

Smyth, Emer. 2005. "Gender differentiation and early labour market integration across Europe." *European Societies* 7(3):451-79.

Smyth, Emer, and Stephanie Steinmetz. 2008. "Field of Study and Gender Segregation in European Labour Markets." *International Journal of Comparative Sociology* 49(4-5):257-81.

—. 2015. "Vocational Training and Gender Segregation Across Europe." Pp. 53-81 in *Gender Segregation in Vocational Education (Comparative Social Research)* edited by Christian Imdorf, Kristinn Hegna, and Liza Reisel: Emerald Group Publishing Limited.

Solga, Heike, and Dirk Konietzka. 2000. "Das Berufsprinzip des deutschen Arbeitsmarktes: Ein Geschlechtsneutraler Allokationsmechnismus?" *Schweizerische Zeitschrift für Soziologie* 26(1):111-47.

Spence, Michael. 1973. "Job Market Signaling." *The Quarterly Journal of Economics* 87(3):355-74.

Spitz-Oener, Alexandra. 2006. "Technical Change, Job Tasks, and Rising Educational Demands: Looking outside the Wage Structure." *Journal of Labor Economics* 24(2):235-70.

Steinmetz, Stephanie. 2012. *The Contextual Challenges of Occupational Sex Segregation. Deciphering Cross-National Differences in Europe*. Wiesbaden: VS Verlag für Sozialwissenschaften.

Strauß, Susanne, and Steffen Hillmert. 2011. "Einkommenseinbuflen durch Arbeitslosigkeit in Deutschland. Alters- und geschlechtsspezifische Differenzen im Vergleich." *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie* 63(4):567-94.

Su, R., J Rounds, and P. I Armstrong. 2009. "Men and things, women and people: A meta-analysis of sex differences in interests." *Psychological Bulletin* 135(6):859–84.

Tam, Tony. 1997. "Sex Segregation and Occupational Gender Inequality in the United States: Devaluation or Specialized Training?" *American Journal of Sociology* 102(6):1652-92.

Tilly, Charles. 1998. *Durable inequality*. Berkeley, Los Angeles, London: Univ. of California Press.

Tomaskovic-Devey, Don, and Sheryl Skaggs. 2002. "Sex Segregation, Labor Process Organization, and Gender Earnings Inequality." *American Journal of Sociology* 108(1):102-28.

van de Werfhorst, Herman G. 2002. "Fields of Study, Acquired Skills and the Wage Benefit from a Matching Job." *Acta Sociologica* 45(4):287-303.

—. 2004. "Systems of Educational Specialization and Labor Market Outcomes in Norway, Australia, and The Netherlands." *International Journal of Comparative Sociology* 45(5):315-35.

—. 2011. "Skill and education effects on earnings in 18 Countries: The role of national educational institutions." *Social Science Research* 40(4):1078-90.

Vandecasteele, Leen. 2011. "Life Course Risks or Cumulative Disadvantage? The Structuring Effect of Social Stratification Determinants and Life Course Events on Poverty Transitions in Europe." *European Sociological Review* 27(2):246-63.

Wagner, Gert G, Joachim R Frick, and Jürgen Schupp. 2007. "The German Socio-Economic Panel Study (SOEP): Scope, Evolution and Enhancement." in *SOEPpapers on Multidisciplinary Panel Data Research, No. 1*, edited by Deutsches Institut für Wirtschaftsforschung (DIW). Berlin.

Wang, Ming-Te, and Jessica Degol. 2013. "Motivational pathways to STEM career choices: Using expectancy–value perspective to understand individual and gender differences in STEM fields." *Developmental Review* 33(4):304-40.

Wang, Ming-Te, Jacquelynne S. Eccles, and Sarah Kenny. 2013. "Not Lack of Ability but More Choice: Individual and Gender Differences in Choice of Careers in Science, Technology, Engineering, and Mathematics." *Psychological Science* 24(5):770-75.

Watt, Helen M. G. 2006. "The role of motivation in gendered educational and occupational trajectories related to maths." *Educational Research and Evaluation* 12(4):305-22.

Weeden, Kim. 2002. "Why Do Some Occupations Pay More Than Others? Social Closure and Earnings Inequality in the United States." *The American Journal of Sociology* 108(1):55-101.

Weeden, Kim, and David B. Grusky. 2005. "The Case for a New Class Map." *American Journal of Sociology* 111(1):141-212.

Willingham, Warren W, and Nancy S. Cole. 1997. *Gender and Fair Assessment*. Mahwah: Lawrence Erlbaum.

Wiseman, Alexander W., David P. Baker, Catherine Riegle-Crumb, and Francisco O. Ramirez. 2009. "Shifting gender effects: Opportunity structures, institutionalized

mass schooling, and cross-national achievement in mathematics." *Gender, Equality and Education from International and Comparative Perspectives* 10:395-422.
Wolter, Ilka, Ursula Kessels, and Bettina Hannover. 2011. "Geschlechtsspezifische Unterschiede in der Selbstkonzeptentwicklung." Pp. 117-32 in *Selbstkonzepte im Grundschulalter. Modelle, empirische Ergebnisse, pädagogische Konsequenzen*, edited by Frank Hellmich. Stuttgart: Kohlhammer.
Xie, Yu, Michael Fang, and Kimberlee Shauman. 2015. "STEM Education." *Annual Review of Sociology* 41(1):331-57.
Xie, Yu, and Kimberlee A. Shauman. 1997. "Modeling the Sex-Typing of Occupational Choice: Influences of Occupational Structure." *Sociological Methods & Research* 26(2):233-61.
Zafar, Basit. 2013. "College Major Choice and the Gender Gap." *Journal of Human Resources* 48(3):545-95.
Ziefle, Andrea. 2009. *Familienpolitik als Determinante weiblicher Lebensverläufe? Die Auswirkungen des Erziehungsurlaubs auf Familien- und Erwerbsbiographien in Deutschland*. Wiesbaden: VS Verlag für Sozialwissenschaften.
Ziegler, Astrid. 2005. "Erwerbseinkommen." Pp. 241-306 in *WSI-FrauenDatenReport 2005. Handbuch zur wirtschaftlichen und sozialen Situation von Frauen*, edited by Silka Bothfeld, Klammer Ute, Christina Klenner, Simone Leiber, Anke Thiel, and Astrid Ziegler. Berlin: edition sigma