Econometric Analysis of Gender Differences in the German Labor Market

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Chapter 1

Dissertation Introduction

Women constitute around half of the world's population, they represent 40 percent of the global labor force and make up the majority of higher education graduates. The principle of equal pay is reflected in numerous legislations. Nevertheless, women's labor force participation is lower and they earn, on average, less than comparable male counterparts. Looking at the development over time one can observe the tendency that women catch up, with respect to educational background and labor force participation rates, but gender differences in labor productivity and earnings are remarkably persistent. These differences appear to be a result of different economic and social mechanisms. In particular, a non-random distribution of men and women along different occupations, sectors and firms can be observed. Women are concentrated in low-productivity jobs, they are overrepresented among unpaid family workers and rise less often to high status positions (World Bank, 2011).

It is beyond dispute that it follows ethical reasons to promote gender equality. Moreover, narrowing the gender gap in labor market participation and outcomes also has considerable economic relevance for a society. In 2012 the World Bank devoted its annual publication, the World Development Report, to the topic of gender equality. This report points out that "*First, gender equality matters intrinsically, because the ability to live the life of one's own choosing and be spared from absolute deprivation is a basic human right...* [and further, SS] *matters instrumentally, because greater gender equality contributes to economic efficiency and the achievement of*

other key development outcomes" (World Bank 2011, p.3). The authors further argue that female labor force participation promotes equity and strengthens the economic and social position and the empowerment of women. Gender equality is therefore important for socio-economic development and to avoid women being caught in a productivity trap that imposes costs on women's welfare and economic empowerment.

It is important to understand which mechanisms drive gender differences in labor market behavior in order to identify policy measures that help to promote equity. Over the last decades, the analysis of gender differences in the labor market has drawn considerable attention in economic literature. During the 1960s, the work on family economics and the New Home Economics by Becker and Mincer contributed to explanations of labor force participation decisions of women (e.g. Mincer, 1962; Becker, 1965). Lower participation rates of women were attributed to their comparative advantage in home production, and lower investment in human capital was explained by lower returns for those who spend less time in the market. Fertility-related aspects and unpaid home work are central aspects in this argumentation. Other theories explain the sources of gender differences in labor market outcomes as a result of differences in skills or preferences. The hypothesis of compensating wage differentials, for example, states that jobs which require employees to be tolerant of dirt or danger will offer a wage premium, which will mostly be accepted by men. Women, on the other hand, accept wage cuts in return to family friendly working arrangements, or interpersonal and other non-wage aspects (Filer, 1985).

In human capital based theories, discrimination may be seen as the residual in labor market outcomes that remains after controlling for observable differences. Other theories exist, that explicitly state assumptions on the mechanisms underlying discriminatory actions, which can be broadly divided into two classes, namely taste based and statistical discrimination. Models of the first type rely on a competitive framework and shed light on employer considerations that may lead to differences in pay based on employers' or customers' taste of discrimination (Becker, 1971). Statistical discrimination, as introduced in the seminal papers of Phelps (1972) and Arrow (1973), is based on the problem of imperfect information about employee attributes. For a

more detailed outline of theories on group-specific differences in the labor market, see Altonji and Blank (1999). Previous empirical and theoretical studies cover a wide range of research questions concerning gender differences in employment and wages, and how they are related to differences in characteristics, and labor market treatment based on these characteristics. Among other things, the discussion on gender differences concerns topics such as labor force attachment, occupational choice and career development. The gender wage gap, however, is probably the most widely researched phenomenon.

Generally, the reasons for gender differences in wage that have been identified by economic research can be classified according to two major lines of argumentation: discrimination and differences in human capital. The latter captures approaches like occupational choice and resulting segregation patterns, or the effect of (family-related) career interruptions. As a third line, newer explanations refer to differences in non-cognitive skills and psychological traits such as risk aversion or different attitudes toward competitiveness. Blau and Kahn (2016) provide a detailed survey on the existing theoretical explanations and current empirical evidence. A popular method for exploring gender wage differentials are decomposition techniques (see Fortin et al., 2011, for an overview). These methods have in common that they decompose the difference in wages into a component that results from differences in the observed characteristics, and a second one that reflects differences in the reward to these characteristics. The second component, also called unexplained part, is often attributed to discrimination. This interpretation is flawed as it misses the point that the unexplained part also captures unobserved group differences in productivity and tastes. Furthermore, different characteristics as captured in the so-called explained part can also be the result of discriminatory barriers at the labor market. Occupation and industry are two categories that lead to a substantial drop in the gender-specific wage gap once they are controlled for (e.g. Gartner, 2016, for Germany). The question of whether occupational choice, and the sorting of sexes along different sectors, is driven by taste or by barriers in access to the respective positions leads to another area of research that has found wide interest in economics and social sciences, namely gender-specific occupational segregation.

The unequal distribution of men and women along occupations is important for understanding the evolution of the gender wage gap. The continued segregation of labor markets contributes to gender differences in earnings. Yet, while it is widely found to be a source of the wage gap, it could also narrow it due to the movement of women into higher paying male-dominated occupations (Blau et al., 2013). Segregation describes the non-random sorting of individuals along horizontal and vertical dimensions of the labor market, i.e. along occupations or hierarchies. Several statistical concepts exist to describe segregation, among which the calculation of segregation indices is very popular (see Flückiger and Silber, 1999, for a summary of segregation measures). An accurate calculation, however, hinges on the availability of suitable data with detailed and comparable occupational categories. Besides the effort to quantify the extent of segregation, economic research offers explanations for its occurrence and assesses the consequences of segregated structures, such as on the extent of the gender pay gap or on the economic performance of teams or establishments.

Statistical analysis reveals that the amount of occupational segregation in the U.S. labor market was relatively stable until the 1960s and since then has slightly decreased over time (Blau et al., 2013). For Germany, considerable differences between East and West Germany can be observed, but the overall trend reveals a very stable level of occupational segregation, irrespective of other labor market trends (Busch, 2013). Theories explaining occupational segregation are concerned with different occupational choices. Human capital theory explains gender differences in occupational choice by differences in preferences and differential investment in human capital. Other arguments trace back gender-specific occupational choices to socialization processes. Besides supply-side oriented explanations, institutional characteristics are found to be influential as well. A non-random sorting of individuals across firms can contribute to the reproduction of segregation. Hinz and Schübel (2001) were among the the first to calculate segregation measures at the establishment level with German data. As shown by Achatz et al. (2010) establishment characteristics explain a substantial part of the observed heterogeneity in the segregation levels of German firms.

Knowledge about the driving factors of segregation is of high relevance for policy makers. Fostering a reduction in overall segregation may be a starting point to reduce labor marker inequalities. While policy measures with respect to vertical segregation, as female quotas on boards or transparency in wage setting processes, have recently been discussed in the public sphere, horizontal segregation is of high relevance as well. Not only are status and career development possibilities lower in female-dominated jobs, reducing horizontal segregation might also help to narrow the gender wage gap (e.g. Leuze and Strauß, 2016). Through increased gender diversity in teams, a reduction of segregation may also help to increase economic performance; however, empirical evidence on the effect of diversity on team performance leads to ambiguous results (Azmat, 2014).

The underrepresentation of women in high status positions is a special case of vertical segregation. Apart from being a potential driver of the wage gap, gender difference in career development should be studied in more detail because it has implications on spheres outside of the wage level as well. Career progression is linked to wage growth, status and job satisfaction. Differences in career transition patterns between men and women are important for identifying the factors that hamper women's career progression. The literature on career development of men and women covers a large range of aspects such as differences in promotion, wage growth or job mobility. The relationship between the latter is described by the 'job shopping' theory, which states that employees benefit from early job mobility (Johnson, 1978). Mobility, in this case, covers job to job transitions, irrespective of the change in rank. Gender differences in the representation of high status positions, however, have been addressed in a large number of studies. Of particular concern is the representation of women in top management positions or on boards, as promoting a female quota for such position is heavily discussed among policy makers (e.g. Smith and Smith, 2015). Apart from the effect on the individual women, such as an increase in status and pay, economic research raises the question of whether female representation may have an effect on performance. As outlined by Joecks et al. (2013), empirical evidence on the effect of increasing female representation on performance is mixed.

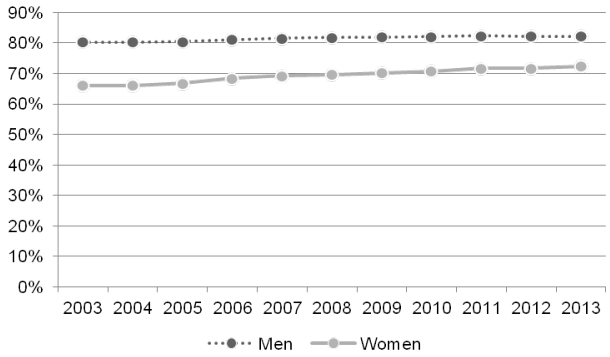
When it comes to explaining gender differences in career progression, fertility-related aspects are found to be one major driver. Family obligations may not solely disadvantage women's careers, but adversely benefit men's, further increasing gender differences in the workplace. Being married, for example, reduces women's transition probabilities to higher ranked jobs while it positively influences men's transition probabilities, as shown by Granqvist and Persson (2005). They also find negative effects of career interruptions due to child birth on women's career mobility. Some authors claim the exclusion of women from high earnings and high status positions to be the result of an existing 'glass ceiling' to women's career perspectives (e.g. Arulampalam et al., 2007). Another well known concept is the one of the 'glass door' describing the non-random selection of women into lower paying firms (Javdani, 2015). This shows that taking the organizational level into account is a crucial factor for the analysis of gender differences in labor market outcomes.

This idea is not new. In their seminal paper, Baron and Bielby (1980) call for bringing the firms back in: Organizations should be regarded as corporate actors that employ men and women for certain positions, open up career opportunities and show preferences for a gender-specific selection of staff for their positions. Understanding the firm as social unit is central in approaches to organizational theory. Also in processes like segregation or career development, as discussed above, organizational culture and demographics may play a central role. Bringing this into the analysis can explain a lot of observed heterogeneity in outcomes. A closer look at the effects of organizational characteristics is also interesting for policy recommendations. The implementation of gender mainstreaming measures such as formalized recruitment procedures or the provision of childcare facilities can be fostered by political incentives. Conducting firm level analyses, however, requires databases that provide firm characteristics as well as information on individuals. As discussed below, such data only became available in recent years.

This thesis sheds light on different aspects of sources and consequences of gender differentials in the German labor market, whereby the effect of organizational characteristics is particularly considered. The first study (chapter 2) is concerned with an investigation of horizontal occupa-

tional segregation within firms and aims at identifying organizational factors that influence the level of intra-firm segregation. It is followed by an investigation of gender differences in career trajectories as possible driver of vertical segregation (chapter 3). Again, organizational characteristics are taken into account as far as is available in the data. Finally, I look at the gender wage gap and its relationship to the unemployment rate in local labor markets (chapter 4). The gender wage gap is not only calculated at the level of local labor markets, but also intra-firm wage gaps are investigated. This sheds light on the glass door hypothesis, and further shows that firm heterogeneity heavily influences the level of the gender wage differential. Accounting for the relationship with the unemployment rate offers a very different approach to explain gender differences in pay, apart from the issues discussed before.

As the empirical evaluations carried out in all three studies are based on German data, it is worth looking at some key figures and particularities of the German labor market. According to the Federal Agency of Employment, labor force participation rates, especially those of women, rank among the highest in Europe (Bundesagentur für Arbeit, 2015). The gender gap in employment rates narrowed, but still exists (see figure 1.1).

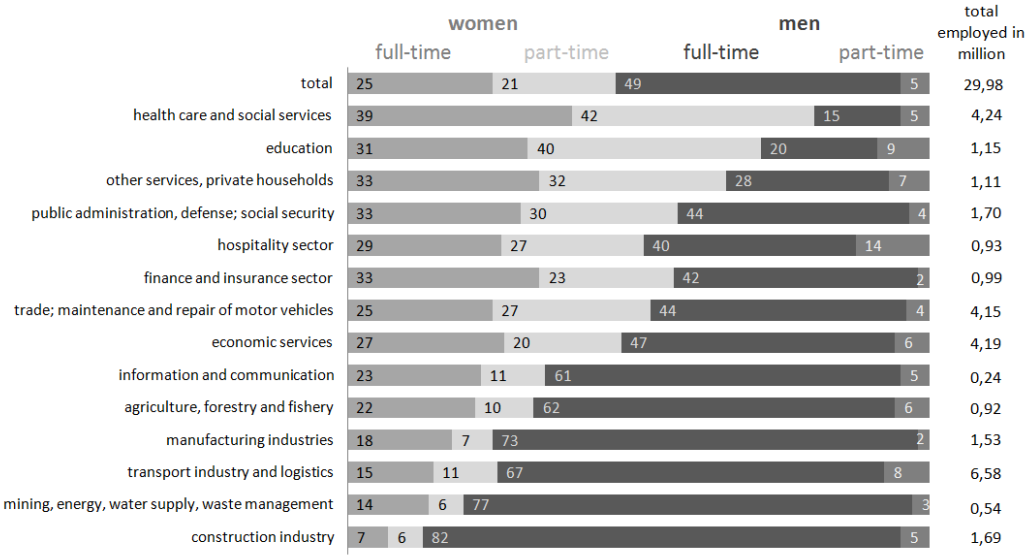


Source: Bundesagentur für Arbeit (2015)

Figure 1.1: Employment rates of women and men in Germany

Men and women are differently distributed across sectors, types of jobs and working time arrangements, as shown in figure 1.2. Women are disproportionately employed in the tertiary

sector, while this is the fact for men in agriculture. While men make up the majority of self employed and employees subject to social security, women are overrepresented in marginal employment. Part-time arrangements are mainly a women's field.



Source: Bundesagentur für Arbeit (2015)

Figure 1.2: Distribution of women and men across sectors and working time arrangements

The unemployment rates of men and women converged in recent years, with the female unemployment rate being lower than that of their male counterparts. However, the share of long term unemployment is higher among women. According to the Federal Statistical Office women's wages were, on average, 22 percent lower than men's in 2014 (Federal Statistical Office, 2016).

A particular feature of the German labor market is the ongoing division between the eastern and western part. Even after 25 years of reunification, considerable differences exist between East and West Germany, such as differences in participation rates, hours worked, unemployment and especially with respect to gender differences in the labor market. Historically, women in the German Democratic Republic experienced greater equality in the labor market than their West German counterparts because both sexes were expected to be in paid work. While in West Ger-

many, women tended to work unpaid at home, whereas men followed the traditional breadwinner model, East German women had participation rates of 89 percent, compared to 92 percent for men (Rosenfeld et al., 2004). This was largely driven by the fact that labor market participation varied little by parental or marital status, which was expedited by employment structures and policy norms, and probably accompanied by different social norms and values concerning childcare. After 1989, a rapid transformation of employment structures could be observed, but the historically different background still continued to have an effect. Men's participation rates converged while the gender gap in participation rates remained smaller in East Germany, which may indicate differences in cultural legacy, such as in attitudes towards full-time homemaking. Today, mainly differences in maternal full-time employment can be observed, which is considerably higher in East Germany (Holst and Wieber, 2014). The structural differences between the East and West German labor market are not the focus of this thesis. However, they have to be considered carefully in empirical applications by controlling for location or restricting the sample to either one of the regions.

A central issue in analyzing gender differences in the labor market, especially when focusing on differences in pay, is data availability. Studies based on individual survey data can provide useful information on personal characteristics, but they lack variables related to the employer. Further, a potential pitfall of such data is that the wage information may not always be given or may possibly suffer from response bias. For a long time, studies on the German labor market concentrated on either employees or organizations. This was due to a lack of data access. Linking employer and employee data is a matter of high concern regarding data protection laws.

However, in 2004 a new data set became available in Germany that offered new possibilities of simultaneous analysis of the supply and demand side of the labor market: the Linked Employer-Employee Data Set of the Institute for Employment Research (IAB). This unique data set combines highly reliable individual level information from the process-generated data of the Federal Employment Agency (BA) with the IAB Establishment Panel, which covers a range of organizational characteristics. The data are provided by the Research Data Centre (FDZ) of the

BA at the IAB. To ensure a regulated procedure that keeps track of all data protection issues, data access is only possible via on-site use and subsequent remote data access. Information on individuals is taken from the IAB's Integrated Employment Biographies, in which data from different sources are merged to cover all employees subject to social security, as well as marginal part-time employment, recipients of social benefit, registered jobseekers and participants in employment measures. A detailed description of the data sources and the sampling procedure can be found in Heining et al. (2013). Using these data, one can construct complete employment histories covering employment and non-employment spells. For the employment spells information is available on, among others, the occupation and daily gross wage as reported by the employer.

Data on establishments[1] are taken from the IAB Establishment Panel (IABEP). The IABEP is a representative annual survey of German establishments on employment policy-related subjects with shifting priorities that covers all industries and firm sizes. Data are available from 1993 onwards for West Germany and since 1996 nationwide, including East Germany. All establishments with at least one employee liable to social security represent the population of the panel. Out of these approximately two million units, a disproportional stratified sample of around 16,000 establishments is surveyed. The sample is drawn from the establishment file as of 30th of June of the previous year and stratification is based on federal state, industry and establishment size. As large establishments, small federal states and small industries are overrepresented in the sample, weighting factors are provided for cross-sectional and longitudinal analysis. Interviews are carried out by TNS Infratest in the form of face-to-face interviews. Response rates vary between 63 to 73 percent, being even higher in establishments that continue to be part of the panel. Each establishment receives an establishment number as unique identifier. This number serves to identify an establishment as a survey unit throughout the years and to merge the individual employment data. Most establishments are interviewed every year, so that the resulting longitudinal structure allows panel analyses. Each wave of the questionnaire includes items on general information on the establishment, employment structure and development,

[1] An establishment "denotes a regionally and economically separate unit, in which employees liable to social security work" (Fischer et al., 2009). Note that throughout the text the terms establishment, firm and organization are used interchangeably.

business policy, innovation and investment, vocational training, wages, and working time. Generally, these questions are identical over the year in order to form a longitudinal panel and depict developments over time. Additionally, specific blocks are incorporated at certain intervals and varying current focus subjects are included every year. Of peculiar interest in the discussion of gender differences, are questions on gender mainstreaming that were part of the 2004 and 2008 questionnaires. A detailed description of the data and sample design can be found in Fischer et al. (2009).

The LIAB allows analyses at the establishment level taking into account very detailed background information that capture a large amount of firm heterogeneity. Though, for analyses covering individuals' social background and fertility history, these data are not suitable. A useful alternative is offered by the ALWA data set from the IAB, which will be used in chapter 3. A full description of the data is provided in Kleinert et al. (2011). The ALWA data (the name derives from the German study name *Arbeiten und Lernen im Wandel*) result from a retrospective life course study that was carried out in 2007 and 2008 and made available in 2010. A major advantage of the ALWA data is that they provide detailed information on education and employment, partners and children, and the history of habitation in one data set. This allows the analysis of various dynamic processes in life, such as employment transitions or family formation. The data were sampled from the underlying population of the birth cohorts 1956 to 1988 with a primary residence in Germany. The survey was conducted via computer assisted telephone interviews with retrospective longitudinal designs. The interview design consists of different independent models in which the interviewee reports on aspects of educational and employment throughout their lives. Anchoring and memory strategies help to complete the information and fill possible gaps. Corrections are done in cooperation with the respondent. This questionnaire design allows an extraordinary large range of topics to be covered and ensures consistency of the data. Due to the complete life-course information, which is given in monthly intervals, the data can be recoded to a longitudinal structure and offer the possibility to conduct, for example, panel or survival analyses.

It should be mentioned at this point that other data sources for the German labor market are available than those described above; for example, the widely used German Socioeconomic Panel (GSOEP) conducted by the German Institute for Economic Research or the Mikrozensus provided by the Federal Statistical Office. However, most of them suffer from one or another limitation. The Mikrozensus for instance provides detailed information on living conditions, but cannot be used for panel analysis and offers only an interval coded income variable. For the purpose of the text at hand, the LIAB and ALWA data turned out to be most suitable.

I conclude this introductory chapter by giving a brief overview of the three studies contained in this thesis.

Chapter 2: Occupational Segregation and Organizational Characteristics - Empirical Evidence for Germany

Chapter 2 studies the extent of occupational gender segregation in Germany with a particular focus on the influence of organizational characteristics on the extent of firm level segregation. Based on the 2004 and 2008 survey waves of the LIAB, the corrected dissimilarity index is calculated for each establishment following Carrington and Troske (1997). This index captures the amount of segregation, while accounting for a random distribution of men and women among occupations in small firms, which would otherwise lead to an overestimation of segregation due to random deviations from evenness. To identify the effect of firm characteristics on the extent of segregation inside establishments while accounting for possible unobserved heterogeneity, different panel data models are applied. As explanatory variables, a set of organizational characteristics is taken into account, as derived from theoretical considerations as well as from previous empirical evidence. Our main variables of interest are the implementation of gender mainstreaming measures and formalized recruitment procedures, as well as the share of part-time workers. The latter has been a concern of theoretical work, but no significant effect has been found in empirical studies so far. We argue, that effects of part-time work and human resource policies cannot be interpreted in isolation from organizational demographics. Considering the female share in the workforce as a moderating variable leads to the result that in a

male-dominated workforce an increase in the share of part-time employment is associated with lower segregation levels. In the case of a high female share in the workforce, however, the part-time share is positively related to the level of segregation. This suggests that part-time employment can help to integrate women into a male-dominated workforce, but does not offer a lead in for men. Similarly, we find an overall negative effect of the female share of the workforce on the level of segregation within firms. This result confirms the assumption that men access female-dominated spheres more easily than women enter a field dominated by men. The study reveals that substantial variation in the amount of segregation is found across establishments in the German labor market. Organizational characteristics can explain a large share of these differences. In particular, organizational demographics have to be considered carefully, as they moderate the effect of other influential factors.

Chapter 3: Potential Parenthood and Career Progression of Men and Women - A Simultaneous Hazards Approach

In chapter 3, we will analyze individual career trajectories of men and women in Germany. The goal of this study is to analyze the determinants of career transitions and to trace back gender differences in the career progression patterns. Job transitions are categorized into upward, downward or horizontal movements according to a change in personal responsibility, or alternatively in terms of a change in job prestige as measured by the SIOPS scale. Our particular focus is on the association of job changes with individual fertility. In contrast to most of the literature, we focus on *potential* rather than *realized* fertility. Our analysis is based on a rich data set on the life histories of people living in Germany. The ALWA (Working and Learning in a Changing World) data set from the Institute for Employment Research contains the life histories of more than 10,400 individuals. Besides information on schooling and training, we have detailed insight on labor market behavior as well as on processes of family formation and regional mobility, all on a monthly basis. We estimate a mixed multivariate proportional hazard model with competing risks. The three job transition equations are modeled simultaneously with the pregnancy hazard, which enters as regressor in the career equations. As further explanatory variables, we consider socioeconomic variables (educational and work history, partnership) as well as regional

information based on the person's history of habitation. We also consider the dependence of career transitions on the time already spent in given or in previous career levels (duration dependence and lagged duration dependence), and we allow for unobserved heterogeneity that might be correlated among the different destination states. Our findings generally suggest lower career mobility for women, even after controlling for relevant socioeconomic characteristics. The results of the mixed multivariate proportional hazard models indicate that the relevant factors influencing the career transitions follow different mechanisms for men and women. We find a significant negative relationship between the contemporaneous probability of having a child and horizontal career transitions for women, and a positive significant association of the hazard of parenthood with upward career transitions for men. These effects persist if we apply fixed effects panel data models allowing for correlation of individual parenthood hazards with unobserved individual characteristics. Independent of their sources, the results suggest clear gender differences in the relationship between career patterns and potential fertility.

Chapter 4: Mind the Gap - Gender Wage Gap and Unemployment Rate in Local Labor Markets
Chapter 4 addresses the relationship between the gender wage gap and the local unemployment rate. Looking at the differences in mean wages within German districts, one finds considerable variation in the local gender wage gaps. This suggests that labor market conditions may serve as an explanation of the gender wage gap, in addition to traditional approaches like differences in human capital characteristics or discrimination. The wage curve, introduced by the seminal paper of Blanchflower and Oswald (1994), describes the inverse relationship between wages and regional unemployment. Empirical evidence suggests that gender-specific wage curves exist. This is why I conclude that the wage gap should also be related to the local unemployment rate. To examine this relationship empirically, I use a linked employer-employee data set (LIAB from the IAB) which combines wage information from the Federal Employment Agency with plant-level data from the IAB establishment panel. The sample is restricted to West Germany from 2002 to 2008. I calculate a human capital-adjusted gender wage gap at the level of local labor markets (German Landkreise) as well as at the firm level. The calculation is done based on time- and region-specific wage curves. At the district level, I also apply a reweighting approach

to explore the wage differential along the distribution. The resulting adjusted wage gaps are then related to the local unemployment rate and, in case of the intra-firm wage gaps, also to firm characteristics. The models are further extended by the effect of the unemployment rate in the commuting area to capture possible spatial effects of unemployment on the wage gap. The estimation results suggest that the gender wage gap is negatively associated with the local unemployment rate. According to the wage curve literature, an increase in the unemployment rate goes along with lower wages. The drop in wages will be more pronounced for men, which provides the intuition for the effect of the unemployment rate on the wage gap. The negative effect can be rationalized by the efficiency wage theory. Employers may pay a lower wage premium for men, whereas for women's wages the adjustment is less pronounced. Empirically, I find a negative relationship between the unemployment rate and the gender wage gap at the district level as well as for the intra-firm wage gap. The spatial unemployment rate, however, turns out to be positively related to the level of the gender wage gap. The effects survive using different measures of the gender wage gap, as the raw gap or human capital-adjusted wage gaps with different underlying wage functions. It is worth noting that organizational characteristics can explain a substantial share of the gap within firms and interact with the effect of the unemployment rate. Taken together, I believe that my results contribute to the literature on the gender wage gap because, to my best knowledge, the implications of the wage curve approach have not been considered in this context so far. Considering the local unemployment rate might offer an explanation of the part of the gender wage gap that cannot fully be accounted for by productivity differences, human capital, or other observed factors and that is otherwise commonly attributed to discrimination.

Chapter 2

Occupational Segregation and Organizational Characteristics - Empirical Evidence for Germany

2.1 Introduction

Occupational gender segregation, i.e. the unequal distribution of men and women across different positions and fields of the labor market, is a well-documented phenomenon. A relatively high and stable level of segregation can be confirmed for the German labor market, particularly in comparison with other European countries (European Commission, 2010). Despite the equalization of women and men in many respects in and around the labor market, for example in labor market participation rates and the investment in education and training (e.g. Jürges and Schneider, 2011), the level of segregation appears to be rather persistent. Job preferences that differ between men and women hold as a supply-driven explanation of segregation. However, the demand side of the labor market can be examined as another potential source, which is why we put the firm at the center of our study.

The level of segregation within firms shows substantial variation across sectors and organiza-

This chapter is based on the article 'Occupational Segregation and Organizational Characteristics. Empirical Evidence for Germany' by Stefanie Seifert and Eva Schlenker.

tional types. This suggests that firm characteristics may be related to the level of work force segregation. Therefore, the aim of our paper is to investigate the level of within firm occupational segregation and to relate it to organizational characteristics in order to identify levers that can facilitate the reduction of segregation. Identifying these levers is particularly relevant since segregation reflects a dimension of social inequality. As separation based on different positions along the occupations and hierarchies goes along with different career trajectories and remuneration, segregation can be seen as an obstacle to equal opportunities between genders. Consequently, ways to promote more gender parity among employees are a question of high political and social relevance. Moreover, if we assume a productivity increase for mixed-gender working groups (empirical evidence is found, for example, by Lee and Farh, 2004), ways to reduce segregation can be of economic interest for companies.

Our paper studies the factors influencing the level of occupational gender segregation in German firms based on the 2004 and 2008 survey waves of the Linked Employer-Employee data set from the IAB (LIAB). The relationship between the extent of firm level segregation and organizational characteristics - such as the number of employees, the industrial sector, or organizational demographics - has its theoretical foundation in organizational sociology (see Acker, 1990) as well as in economic approaches, such as the theory of statistical discrimination.

Empirical evidence for the German labor market can be found, among others, in Achatz et al. (2010) or Hinz and Schübel (2001). The aim of our contribution is, first of all, to verify the relationships found in these studies using recently available data and to extend the econometric models by further explanatory variables of interest. The data structure of the LIAB allows us to calculate segregation indices at the firm level and to perform subsequent estimations of panel data models that control for numerous organizational characteristics. Our focus is on the association of measures of gender mainstreaming and formalized recruitment procedures with the extent of segregation within establishments. By studying these two potentially influencing factors, we can show whether there is a systematic connection between measures in the field of human resources and organization on the one side and the internal level of workforce segregation

on the other side. Our paper also considers a new aspect of modeling the interdependent effect of the proportion of part-time positions and the female share in the workforce. So far, no significant influence of the proportion of part-time positions has been found in empirical investigations (e.g. Achatz et al., 2010). We assume, however, that the true effect of part-time work only reveals if the share of women in the organization is considered simultaneously in the estimation. To our best knowledge, an interaction of both factors has not been empirically tested yet. This chapter is structured as follows: Section 2.2 provides an overview of the theoretical background as well as the present state of research on horizontal segregation. Section 2.3 introduces the data and section 2.4 explains possible measures of horizontal segregation and describes the econometric framework. Section 2.5 presents the findings regarding the extent of horizontal gender segregation as well as the estimation results. Section 2.6 concludes.

2.2 Related Literature

Gender segregation in the labor market describes the different distribution of men and women across occupations or occupational positions. One can distinguish between two dimensions - horizontal and vertical segregation (see Blackburn et al., 2002) - and one can define these measures at different levels, i.e. at the labor market or within firms. Horizontal segregation describes the distribution of men and women across different firms, occupations, or industries. However, the hierarchical level or the degree of responsibility is not considered. When being measured at the labor market level, it demonstrates to what extent the gender ratio of the labor force is reflected in each firm, occupation or industry. In contrast, segregation within a single company's workforce can be interpreted as a difference in opportunity structures within that organization (Handl, 1984). Vertical segregation, as the second dimension of segregation, refers to the corporate rank hierarchy of employees, which depicts the gender inequality that comes along with higher income and differences in organizational power (e.g. Allmendinger and Podsiadlowski, 2001). In the following, we focus on the analysis of the extent of horizontal segregation while choosing the firm as the unit of analysis. Aspects of vertical segregation are incorporated as potential explanatory factors.

Theoretical approaches that explain the emergence of segregation can be divided into supply- and demand-oriented theories. Theories focusing on supply-side explanations claim that horizontal gender segregation can be attributed to individual characteristics, pre-professional constellations originating from outside the work environment as well as different preferences between men and women. Approaches are, for instance, the theory of human capital (Becker, 1964) or preference theory (Hakim, 1998). As opposed to this, demand-oriented approaches emphasize the existence of social control mechanisms, structural constraints and barriers on the level of the labor market, that make it more difficult for women to enter professions dominated by men. Moreover, such approaches imply that employers practice discrimination and personnel selection, hampering the entry of women into professions dominated by men and vice versa (for an overview see Busch, 2013). Apart from the role of the employer, demand-side approaches stress the organization's role as a social unit (see Achatz et al., 2010). This requires taking a firm level perspective, which, in the field of segregation research, has mostly been neglected in early studies. The starting point is to regard organizations as corporate actors that employ men and women for certain positions, open up career opportunities and show preferences for a gender-specific selection of staff for their positions (Baron and Bielby, 1980).

So far, several empirical studies have analyzed the relationship between different organizational characteristics and the extent of occupational segregation in the tradition of organizational theory. One of the most widely discussed factors is the firm size, measured by the number of employees. A higher number of employees goes along with the implementation of human resource policies, e.g. a formalization of recruitment procedures which impedes gender based discrimination. In addition, gender-homogenous recruitment simply becomes more difficult as the size of the company increases (e.g. Tomaskovic-Devey and Skaggs, 2001). For German establishments, Hinz and Schübel (2001) show that the number of employees has a significantly negative influence on the extent of occupational gender segregation.

Further, organizational demographics, i.e. the structure of the workforce, are empirically found to influence the level of segregation within a firm. Special attention is drawn to the effect of the

workforce's gender ratio. Based on German data, Achatz et al. (2010) find a negative effect of the proportion of women in the workforce (also Achatz, 2008; Allmendinger and Podsiadlowski, 2001; Beblo et al., 2008; and Bansak et al., 2012, for effects at labor market level in the USA). This can be interpreted as an indicator of men having easier access to professions dominated by women, while male-dominated occupational fields have strong entry barriers for women (Achatz et al., 2010).

It can be assumed that further diversity categories - apart from gender - are connected with segregation (see theories on intersectionality, e.g. Sieben and Bornheim, 2011). In our analysis, we consider the age structure of the workforce. This is based on the theoretical assumption that older cohorts might initially have a higher proportion of men. Moreover, it can be argued that preferences concerning occupational choice and the employment behavior of women have changed over the past decades. Therefore, one can assume that younger women who have started their work life during the last years tend to fill more full-time positions as compared to older women.

The proportion of part-time employees is another characteristic feature of the workforce whose influence on the level of segregation is theoretically discussed. A high proportion of part-time employment can be seen as an opportunity to enable women to enter male-dominated occupational fields. However, Achatz et al. (2010) are not able to show significant effects of the part-time share on the level of occupational segregation. We assume that the direction of the effect depends on other variables of organizational demographics. Instead of facilitating a gender balanced workforce, the offer of part-time work in an environment already dominated by women might actually enforce segregation, as there is no 'lead in' for men. The direction of the effect of the part-time share on segregation thus changes depending on the proportion of women in the workforce (this mechanism is theoretically discussed in Allmendinger and Podsiadlowski, 2001). We model the moderating effect of the organizational demographics by considering the interactions of the proportion of women and the share of part-time positions with regard to the respective workforce in our empirical framework.

Empirical evidence suggests that a firm's legal form influences the level of segregation: For corporations under public law in Germany, a higher degree of formalization can be expected leading to lower segregation on average as a discriminating recruitment policy is more difficult to maintain (e.g. Achatz et al., 2010). It can further be argued that due to different legal conditions the exogenous pressure on the organization varies in strength. Following the argumentation above, we also expect less pronounced segregation structures in firms which have a lower organization age. The age of the organization is assumed as an influencing factor here, as younger firms are exposed to particularly strong legal and social pressure when it comes to gender equality (see Tomaskovic-Devey and Skaggs, 2001, for the USA).

International evidence exists that the industrial sector in which a company operates serves as another distinguishing feature for the extent of occupational segregation (among others OECD, 2012). This is driven by the varying distribution of men and women across different occupational fields as well as different corporate cultures within the industrial sectors. Furthermore, a company's location can influence the level of segregation. Especially in the case of Germany, distinguishing between organizations located in East and West Germany is crucial in identifying the driving factors. In this context, many studies have provided empirical evidence for the differences between West and East German firms indicating a higher level of segregation in East Germany (e.g. Falk, 2002; Trappe and Rosenfeld, 2001). For the time immediately after reunification, a higher level of segregation in East Germany can be interpreted as a result of the state-controlled labor force distribution in the former GDR, where, despite high female employment, women more frequently worked in typically female occupational fields than their West German counterparts (see Busch, 2013). The fact that these differences increased shortly after reunification and have remained consistent until today is connected to the decline of the proportion of women in total employment in East Germany and implies transformation-related reasons in the form of changes in the occupational structure (see Falk, 2002). All factors discussed above have been subject to international research and their relationship to the extent of occupational gender segregation has been empirically confirmed. We therefore consider the discussed factors as control variables in our analysis.

However, less attention has been paid to the relationship between segregation and formalized recruitment processes as well as gender mainstreaming policies, presumably because of the limited availability of data. At the international level, the studies of Stainback and Kwon (2012) and Tomaskovic-Devey and Skaggs (2001) analyze the effects of formalized processes in organizations. They find that formalization can promote a balanced gender distribution under certain conditions. Thereby, a well-known theoretical argument is that the less formalized organizational routines are, the more room is left for "cronyism, subjectivism, sex stereotyping and bias" (Reskin and McBrier, 2000, p. 214) in recruitment processes, job assessment, or in promotion. Further, we look at the implementation of active gender mainstreaming measures. While some studies discuss these as a form of formalized personnel routines, possibly due to data restrictions, we consider them as an independent factor. In their study, Stainback and Kwon (2012) show a negative effect of equal opportunity measures on horizontal segregation for South Korean data. A negative association between the implementation of gender mainstreaming and horizontal segregation in Germany also results from the bivariate analysis carried out by Beblo et al. (2008). Achatz et al. (2010) assume a causal relationship, however, the authors cannot verify this empirically as their analysis is based on data without information on whether gender equality policies exist. We close this particular research gap by using other waves of the same data set for our analysis which include variables for the implementation of gender mainstreaming. Using these waves of the LIAB, we are also able to identify the degree of formalization in organizations and to analyze its effect on the extent of firm level gender segregation.

Using American data, Tomaskovic-Devey and Skaggs (2001) analyze the influence of bureaucracy. They find that bureaucratization in general does not lead to a reduction of segregation, but that the direction of effect depends on other organization-specific variables such as management culture. A corresponding interdependence of formalization and other organizational characteristics for Germany is also assumed by Allmendinger and Podsiadlowski (2001). Consequently, we will empirically consider the interaction of the gender ratio in the workforce and the degree of formalization. Another determinant of the level of occupational segregation, which, from our point of view, has not been sufficiently studied yet, is vertical segregation. Stainback

and Kwon (2012) also analyze this connection and find a positive relationship for South Korean data. We assume a connection between horizontal and vertical segregation (see Blackburn et al., 2002), yet, the exact direction of the effect is theoretically ambiguous and should be investigated in empirical studies. It is possible that the gender ratio in leadership structures has an effect on horizontal segregation, or that horizontal segregation entails inequalities in the vertical dimension. The latter is based on the assumption that wage discrimination despite equal work performance is easier when men and women do not work in the same professions than it is with work in comparable fields (Ludsteck, 2014). Thus, we consider the share of women in top management positions, serving as an indicator of vertical segregation, as an explanatory factor in our model. Further research in the field of gender segregation, which is not reviewed here, refers to the empirical investigation of supply-side theories as well as studies on the consequences of occupational segregation, such as the gender pay gap (e.g. Busch, 2013; Gartner and Hinz, 2009). In the following, we will concentrate on the empirical investigation of factors explaining firm level occupational segregation.

2.3 Data

This study uses the cross-sectional model of the Linked Employer-Employee Data (LIAB) from the IAB.[1] The LIAB data link process-generated personal data of the Federal Employment Agency and of the social security system with data from the IAB establishment panel (IABEP). The IABEP is a representative, disproportionately drawn random sample of establishments with at least one employee subject to social security contribution. The annual panel survey (reference date 30th of June) covers recurring information on firm size, workforce structure, or turnover, but also alternating selected issues such as gender mainstreaming. The process data consist of employee and benefit notifications as of 30th of June, covering those persons, who at that time were employed by an establishment panel firm. Not included are therefore occupational groups such as self-employed, civil servants, or those in minor employment. A detailed description of the data can be found in Heining et al. (2013). The LIAB offers the

[1]Data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently remote data access.

exceptional opportunity to analyze workforce characteristics in combination with establishment characteristics so that labor supply and labor demand can be viewed simultaneously. For the analysis at hand, the waves of 2004 and 2008 are used as these waves of the IAB establishment panel contain additional questions on gender mainstreaming. Our sample is restricted to firms with more than 20 employees who are subject to social security contribution, since gender segregation is largely influenced by random fluctuations in smaller businesses. For technical reasons, only firms with a workforce consisting of both men and women and firms with more than one occupational group are included in the analysis. Table A.1 in the appendix shows the descriptive statistics of the data for the years 2004 and 2008.

2.4 Econometric Framework

Calculation and correction of the dissimilarity index

In order to gather and quantify the gender-related segregation in the labor market, various concepts for the operationalization and measurement of the unequal distribution of the sexes across occupations exist. Segregation indices constitute one possibility of condensing the extent of segregation to a single key figure. The existing literature on index measures of occupational segregation is comprehensive and offers numerous approaches (for an overview see Flückiger and Silber, 1999). For this article, we decided on the dissimilarity index introduced by Duncan and Duncan (1955). On the one hand, this index captures the horizontal dimension of segregation that we are interested in, and on the other hand, it is in widespread use in the current literature, facilitating the comparison of our results. The dissimilarity index at the labor market level is defined as

$$DI = \frac{1}{2} \sum_{j} \left| \frac{F_j}{F} - \frac{M_j}{M} \right| \tag{2.1}$$

with $j = 1, \ldots, m$ occupations, where F_j (M_j) states the number of women (men) in occupation j and F (M) the total number of females (males) in the labor market. For the calculation of the value at the establishment level (DI_i), we adapt the formula.

The segregation within an establishment is calculated as

$$DI_i = \frac{1}{2} \sum_j \left| \frac{F_{ij}}{F_i} - \frac{M_{ij}}{M_i} \right| \tag{2.2}$$

with $i = 1, \ldots, n$ establishments and $j = 1, \ldots, m$ occupations, whereby the size of the workforce is chosen as the reference value. Thus F_{ij} (M_{ij}) stands for the number of females (males) in firm i and profession j, and F_i (M_i) denotes the number of females (males) in firm i. In order to receive a meaningful value for Germany as a whole, the index values are averaged over all firms using weighting factors $(\overline{DI_i})$[2]. The dissimilarity index is normalized to the $[0; 1]$ interval, with the value 0 showing that the same gender ratio can be found in all professions. The value 1 indicates complete segregation, i.e. either only women or only men are present in each profession.

A limitation of the index is that a random allocation can correspond to nonzero segregation in the case of small group sizes. For the application of the dissimilarity index at the establishment level, it follows that in firms where certain professional groups are poorly occupied, a strong segregation might be measured even if men and women were randomly distributed (given the gender ratio of the workforce). This issue has been addressed by Carrington and Troske (1997) who show by simulation that it is necessary to control for random deviations from evenness. To account for this problem, they develop a corrected version of the dissimilarity index, which we will use in our study to account for possibly small occupational group sizes. Based on a random distribution, a hypothetical index value (DI^*) which depends on the number of employees for a given size of the professional group is initially simulated. The corrected dissimilarity index (DI_{cor}) then results from the deviation of the measured value (DI) from the hypothetical index value (DI^*) and is defined in the $[-1; 1]$ interval:

$$DI_{cor} = \begin{cases} \frac{DI - DI^*}{1 - DI^*} & \text{for } DI \geq DI^* \\ \frac{DI - DI^*}{DI^*} & \text{for } DI < DI^* \end{cases} \tag{2.3}$$

[2] For descriptive statistics on DI_i we use the weighting factors of the cross-sectional data provided by the IAB establishment panel. These weighting factors are necessary as the IAB establishment panel is based on a disproportionate sample regarding the characteristics establishment size, industrial sector and federal state.

We calculate the corrected index first at the level of the labor market (DI_{cor}) and also individually for each establishment ($DI_{i,cor}$). The correction allows us to capture the systematic extent of horizontal segregation. Random influences are controlled and no longer lead to an overestimation of the actual extent of segregation.

Estimation strategy

The aim of this study is to describe not only the extent of gender segregation in German firms and on the labor market as a whole, but most importantly the influence of organizational characteristics on segregation. To control for unobserved heterogeneity at the firm level, we exploit the panel structure of the LIAB. Using the data of the survey waves from the years 2004 and 2008, we are able to carry out different estimations that exploit the within and between variation in the data. We estimate a model of the following form

$$\begin{aligned} DI_{CORit} &= \beta_0 + \beta_1 formalism_{it} + \beta_2 formalism_{it} \times FS_{it} + \beta_3 mainstr_{it} \\ &\quad + \beta_4 mainstr_{it} \times FS_{it} + \beta_5 pts_{it} + \beta_6 pts_{it} \times FS_{it} + \beta_7 FS_{it} \\ &\quad + \beta_8 topshare_{it} + \beta_9 topshare_{it}^2 + \beta_{10} topshare_{it}^3 + X_{it}\alpha + c_i + u_{it}. \end{aligned} \tag{2.4}$$

DI_{CORit} marks the corrected dissimilarity index as described in equation (2.3) in establishment i at time t, which is normalized to a $[0;1]$ interval.[3] $formalism_{it}$ and $mainstr_{it}$ are dummy variables that take the value 1 if establishment i at time t uses formalized recruitment procedures or applies gender mainstreaming measures respectively. FS_{it} marks the female share in the workforce of establishment i at time t. pts_{it} denotes the proportion of part-time employees in establishment i at time t. $topshare_{it}$ refers to the share of women in top management positions in establishment i at time t. Vector X_{it} comprises the control variables: Location (East/West Germany), age of organization, number of employees, year, share of graduates, share of female

[3]For the purpose of regression analysis we transform the index values to a $[0;1]$ interval. By linearly transforming the corrected index, we can estimate fractional response models, which are characterized by the fact that the dependent variable is limited to the $[0;1]$ interval. We make use of the fact that a linear transformation of the dependent variable does not alter the signs of the estimated coefficients. The transformation is carried out as $DI_{CORi} = 0.5 + 0.5 \cdot DI_{i,cor}$.

graduates, number of employees in typical male/female professions, mean age of employees, variation coefficient of employee age, number of occupational groups in the establishment, industrial sector, legal form, collective bargaining, works council, downsizing indicator and a constant. c_i describes a time constant firm fixed effect. u_{it} is the error term. The full description of regressors is given in table 2.1.

Table 2.1: List of regressors

Variable	Description
Year2008	Dummy variable: 1=2008; 0=2004
Female share (FS)	Proportion of women in the workforce
Gender mainstreaming	Dummy variable for application of measures promoting the equality of men and women
Formalism	Dummy variable indicating formalized recruitment procedures
Part-time share (pts)	Share of part-time workers in the workforce
Topshare	Share of women in top management positions
East Germany	Dummy variable: 1=East Germany, 0=West Germany
Age of establishment	Dummy variable defined as 1 when the establishment was founded before 1990
Firm size	Number of employees (logarithmical)
Share of graduates	Share of employees with university degree
Share of female graduates	Share of female employees with university degree
Female/male professions	Percentage of employees typical in male/female professions, where a profession is defined as a male/female profession when at labor market level more than 70 percent of the employees in this profession are male/female.
Mean age	Average age of employees
Variation age	Variation coefficient of employee age
No. of occup. groups	Number of occupational groups
Industrial sector (17 categories)	
	Agriculture/forestry
	Mining/energy
	Food/luxury
	Consumer goods
	Investment goods
	Inv./consumer goods
	Building sector
	Trade/manufacturing

Continued on next page...

... table 2.1 continued

	Traffic/news
	Financial/insurance
	Restaurants
	Educational institutions
	Health/social sector
	Services for concerns
	Other services
	Civil service
	Social insurance
Legal form (6 categories)	
	Individually-owned firm
	Partnership
	Limited liability company
	Company limited by shares
	Public corporation
	Other legal form
Collective bargaining	Dummy variable defined as 1 in case of collective bargaining
Works council	Dummy variable defined as 1 if works council exists
Downsizing	Dummy variable defined as 1 if the number of employees decreased by a minimum of 10 percent compared to the previous year

By incorporating the interaction effects of the proportion of women in the workforce and the proportion of part-time positions as well as interactions between the female share and gender mainstreaming or formalism respectively, we can flexibly model the direction of the relationship of these influencing factors and thus depict theoretically assumed interdependencies between the independent variables.[4]

Regarding the estimation of our model, it should be noted that we cannot rule out that unobserved heterogeneity between the firms exists, for example in the form of the corporate culture. By using numerous control variables, we assume that the possibly existing endogeneity of the explanatory variables is significantly reduced and that unobserved factors such as the corporate culture can be seen as time-constant in the considered period and are therefore captured by the

[4]We have also estimated the models separately for establishments employing mostly white-collar or mostly blue-collar workers. If the ratio of blue-collar to white-collar workers was more than 60/40 (less than 40/60), an establishment was categorized as 'blue collar' ('white collar'). The results do not show significant differences in the direction of effects of the explaining variable between the two sectors. However, the coefficients differ in strength. The results are available on request.

firm fixed effect c_i. To account for the problem of time-constant unobserved heterogeneity, we use panel data models which explicitly control for the company-specific individual effects.

Following Wooldridge (2010), we treat the unobserved effect as a time-constant random variable and write the basic unobserved effects model in the error form as

$$y_{it} = x_{it}\beta + c_i + u_{it}, \tag{2.5}$$

where x_{it} is the vector that holds firm-specific observable variables, c_i represents an unobserved but time-constant heterogeneity term and u_{it} is the idiosyncratic error term. Assuming contemporaneous exogeneity of the idiosyncratic error and that the unobserved effect is uncorrelated with the regressors, one can consistently estimate the model using pooled OLS (POLS). Under the stronger assumption of strict exogeneity (u_{it} has to be uncorrelated with the regressors at any time period), one can improve upon POLS in terms of efficiency by exploiting the structure of the error term. Again, one has to assume zero correlation between the regressors and c_i as in the POLS model. This assumption, however, is critical. Allowing for c_i to be arbitrarily correlated with x_{it} may be necessary in some cases.

To account for possible correlation between the heterogeneity term and the regressors, we can apply a fixed effects model (FE). Under the strict exogeneity assumption the FE estimation leads to unbiased estimates while allowing for an arbitrary correlation between x_{it} and c_i. However, only the within variation is used for the estimation of the coefficients, which is why no effects of time-constant variables can be estimated. The variables that we use are organizational characteristics which predominantly show variation at the intercompany level. Yet, we observe little variation within firms over time as most organizational characteristics remain stable and show only few changes within a four-year period (e.g. industry and location only change in individual cases). As a result, some effects cannot be estimated and others only on the basis of a small number of cases with variation over time. Consequently, high standard errors of the estimators and therefore missing significances occur.

Alternatively, one can apply a Correlated Random Effects Model (CRE), which exploits both within and between variation and can therefore estimate coefficients on time-constant regressors. CRE allows for correlation between c_i and the regressors, but distributional assumptions on the unobserved effect have to be made. The coefficients on the time-variant regressors turn out to be the same as in the FE approach. As CRE cannot improve upon FE in terms of validity in our case, we have decided to omit the model. Random effects models (RE) or POLS regressions are more suitable as they rely on the analysis of intercompany differences and less on within variation. As discussed above, the problematic assumption for both estimation methods is, however, that the specific unobserved heterogeneity of the firms, i.e. the company-specific effect c_i, must not be correlated with the regressors. We cannot rule out that some of the regressors we use are correlated with unobserved characteristics. To the extent to which that is the case, it limits a purely causal interpretation of the estimated effects, which needs to be considered in the discussion of the results. We decided to use both POLS and RE under these constraints, yet we report the result of the FE estimation in the appendix. A direct comparison of RE and POLS models shows that RE models, under the validity of all assumptions, estimate more efficiently than POLS. However, strict exogeneity is required as identifying assumption in the RE model. This can be problematic if we expect serial correlation in the variables. Such a correlation structure might exist in our data as, for example, we cannot rule out a relationship between the level of segregation in 2004 and the implementation of equality measures or formalized personnel recruitment processes in 2008. In this case, POLS would be more suitable as it does not require the assumption of strict exogeneity. Eventually, we decided to juxtapose the two models.

Besides unobserved heterogeneity, another aspect of our model has to be taken into account: Our dependent variable is defined as a continuous variable in the $[0; 1]$ interval. The effect of any particular regressor cannot be constant throughout its range. This issue is already addressed by the non-linear form of the interaction terms. Nevertheless, the predicted values of the POLS or RE regression can still be outside the unit interval. To account for this, we additionally estimate the model from equation (2.5) as a fractional probit model (FP) following Papke and Wooldridge (1996). Thereby, the fact that the dependent variable, i.e. the corrected dissimilar-

ity index, is of bounded nature is considered. Moreover, it allows outcomes at the endpoints by using the standard normal cumulative density function as a non-linear link function, for which $0 \leq \Phi(\cdot) \leq 1$. As proposed in Papke and Wooldridge (1996), we estimate this model using a pooled Bernoulli quasi-maximum likelihood estimator. We report the result along with the POLS and RE estimation results to account for the sensitivity of the structural form to non-linear modeling. In the fractional probit model, the specification of the correlation structure of the companies' unobserved heterogeneity with the other explaining variables is analogous to POLS and RE: Zero correlation between the regressors and c_i is assumed. As in the linear models, it is possible to relax this assumption. For that reason, we apply a panel data model for fractional response variables (PFR) as proposed by Papke and Wooldridge (2008). Here as well, the standard normal cumulative density function is used as non-linear link function as in the fractional probit model, but time averages of all regressors are additionally added to the regression. This allows correlation between the regressors and c_i, but distributional assumptions on c_i have to be made. Yet, because of the low variation over time in the data we used, the limitations discussed above equally apply.

2.5 Empirical Results

The extent of gender segregation in German firms

On the basis of the LIAB, we calculated the dissimilarity index as introduced by Duncan and Duncan (1955) (DI, DI_i) as well as the corrected index by Carrington and Troske (1997) (DI_{cor}, $DI_{i,cor}$) at the labor market and the establishment level for the years 2004 and 2008. We measure the (un)equal distribution of men and women across occupational *groups*. This grouping was chosen because the more refined the breakdown of occupations, the larger the extent of random segregation would be. For that purpose, we compile all three-digit occupational titles to two-digit ones, which leads us to a maximum of 65 occupational groups per establishment (see table A.1 in the appendix). Table 2.2 provides an overview of the calculated values of the dissimilarity index at labor market level (DI, DI_{cor}) and at establishment level (DI_i, $DI_{i,cor}$) in the years 2004 and 2008.

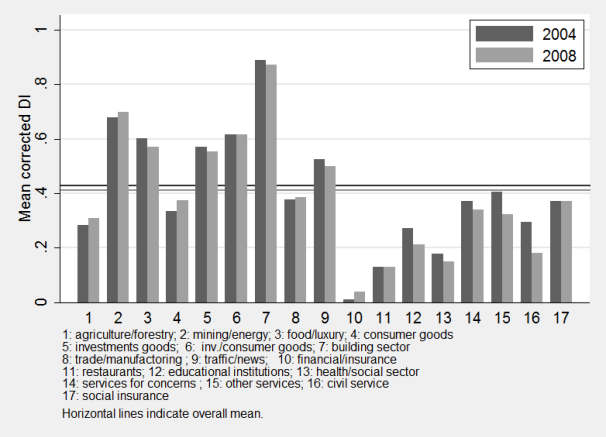
Table 2.2: Dissimilarity indices at labor market and establishment level by year

	2004			2008		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Labor market level						
DI	0.5481	0	7326	0.5437	0	6616
DI_{cor}	0.5463	0	7326	0.5416	0	6616
Establishment level						
DI_i	0.5796	0.2852	7326	0.5695	0.2810	6616
$DI_{i,cor}$	0.4211	0.3767	7326	0.4082	0.3691	6616

Source: LIAB, own calculation using weighting factors.

As measured in terms of the dissimilarity index by Duncan and Duncan (1955), segregation is lower at the labor market level (0.5481) compared to the establishment level (0.5796) in 2004. The same pattern is found in 2008 (0.5437 as opposed to 0.5695). Our results correspond with the findings of previous empirical studies. For instance, Hinz and Schübel (2001), who calculate the index in accordance with Duncan and Duncan (1955), show that segregation is higher at the establishment level than on the labor market as a whole. However, a different picture emerges as soon as the corrected index is applied, as shown by, e.g., Achatz et al. (2010). Our results confirm this finding. At the labor market level, the corrected DI_{cor} yields a value of 0.5463 in the year 2004. With 0.4211 the value at the establishment level is lower. Also in 2008, the segregation at the labor market level is higher than at the establishment level (0.5416 and 0.4082 respectively), measured by the corrected index. The comparison of the correction effect at the labor market and establishment level shows that the seemingly higher segregation at the establishment level measured by the uncorrected index can be explained with a higher random distribution within the small units: While the correction at the labor market level effects change only little - here each occupational group is represented by large numbers of employees - the index drops substantially at the establishment level after correction. This result suggests that the application of the correction procedure is necessary once the establishment level is taken into account. Regarding the development over time, we cannot determine any relevant changes between 2004 and 2008, neither for the corrected, nor for the uncorrected index.

As reported in table 2.2, the level of segregation considerably varies between establishments. In order to explain this observed heterogeneity, we first descriptively analyze the conditional distributions of the $DI_{i,cor}$ by different organizational characteristics. It appears that the mean level of segregation varies systematically with organizational characteristics such as firm size, industrial sector or location. Features of organizational demographics as well as the existence of formalized recruitment procedures and gender mainstreaming seem to be associated with the level of $DI_{i,cor}$.[5] Figure 2.1 shows the mean values of the firm level corrected dissimilarity index by sector and year.

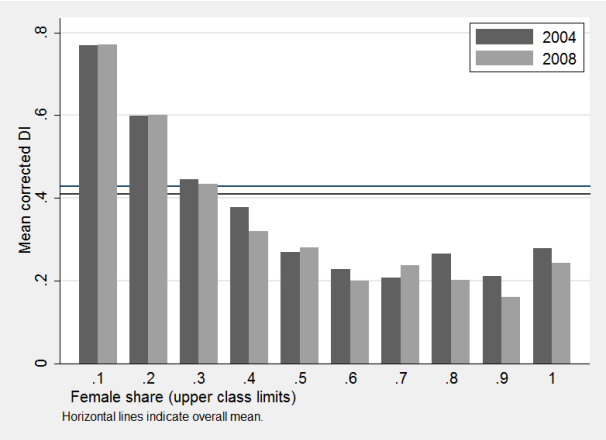


Source: LIAB, own calculation using weighting factors.

Figure 2.1: Corrected dissimilarity index by sector and year

In figure 2.2 one can see how the mean $DI_{i,cor}$ varies depending on the proportion of women in the workforce. It is worth noting that with a very low proportion of women (≤ 0.1), the segregation is substantially more pronounced than with a very high proportion of women (> 0.9), even though there is the same asymmetry between the number of men and women. This can be interpreted as an indication that men integrate more easily in female occupations than women do in male occupations (see Achatz et al., 2010). Yet, this example reveals the limitation of the bivariate analysis: The proportion of women in the workforce is not independent of other organizational characteristics, such as the industrial sector. A clear statement about the actual

[5]For a detailed discussion of the bivariate relations see Seifert and Schlenker (2014).



Source: LIAB, own calculation using weighting factors.

Figure 2.2: Corrected dissimilarity index by female share in the workforce and year

effects of the proportion of women in the workforce can therefore not be drawn solely based on bivariate analysis.

Multivariate estimation results

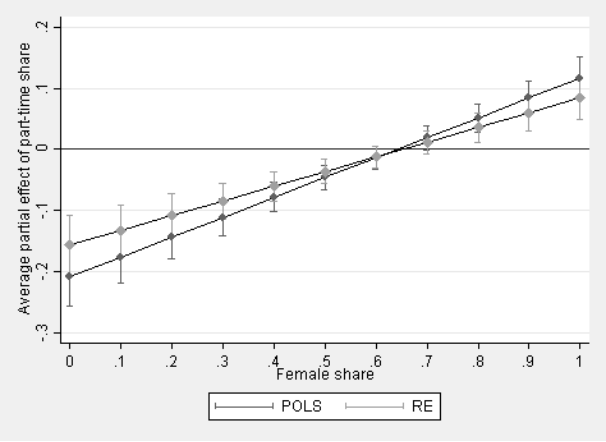
The bivariate results are now to be verified by means of multivariate models. For that purpose, we estimate three model types: pooled OLS, random effects, and fractional probit. In each model, the dependent variable is the linear transformation of the corrected dissimilarity index at the establishment level (DI_{CORit} in the $[0;1]$ interval). We compare the specification presented in equation (2.5) with estimation results based on a functional form without interactions in the variables related to the proportion of women in the workforce. This specification illustrates which influence the non-linear modeling (i.e. using interactions) of the effects of the variables gender mainstreaming, formalism, and proportion of part-time employment has, compared with the models presented in previous studies, which only consider the base effect of the variables. Table 2.3 provides an overview of the estimation results for the POLS, RE and FP model. Columns (1) and (2) of Table 2.3 show the results of the POLS estimations. Columns (3), (4) and (5), (6) contain the estimation results for the RE and FP models. Columns with odd numbers show the specification without interactions and columns with even numbers show the model with interactions added. Only selected coefficients are displayed. The full list of coefficients is reported in table A.2 in the appendix.

Table 2.3: Selected estimation results of the POLS, RE, and FP models in different specifications

	(1)	(2)	(3)	(4)	(5)	(6)
	(POLS)	(POLS)	(RE)	(RE)	(FP)	(FP)
Year2008	−0.0021	−0.0044	−0.0083***	−0.0087***	−0.0057	−0.0135
	(0.0031)	(0.0030)	(0.0023)	(0.0023)	(0.0103)	(0.0101)
Proportion of women (FS)	−0.1639***	−0.2614***	−0.1593***	−0.2310***	−0.4962***	−0.8329***
	(0.0135)	(0.0168)	(0.0135)	(0.0159)	(0.0347)	(0.0457)
Gender Mainst. × FS		0.0483***		0.0282***		0.1722***
		(0.0116)		(0.0095)		(0.0343)
Gender Mainstreaming	−0.0081***	−0.0284***	−0.0024	−0.0143***	−0.0255***	−0.1028***
	(0.0030)	(0.0058)	(0.0023)	(0.0043)	(0.0087)	(0.0188)
Formalism	−0.0087***	−0.0274***	−0.0048*	−0.0195***	−0.0274***	−0.0974***
	(0.0032)	(0.0059)	(0.0025)	(0.0044)	(0.0094)	(0.0198)
Formalism × FS		0.0442***		0.0341***		0.1548***
		(0.0123)		(0.0107)		(0.0368)
Part-time share	0.0020	−0.2079***	−0.0011	−0.1562***	0.0160	−0.6742***
	(0.0099)	(0.0249)	(0.0094)	(0.0251)	(0.0255)	(0.0681)
Part-time share × FS		0.3242***		0.2397***		1.0563***
		(0.0378)		(0.0385)		(0.1012)
Establishment size(ln)	−0.0229***	−0.0244***	−0.0221***	−0.0231***	−0.0667***	−0.0709***
	(0.0023)	(0.0023)	(0.0023)	(0.0023)	(0.0060)	(0.0059)
Age of establishment	0.0167***	0.0169***	0.0131***	0.0137***	0.0503***	0.0509***
	(0.0039)	(0.0039)	(0.0035)	(0.0035)	(0.0109)	(0.0108)
East Germany	0.0212***	0.0197***	0.0163***	0.0155***	0.0622***	0.0578***
	(0.0041)	(0.0041)	(0.0041)	(0.0040)	(0.0111)	(0.0110)
Top share	0.1172**	0.1224***	0.0989***	0.1022***	0.3249**	0.3402***
	(0.0455)	(0.0451)	(0.0365)	(0.0368)	(0.1278)	(0.1267)
Top share^2	−0.3178**	−0.3387**	−0.2865**	−0.2970**	−0.8580**	−0.9248**
	(0.1466)	(0.1454)	(0.1187)	(0.1198)	(0.4076)	(0.4043)
Top share^3	0.1981*	0.2110**	0.1861**	0.1920**	0.55312*	0.5735**
	(0.1044)	(0.1036)	(0.0844)	(0.0852)	(0.2891)	(0.2868)
N	9087	9087	9087	9087	9087	9087
R^2	0.3975	0.4088				

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; Source: LIAB, own calculation.
All models control for industry sector, legal form, share of employees in typical male/female occupations, mean and variation coefficient of employee age, number of occupational groups, collective bargaining, works council, downsizing, share of graduates among employees and among female employees.

We can see that particularly the relationship between segregation and the proportion of part-time is strongly context-sensitive, i.e. it differs depending on the proportion of women in the workforce. Without consideration of the interaction term, as in models (1), (3) and (5), no significant effect is found in any of the models. This might be the result of positive and negative effects balancing out in the total sample. Considering the interactions with the proportion of women in the workforce, all three models yield highly significant results. The interpretation of the coefficients on female share and part-time share is not straightforward. Thus, for a meaningful interpretation, one has to consider the partial effects at different values of the variables.



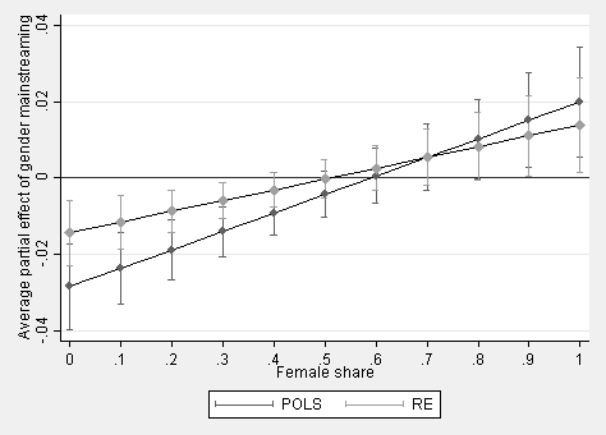
Source: LIAB, own calculation.

Figure 2.3: Average partial effects of part-time share on the corrected dissimilarity index (POLS, RE)

Figure 2.3 illustrates the relationship based on the POLS and RE models as reported in column (2) and (4) in table 2.3. The reported effects are the average partial effects of the part-time share, evaluated at different values of the female share. The plotted values show the amount of change in the level of segregation (measured in terms of $DI_{i,COR}$) with a one unit change in part-time share while holding the female share constant at different values. Along with the theoretical argumentation, one can clearly see that the partial effects of an increase in part-time share depend on the female share. Whereas in firms with a higher proportion of women, an increase in the proportion of part-time jobs is associated with significantly higher segregation, it

is negatively related to the segregation level in a male-dominated environment. This shows that the coefficients of the proportion of women in the workforce and the proportion of part-time jobs can only simultaneously be interpreted meaningfully.

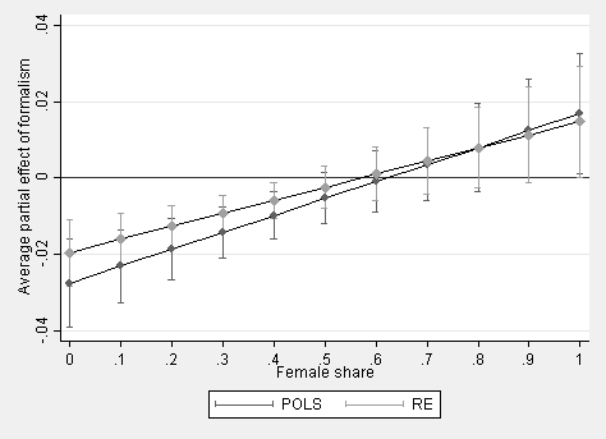
For the coefficients of the variables gender mainstreaming and formalism, the interaction with the proportion of women in the workforce also proves highly significant in all three estimation procedures. As with the effect of part-time share, the effects of formalism and gender mainstreaming cannot be interpreted solely from the estimated beta coefficients. To see how the effects vary by the proportion of women in the workforce, average partial effects have to be calculated for different values of the female share. We find a significant effect of the implementation of gender mainstreaming on the corrected dissimilarity index which varies depending on the female share in an establishment. Figure 2.4 shows these dependencies for the POLS and RE model, i.e. models (2) and (4) in table 2.3. The average partial effects of gender mainstreaming for different values of the female share are plotted. It can be seen that in firms with less than 60 percent women in the workforce gender mainstreaming goes along with a lesser extent of segregation. However, the average partial effect becomes positive with a higher proportion of women.



Source: LIAB, own calculation.

Figure 2.4: Average partial effects of gender mainstreaming on the corrected dissimilarity index (POLS, RE)

The effect of formalized procedures proves significant in all estimated models with and without interaction. While models (1), (3) and (5) suggest a generally negative relationship between formalism and the level of segregation, a more nuanced picture emerges from models (2), (4) and (6): Formalized processes in personnel selection correspond to a lower level of segregation when applied in organizations with less than 60 percent women in the workforce. However, along with a higher female share, positive partial effects of formalized processes on the segregation level are observed. This can be seen in figure 2.5, which shows the average partial effects for formalized processes in personnel selection (*formalism* as estimated in models (2) and (4), table 2.3). Again, the partial effects are calculated at different values of the female share with all other variables evaluated at their observed values.



Source: LIAB, own calculation.

Figure 2.5: Average partial effects of formalism on the corrected dissimilarity index (POLS, RE)

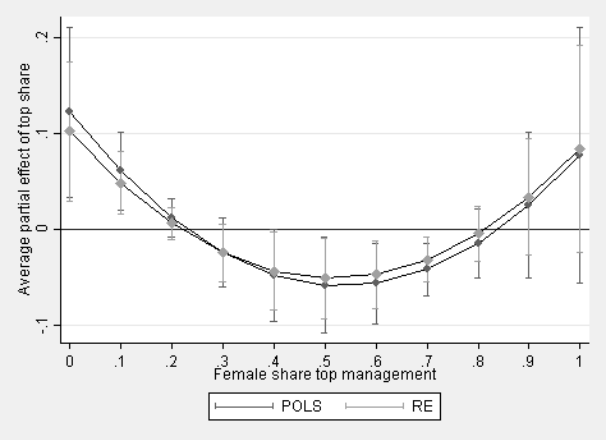
The results suggest that the implementation of gender mainstreaming and formalized processes in personnel selection are associated with, on average, lower segregation levels within establishments. As those measures are organizational characteristics that can - at least theoretically- be changed in the short term, they should be discussed as potential levers for the reduction of segregation. However, it has to be considered, that the partial effects of the different variables are highly context-sensitive with respect to the female share in the workforce. The insights

from figures 2.4 and 2.5 allow two possible interpretations: On the one hand, the existence of gender mainstreaming as well as formalized processes in personnel selection ease women's entry into male-dominated occupations in establishments where the workforce predominantly consists of male workers. On the other hand, neither the implementation of formalized procedures nor of gender mainstreaming measures are associated with a reduction of the segregation level in establishments that already employ a high proportion of female workers.

Furthermore, the effect of the female share itself is of particular interest. As the proportion of women in the workforce is interacted with three variables in our specification, a graphical illustration of the partial effects is not possible in the two dimensional space. Table 2.4 reports the average partial effects for selected coefficients of the POLS, RE and FP models. As for the effect of the female share, the average partial effect is highly significant and around -0.14 throughout all models including interactions terms (columns 2, 4 and 6 of table 2.4). The extent of the correlation is therefore to be regarded as dominant compared with the other estimated coefficients. The negative relationship between the proportion of women in the workforce and segregation is in line with previous results from, e.g., Achatz et al. (2010), who also report on average lower segregation in establishments with a higher female share. This suggests that the entry barriers for women into male-dominated occupations are higher than the ones for men into female-dominated occupations .

To estimate the influence of vertical segregation, we utilize the proportion of women at the top management level (*topshare*). We model the effect of the proportion of women in top management positions as a third-degree polynomial and observe a significant correlation. The results suggest that an increase in the proportion of women in management positions at low or high base levels (< 0.20 or > 0.80) is associated with higher segregation. At a base level in between, an increase of women in management positions corresponds with a lower level of segregation (see figure 2.6 for POLS and RE). However, it should be noted, that low levels of the female share in top management positions are rather common. The size of the estimated coefficient for vertical segregation is comparable with the one for the female share in the workforce. Table 2.4

reveals that the average partial effect is negative. This may be explained by the fact that the mean female share in top positions is less than 15 percent in our sample (see table A.1 in the appendix).



Source: LIAB, own calculation.

Figure 2.6: Estimated effect of the top share on the corrected dissimilarity index (POLS, RE)

Corresponding to our theoretical considerations discussed in section 2.2, we also find a positive estimated coefficient for the age of the organization and a significant correlation with the employees' age structure (reported in table A.2 in the appendix). In accordance with previous studies, we also find a significantly negative effect of the firm size on the corrected dissimilarity index, a significantly higher level of segregation in East German companies, and significant differences by industrial sectors (see table A.2). We can thus validate the previous empirical studies with our results. Moreover, by expanding the examination regarding context-sensitive relationships, namely the proportion of part-time jobs as well as formalized processes and gender mainstreaming, we can contribute to a better understanding of differences in the level of segregation in German firms.

The results discussed above prove stable across the POLS and RE estimation models, as demonstrated in table 2.3. In addition, the directions of the estimated FP coefficients are also in line with the other models' results. However, those are not comparable in their magnitude. For a meaningful interpretation of the FP model, average partial effects have to be calculated for all

coefficients in order to account for the nonlinear structure of the model. Therefore, table 2.4 reports the average partial effects for selected coefficients. The full list of average partial effects for the FP models is reported in table A.3 in the appendix. Figure 2.7 additionally provides insight into selected partial effects of gender mainstreaming and formalism at different values of the female share. It shows the non-linearity in the partial effects along the female share. Nevertheless, the effects are close to the ones estimated by POLS and RE.

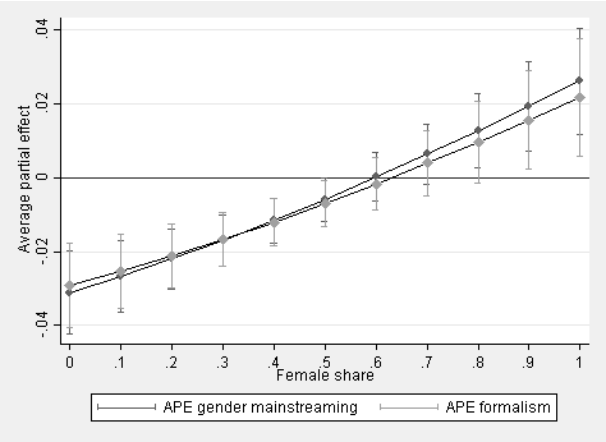
Table 2.4: Selected average partial effects of the POLS, RE and FP models in different specifications

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	POLS	POLS	RE	RE	FP	FP
Gender Mainstreaming	-0.0081^{***}	-0.0070^{**}	-0.0024	-0.0019	-0.0084^{***}	-0.0068^{**}
	(0.0030)	(0.0030)	(0.0023)	(0.0023)	(0.0029)	(0.0029)
Formalism	-0.0087^{***}	-0.0079^{**}	-0.0048^{*}	-0.0044^{*}	-0.0091^{***}	-0.00076^{**}
	(0.0032)	(0.0032)	(0.0025)	(0.0025)	(0.0031)	(0.0031)
Proportion of women (FS)	-0.1639^{***}	-0.1461^{***}	-0.1593^{***}	-0.1482^{***}	-0.1638^{***}	-0.1377^{***}
	(0.0135)	(0.0134)	(0.0135)	(0.0136)	(0.0114)	(0.0113)
Part-time share	0.0020	-0.0648^{***}	-0.0011	-0.0503^{***}	0.0053	-0.0552^{***}
	(0.0099)	(0.0113)	(0.0094)	(0.0112)	(0.0084)	(0.0094)
Top share	0.0856^{**}	0.0887^{***}	0.0728^{***}	0.0748^{***}	0.0776^{**}	0.0803^{***}
	(0.0342)	(0.0339)	(0.0273)	(0.0276)	(0.0315)	(0.0311)

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; Source: LIAB, own calculation.

As can be seen in table 2.4 and figure 2.7, the magnitude of the estimated coefficients in the FP model is comparable to the one of the RE model and does not differ considerably from the POLS estimates. While the non-linear modeling of the structural form as in equation (2.5), which includes the interaction terms, seems to have a strong effect on the estimated coefficients (compare even and odd columns in tables 2.3), the additional non-linear form of the FP model does not lead to substantially different results regarding the average partial effects.

So far, the models discussed rely on the assumption of zero correlation between c_i and the regressors. However, as already discussed theoretically, the validity of the identification assumptions



Source: LIAB, own calculation.

Figure 2.7: Average partial effects of gender mainstreaming and formalism on the corrected dissimilarity index (FP)

of all three models must be questioned critically. From a theoretical point of view, the FE model should be preferred to the RE model in order to consider a potential correlation between firm-specific unobserved heterogeneity and the explaining variables. The same argument holds for the non-linear model, where the panel fractional probit model (PFR) should be preferred to the model presented above. Yet, as indicated in section 2.4, the estimation of FE models did not prove useful. Many of the variables used in the estimation are practically time-constant at the firm level (e.g. industrial sector, location, year of company foundation). Moreover, for time-variable parameters, particularly the implementation of formalized processes and gender mainstreaming, changes can only be observed in a small proportion of the firms (less than 15 percent of the sample[6]). For these firms, we can furthermore assume that the change might have no directly measurable effect on the level of segregation yet, as it would becomes visible only in the long run due to a changed recruitment policy. Therefore, the effect can be captured better via inter-firm differences.

As expected, the estimation results reveal only few significant relationships because of the low intra-firm variation. The results of the FE and panel fractional probit estimation can be found in table A.4 in the appendix. It should be noted that some of the significant effects survive in

[6]Detailed statistics on the variation of the variables over time are available upon request.

the fixed effects setting. Organizational demographics, especially the female share, but also the female share in top management and the age structure show the same effects as in the models discussed above. The effect of formalism turns out to be negative but insignificant. Gender mainstreaming does not show significant effects as well. In order to state meaningful assumptions about possible causal effects of the implementation of such measures, it would certainly be desirable to apply the model to a broader data basis with a longer time dimension and more time variation.

2.6 Conclusion

This article describes the extent of horizontal occupational segregation in German firms on the basis of the 2004 and 2008 LIAB data and analyzes the relationship between the extent of horizontal segregation and organizational characteristics. The consistently high level of segregation in Germany and the identification of potential levers in firms for its reduction are of high scientific as well as sociopolitical relevance as horizontal gender segregation is not only accompanied by differences in the distribution of the sexes across occupational groups, but also leads to inequalities in wages, status and career opportunities. We calculate the dissimilarity index in accordance with Duncan and Duncan (1955) to measure the extent of horizontal segregation in the German labor market and within firms and use Carrington and Troske (1997)'s correction method to control for random fluctuations in the gender ratio of small occupational groups. We can show that particularly the firm level results are affected by the correction procedure while the results at labor market level remain rather unchanged.

We find substantial variation in the extent of horizontal segregation in German firms. A bivariate analysis shows that these differences occur systematically according to organizational characteristics. Using panel data models, we estimate the influence of individual organizational characteristics on the segregation level within the firms. Thereby, we address the problem of existing firm-specific unobserved heterogeneity. In accordance with previous studies, we find relationships between the extent of horizontal segregation and establishment size, industrial sec-

tor, and legal form. We can also show that organizational demographics significantly influence the level of segregation. In particular, the proportion of women in the workforce is of high relevance. The results are especially meaningful as the estimated negative effect survives even in the fixed effect framework. The negative relationship suggests that, for women, the access to male-dominated fields is aggravated compared to men, which more easily enter female-dominated occupations.

Furthermore, the female share in the workforce is highly relevant for the relationship between part-time work and the level of segregation. We show that the share of part-time workers does not prove significant if considered alone. However, once we allow for an interaction of part-time share and female share, the results turn significant. In firms with a female-dominated workforce, an increase in the proportion of part-time jobs is associated with significantly higher segregation. Conversely, we find it to be negatively related to the segregation level in a male-dominated environment.

Another central aspect of our study is to analyze the association of human resource measures with the extent of occupational segregation. Our results suggest a negative relationship between these measures and the amount of within firm segregation, meaning that lower levels of segregation are found in firms where gender mainstreaming and formalized recruitment procedures are implemented. Yet, these effects appear to be context-sensitive and go along with an on average lower segregation only in those firms that have less than 60 percent women in their workforce. Consequently, the adoption of human resource measures with the aim of reducing segregation must be discussed in the context of other organizational characteristics. It seems that the implementation of gender mainstreaming or formalized recruitment procedures only provide a 'lead in' for women in male-dominated firms. Nevertheless, gender mainstreaming and formalism seem to be relevant factors that are of high interest for policy makers who want to identify levers for changing the level of segregation within firms. Even though we cannot identify causal relationships, we still find correlation structures that give interesting insight for future research.

Finally, we examine the relationship of horizontal and vertical segregation: The multivariate models suggest that there is a non-linear relationship between the proportion of women at top management level and the level of occupational segregation within firms. Beyond a critical threshold of around 20 percent women in management positions, higher female shares in management are associated with a lower level of segregation in the firm. This relationship is particularly interesting for the debate about a compulsory women's quota. However, it requires further research in order to identify the direction of the relationship between horizontal and vertical segregation and possibly additional determinants of this relationship.

Appendix A: Additional Tables

Table A.1: Summary statistics: panel data set

Variable	Mean	Std. Dev.	Min.	Max.
DI_{CORit}	0.705	0.159	0.020	1
Year (2008)	0.510	0.500	0	1
Female share	0.442	0.271	0.001	0.996
Gender Mainstreaming	0.446	0.497	0	1
Formalism	0.624	0.484	0	1
Part-time share	0.204	0.221	0.001	1
Male professions	0.400	0.330	0	1
Female professions	0.236	0.314	0	1
No. of occup. groups	12.971	8.526	2	65
Firm size	4.844	1.182	3.045	10.780
Industrial sector				
Agriculture/forestry	0.014	0.118	0	1
Mining/energy	0.023	0.150	0	1
Food/luxury	0.032	0.175	0	1
Consumer goods	0.034	0.180	0	1
Investment goods	0.095	0.293	0	1
Inv./consumer goods	0.148	0.355	0	1
Building sector	0.033	0.180	0	1
Trade/manufacturing	0.094	0.291	0	1
Traffic/news	0.037	0.190	0	1
Financial/insurance	0.039	0.194	0	1
Restaurants	0.014	0.118	0	1
Educational institutions	0.043	0.204	0	1
Health/social sector	0.118	0.322	0	1
Services for concerns	0.095	0.293	0	1
Other services	0.029	0.168	0	1
Civil service	0.023	0.149	0	1
Social insurance	0.130	0.336	0	1
Legal form				
Individually-owned firm	0.024	0.154	0	1
Partnership	0.022	0.148	0	1

Continued on next page...

... table A.1 continued

Variable	Mean	Std. Dev.	Min.	Max.
Limited liability company	0.570	0.495	0	1
Company limited by shares	0.068	0.251	0	1
Public corporation	0.214	0.410	0	1
Other legal form	0.101	0.301	0	1
Age of establishment	0.648	0.478	0	1
East Germany	0.342	0.474	0	1
Share of graduates	0.138	0.192	0	1
Share of female graduates	0.121	0.186	0	1
Collective bargaining	0.703	0.457	0	1
Works council	0.670	0.470	0	1
Downsizing	0.097	0.296	0	1
Top share	0.146	0.286	0	1
Mean age	41.973	4.216	19.417	55.452
Variation coeff. age	0.258	0.054	0.063	0.520
Number of observations		9087		

Source: LIAB cross-sectional model 2004 and 2008, own calculation.

Table A.2: Estimation results of the POLS, RE, and FP models in different specifications

	(POLS)	(POLS)	(RE)	(RE)	(FP)	(FP)
Year2008	−0.0021	−0.0044	−0.0083***	−0.0087***	−0.0057	−0.0135
	(0.0031)	(0.0030)	(0.0023)	(0.0023)	(0.0103)	(0.0101)
Proportion of women (FS)	−0.1639***	−0.2614***	−0.1593***	−0.2310***	−0.4962***	−0.8329***
	(0.0135)	(0.0168)	(0.0135)	(0.0159)	(0.0347)	(0.0457)
Gender Mainst. × FS		0.0483***		0.0282***		0.1722***
		(0.0116)		(0.0095)		(0.0343)
Gender Mainstreaming	−0.0081***	−0.0284***	−0.0024	−0.0143***	−0.0255***	−0.1028***
	(0.0030)	(0.0058)	(0.0023)	(0.0043)	(0.0087)	(0.0188)
Formalism	−0.0087***	−0.0274***	−0.0048*	−0.0195***	−0.0274***	−0.0974***
	(0.0032)	(0.0059)	(0.0025)	(0.0044)	(0.0094)	(0.0198)
Formalism × FS		0.0442***		0.0341***		0.1548***
		(0.0123)		(0.0107)		(0.0368)
Part-time share	0.0020	−0.2079***	−0.0011	−0.1562***	0.0160	−0.6742***
	(0.0099)	(0.0249)	(0.0094)	(0.0251)	(0.0255)	(0.0681)
Part-time share × FS		0.3242***		0.2397***		1.0563***
		(0.0378)		(0.0385)		(0.1012)
Male professions	0.0972***	0.0916***	0.0966***	0.0933***	0.2862***	0.2688***
	(0.0111)	(0.0109)	(0.0112)	(0.0111)	(0.0286)	(0.0280)
Female professions	0.0315***	0.0202**	0.0132**	0.0101	0.0971***	0.0607**
	(0.0091)	(0.0088)	(0.0064)	(0.0063)	(0.0246)	(0.0241)
No. of occup. groups	0.0049***	0.0053***	0.0046***	0.0048***	0.0142***	0.0153***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0008)	(0.0008)
Establishment size(ln)	−0.0229***	−0.0244***	−0.0221***	−0.0231***	−0.0667***	−0.0709***
	(0.0023)	(0.0023)	(0.0023)	(0.0023)	(0.0060)	(0.0059)
Industrial sector (base category: agriculture/forestry)						
Mining/energy	0.1431***	0.1419***	0.1509***	0.1477***	0.4639***	0.4640***
	(0.0179)	(0.0179)	(0.0178)	(0.0178)	(0.0443)	(0.0447)
Food/luxury	0.1435***	0.1417***	0.1555***	0.1530***	0.4263***	0.4228***
	(0.0191)	(0.0192)	(0.0191)	(0.0192)	(0.0466)	(0.0473)
Consumer goods	0.0404**	0.0388**	0.0552***	0.0520***	0.1174***	0.1139**
	(0.0190)	(0.0190)	(0.0188)	(0.0188)	(0.0451)	(0.0458)
Investment goods	0.0676***	0.0587***	0.0786***	0.0703***	0.2058***	0.1786***

Continued on next page...

... table A.2 continued

	(POLS)	(POLS)	(RE)	(RE)	(FP)	(FP)
	(0.0177)	(0.0177)	(0.0176)	(0.0177)	(0.0424)	(0.0430)
Inv./consumer goods	0.0932***	0.0819***	0.1025***	0.0927***	0.2956***	0.2606***
	(0.0174)	(0.0174)	(0.0173)	(0.0174)	(0.0415)	(0.0422)
Building sector	0.2055***	0.1870***	0.2064***	0.1915***	0.8647***	0.8033***
	(0.0184)	(0.0184)	(0.0189)	(0.0189)	(0.0573)	(0.0576)
Trade/manufacturing	0.0821***	0.0760***	0.0919***	0.0858***	0.2466***	0.2294***
	(0.0173)	(0.0173)	(0.0173)	(0.0174)	(0.0409)	(0.0414)
Traffic/news	0.0780***	0.0745***	0.0875***	0.0831***	0.2368***	0.2281***
	(0.0191)	(0.0190)	(0.0189)	(0.0188)	(0.0468)	(0.0469)
Financial/insurance	0.0188	0.0221	0.0189	0.0203	0.1009**	0.1159***
	(0.0177)	(0.0177)	(0.0178)	(0.0178)	(0.0415)	(0.0421)
Restaurants	0.0285	0.0339	0.0470**	0.0486**	0.1024*	0.1243**
	(0.0224)	(0.0222)	(0.0226)	(0.0226)	(0.0541)	(0.0542)
Educational institutions	0.0902***	0.0901***	0.0922***	0.0892***	0.2693***	0.2731***
	(0.0187)	(0.0186)	(0.0186)	(0.0185)	(0.0442)	(0.0444)
Health/social sector	0.0703***	0.0658***	0.0854***	0.0773***	0.2161***	0.2064***
	(0.0184)	(0.0183)	(0.0180)	(0.0181)	(0.0439)	(0.0443)
Services for concerns	0.0634***	0.0631***	0.0692***	0.0671***	0.1927***	0.1946***
	(0.0175)	(0.0174)	(0.0174)	(0.0175)	(0.0413)	(0.0418)
Other services	0.0708***	0.0721***	0.0792***	0.0774***	0.2099***	0.2182***
	(0.0194)	(0.0191)	(0.0191)	(0.0191)	(0.0460)	(0.0461)
Civil service	0.0717***	0.0760***	0.0821***	0.0815***	0.2163***	0.2349***
	(0.0201)	(0.0199)	(0.0203)	(0.0201)	(0.0482)	(0.0481)
Social insurance	0.1059***	0.1075***	0.1088***	0.1063***	0.3131***	0.3217***
	(0.0179)	(0.0179)	(0.0178)	(0.0179)	(0.0426)	(0.0430)
Legal form (base category: individually-owned firm)						
Partnership	−0.0533***	−0.0550***	−0.0321**	−0.0336**	−0.1528***	−0.1583***
	(0.0162)	(0.0159)	(0.0138)	(0.0136)	(0.0448)	(0.0441)
Limited liability company	−0.0259*	−0.0287**	−0.0145	−0.0166	−0.0744**	−0.0877**
	(0.0135)	(0.0133)	(0.0111)	(0.0111)	(0.0376)	(0.0373)
Company limited by shares	−0.0465***	−0.0489***	−0.0288**	−0.0308**	−0.1395***	−0.1487***
	(0.0145)	(0.0143)	(0.0121)	(0.0121)	(0.0400)	(0.0398)

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... table A.2 continued

	(POLS)	(POLS)	(RE)	(RE)	(FP)	(FP)
Public corporation	−0.0351**	−0.0389***	−0.0183	−0.0197	−0.1024**	−0.1159***
	(0.0148)	(0.0146)	(0.0123)	(0.0123)	(0.0402)	(0.0399)
Other legal form	−0.0445***	−0.0470***	−0.0295**	−0.0316***	−0.1315***	−0.1411***
	(0.0145)	(0.0143)	(0.0123)	(0.0122)	(0.0395)	(0.0393)
Age of establishment	0.0167***	0.0169***	0.0131***	0.0137***	0.0503***	0.0509***
	(0.0039)	(0.0039)	(0.0035)	(0.0035)	(0.0109)	(0.0108)
East Germany	0.0212***	0.0197***	0.0163***	0.0155***	0.0622***	0.0578***
	(0.0041)	(0.0041)	(0.0041)	(0.0040)	(0.0111)	(0.0110)
Share of graduates	−0.0083	0.0036	−0.0338**	−0.0251*	−0.0313	0.0073
	(0.0174)	(0.0172)	(0.0144)	(0.0143)	(0.0511)	(0.0511)
Share of female graduates	−0.0594***	−0.0672***	−0.0224	−0.0287**	−0.1620***	−0.1874***
	(0.0176)	(0.0174)	(0.0147)	(0.0145)	(0.0536)	(0.0534)
Collective bargaining	0.0052	0.0038	0.0011	0.0001	0.0159	0.0115
	(0.0039)	(0.0038)	(0.0034)	(0.0034)	(0.0110)	(0.0109)
Works council	−0.0017	−0.0039	−0.0029	−0.0040	−0.0049	−0.0117
	(0.0043)	(0.0042)	(0.0039)	(0.0039)	(0.0116)	(0.0116)
Downsizing	−0.0121***	−0.0112**	0.0022	0.0023	−0.0367***	−0.0399**
	(0.0046)	(0.0046)	(0.0037)	(0.0037)	(0.0138)	(0.0137)
Top share	0.1172**	0.1224***	0.0989***	0.1022***	0.3249**	0.3402***
	(0.0455)	(0.0451)	(0.0365)	(0.0368)	(0.1278)	(0.1267)
Top share^2	−0.3178**	−0.3387**	−0.2865**	−0.2970**	−0.8580**	−0.9248**
	(0.1466)	(0.1454)	(0.1187)	(0.1198)	(0.4076)	(0.4043)
Top share^3	0.1981*	0.2110**	0.1861**	0.1920**	0.55312*	0.5735**
	(0.1044)	(0.1036)	(0.0844)	(0.0852)	(0.2891)	(0.2868)
Mean age	0.0024***	0.0023***	0.0028***	0.0026***	0.0074***	0.0070***
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0017)	(0.0017)
Variation age	0.1063**	0.1078**	0.0893**	0.0890**	0.3307***	0.3301***
	(0.0442)	(0.0437)	(0.0413)	(0.0411)	(0.1201)	(0.1189)
Constant	0.5931***	0.6576***	0.5693***	0.6175***	0.2063*	0.4297***
	(0.0422)	(0.0424)	(0.0403)	(0.0405)	(0.1116)	(0.1126)
N	9087	9087	9087	9087	9087	9087
R^2	0.3975	0.4088				

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; Source: LIAB, own calculation.

Table A.3: Average partial effects of the fractional probit models

Variables	(FP)	(FP)
Year2008	−0.0019	−0.0045
	(0.0034)	(0.0033)
Gender Mainstreaming	−0.0084***	−0.0068**
	(0.0029)	(0.0029)
Formalism	−0.0091***	−0.00076**
	(0.0031)	(0.0031)
Proportion of women (FS)	−0.1638***	−0.1377***
	(0.0114)	(0.0113)
Part-time share	0.0053	−0.0552***
	(0.0084)	(0.0094)
Male professions	0.0944***	0.0886***
	(0.0094)	(0.0092)
Female professions	0.0321***	0.0200***
	(0.0081)	(0.0079)
No. of occup. groups	0.0047***	0.0050***
	(0.0003)	(0.0003)
Establishment size (ln)	−0.0220***	−0.0234***
	(0.0020)	(0.0019)
Industrial sector (base category: agriculture/forestry)		
Mining/energy	0.1560***	0.1547***
	(0.0157)	(0.0158)
Food/luxury	0.1448***	0.1426***
	(0.0163)	(0.0165)
Consumer goods	0.0427***	0.0411**
	(0.0166)	(0.0167)
Investment goods	0.0736***	0.0637***
	(0.0156)	(0.0167)
Inv./consumer goods	0.1037***	0.0914***
	(0.0152)	(0.0154)
Building sector	0.2559***	0.2408***
	(0.0168)	(0.0172)

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... table A.3 continued

Variables	(FP)	(FP)
Trade/manufacturing	0.0874***	0.0810***
	(0.0150)	(0.0151)
Traffic/news	0.0841***	0.0806***
	(0.0169)	(0.0169)
Financial/insurance	0.0368**	0.0419***
	(0.0153)	(0.0154)
Restaurants	0.0374*	0.0448**
	(0.0197)	(0.0195)
Educational institutions	0.0950***	0.0955***
	(0.0160)	(0.0159)
Health/social sector	0.0771***	0.0732***
	(0.0160)	(0.0161)
Services for concerns	0.0691***	0.0692***
	(0.0152)	(0.0153)
Other services	0.0750***	0.0772***
	(0.0167)	(0.0166)
Civil service	0.0772***	0.0829***
	(0.0174)	(0.0171)
Social insurance	0.1094***	0.1113***
	(0.0155)	(0.0155)
Legal form (base category: individually-owned firm)		
Partnership	−0.0501***	−0.0516***
	(0.0145)	(0.0141)
Limited liability company	−0.0249**	−0.0280**
	(0.0118)	(0.0117)
Company limited by shares	−0.0456***	−0.0483***
	(0.0127)	(0.0125)
Public corporation	−0.0331***	−0.0373***
	(0.0127)	(0.0125)
Other legal form	−0.0428***	−0.0458***
	(0.0125)	(0.0124)

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... table A.3 continued

Variables	(FP)	(FP)
Age of establishment	0.0166***	0.0168***
	(0.0036)	(0.0036)
East Germany	0.0205***	0.0191***
	(0.0037)	(0.0036)
Share of graduates	−0.0103	0.0024
	(0.0169)	(0.0168)
Share of female graduates	−0.0535***	−0.0618***
	(0.0177)	(0.0176)
Collective bargaining	0.0052	0.0038
	(0.0036)	(0.0036)
Works council	−0.0016	−0.0039
	(0.0038)	(0.0038)
Downsizing	−0.0121***	−0.0112**
	(0.0045)	(0.0045)
Top share	0.0776**	0.0803***
	(0.0315)	(0.0311)
Mean age	0.0025***	0.0023***
	(0.0006)	(0.0006)
Variation age	0.1092***	0.1088***
	(0.0396)	(0.0392)
N	9087	9087

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$;

Source: LIAB, own calculation.

Table A.4: Estimation results of the FE and panel fractional response models

	(FE)	(FE)	(PFR)	(PFR)
Year2008	-0.0141^{***}	-0.0140^{***}	-0.0444^{***}	-0.0441^{***}
	(0.0033)	(0.0033)	(0.0100)	(0.0100)
Proportion of women (FS)	-0.1295^{***}	-0.1388^{***}	-0.3897^{**}	-0.4317^{***}
	(0.0560)	(0.0568)	(0.1607)	(0.1651)
Gender Mainst. × FS		0.0010		0.0021
		(0.0125)		(0.0370)
Gender Mainstreaming	0.0034	0.0030	0.0093	0.0087
	(0.0029)	(0.0052)	(0.0085)	(0.0174)
Formalism	−0.0002	−0.0056	−0.0011	−0.0235
	(0.0033)	(0.0058)	(0.0098)	(0.0192)
Formalism × FS		0.0122		0.0472
		(0.0155)		(0.0453)
Part-time share	0.0080	0.0041	0.0248	−0.0078
	(0.0179)	(0.0478)	(0.0497)	(0.1425)
Part-time share × FS		0.0054		0.0480
		(0.0827)		(0.2368)
Male professions	0.0087	0.0094	0.0130	0.0157
	(0.0446)	(0.0449)	(0.1307)	(0.1314)
Female professions	0.0004	0.0006	−0.0041	−0.0036
	(0.0074)	(0.0074)	(0.0206)	(0.0206)
No. of occup. groups	0.0021^{***}	0.0021^{***}	0.0064^{***}	0.0064^{***}
	(0.0008)	(0.0008)	(0.0024)	(0.0024)
Establishment size(ln)	−0.0069	−0.0070	−0.0202	−0.0208
	(0.0090)	(0.0090)	(0.0257)	(0.0256)
Legal form (base category: individually-owned firm)				
Partnership	0.0173	0.0161	0.0532	0.0491
	(0.0183)	(0.0184)	(0.0564)	(0.0557)
Limited liability company	0.0183	0.0175	0.0561	0.0523
	(0.0156)	(0.0156)	(0.0491)	(0.0484)
Company limited by shares	0.0245	0.0240	0.0731	0.0704
	(0.0196)	(0.0195)	(0.0604)	(0.0599)

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... table A.4 continued

	(FE)	(FE)	(PFR)	(PFR)
Public corporation	0.0284	0.0283	0.0839	0.0830
	(0.0185)	(0.0186)	(0.0558)	(0.0554)
Other legal form	0.0161	0.0157	0.0487	0.0468
	(0.0187)	(0.0187)	(0.0560)	(0.0555)
Age of establishment	0.0054	0.0058	0.0165	0.0176
	(0.0060)	(0.0059)	(0.0182)	(0.0181)
East Germany	0.0148	0.0150	0.0429	0.0438
	(0.0153)	(0.0153)	(0.0437)	(0.0440)
Share of graduates	−0.0221	−0.0221	−0.0686	−0.0686
	(0.0215)	(0.0216)	(0.0674)	(0.0680)
Share of female graduates	0.0095	0.0092	0.0323	0.0310
	(0.0201)	(0.0201)	(0.0650)	(0.0655)
Collective bargaining	−0.0022	−0.0023	−0.0074	−0.0078
	(0.0055)	(0.0055)	(0.0163)	(0.0163)
Works council	0.0033	0.0036	0.0100	0.0112
	(0.0080)	(0.0080)	(0.0230)	(0.0231)
Downsizing	0.0133***	0.0133***	0.0412***	0.0413***
	(0.0046)	(0.0046)	(0.0135)	(0.0135)
Top share	0.0951**	0.0972**	0.2742**	0.2845**
	(0.0463)	(0.0463)	(0.1329)	(0.1336)
Top share^2	−0.3172**	−0.3232**	−0.9125**	−0.9419**
	(0.1519)	(0.1512)	(0.4301)	(0.4309)
Top share^3	0.2200**	0.2241**	0.6320**	0.6516**
	(0.1079)	(0.1073)	(0.3042)	(0.3042)
Mean age	0.0031**	0.0031**	0.0094**	0.0093**
	(0.0015)	(0.0015)	(0.0045)	(0.0045)
Variation age	−0.0065	−0.0055	−0.0102	−0.0128
	(0.0884)	(0.0883)	(0.2651)	(0.2653)
Gender mainstr.			−0.0516**	−0.1320***
			(0.0206)	(0.0439)
Formalism			−0.0457**	−0.0464
			(0.0230)	(0.0482)

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... table A.4 continued

	(FE)	(FE)	(PFR)	(PFR)
FS			−0.1618	−0.4497**
			(0.1709)	(0.1901)
Part-time share			0.0665	−0.7191***
			(0.0695)	(0.1832)
Male professions			0.2191	0.1843
			(0.1399)	(0.1405)
Female professions			0.1481**	0.0684
			(0.0668)	(0.0655)
No. of occup. groups			0.0071**	0.0082***
			(0.0028)	(0.0028)
Establishment size(ln)			−0.0445	−0.0507*
			(0.0282)	(0.0281)
Partnership			−0.3018***	−0.2953***
			(0.1045)	(0.1035)
Limited liability company			−0.1770*	−0.1806*
			(0.0954)	(0.0945)
Company limited by shares			−0.2846***	−0.2865***
			(0.1059)	(0.1052)
Public corporation			−0.2583**	−0.2748***
			(0.1024)	(0.1016)
Other legal form			−0.2408**	−0.2483**
			(0.1003)	(0.0996)
Age of establishment			0.0479*	0.0466*
			(0.0276)	(0.0273)
East Germany			0.0487	0.0433
			(0.0483)	(0.0484)
Share of graduates			0.1774	0.2197*
			(0.1195)	(0.1168)
Share of female graduates			−0.3244***	−0.3528***
			(0.1218)	(0.1191)
Collective bargaining			0.0608**	0.0557**
			(0.0271)	(0.0267)

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... table A.4 continued

	(FE)	(FE)	(PFR)	(PFR)
$\overline{\text{Works council}}$			−0.0035	−0.0140
			(0.0321)	(0.0320)
$\overline{\text{Downsizing}}$			−0.1010***	−0.0980***
			(0.0376)	(0.0368)
$\overline{\text{Top share}}$			0.3427	0.3554
			(0.2969)	(0.2947)
$\overline{\text{Top share}^2}$			−0.8093	−0.8597
			(0.9420)	(0.9346)
$\overline{\text{Top share}^3}$			0.4614	0.4938
			(0.6643)	(0.6588)
$\overline{\text{Mean age}}$			−0.0067	−0.0060
			(0.0053)	(0.0052)
$\overline{\text{Variation age}}$			0.3380	0.4195
			(0.3544)	(0.3512)
$\overline{\text{Gender Mainst.} \times \text{FS}}$				0.1829**
				(0.0805)
$\overline{\text{Formalism} \times \text{FS}}$				0.0085
				(0.0931)
$\overline{\text{Part-time share} \times \text{FS}}$				1.2119***
				(0.2962)
Constant	0.5958***	0.7281***	0.5301**	0.6847***
	(0.1057)	(0.1086)	(0.2202)	(0.2236)
N	4618	4618	4618	4618

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$;

Source: LIAB, own calculation.

All models control for industrial sector, $\overline{variable}$ denotes time average.

Chapter 3

Potential Parenthood and Career Progression of Men and Women - A Simultaneous Hazards Approach

3.1 Introduction

Gender differences in the labor market remain a hot topic in labor economics. Women generally earn less than men, their wage mobility is lower and they are underrepresented in top management positions (Blau and Kahn, 2000; Weichselbaumer and Winter-Ebmer, 2005; Manning and Swaffield, 2008; Bertrand and Hallock, 2001; Baerts et al., 2011). Some studies have found the existence of a 'glass ceiling' to women's career perspectives which excludes them from high earnings and high-status positions (Albrecht et al., 2003; Arulampalam et al., 2007). Career progression is linked to wage growth, status and job satisfaction. Understanding differences in career transition patterns between men and women is a starting point for identifying the factors that hamper women's career progression and may help to explain the gender gap at the upper end of the career ladder. Fertility-related aspects have been considered to be a potential

This chapter is based on the article 'Potential Parenthood and Career Progression of Men and Women - A Simultaneous Hazards Approach' by Martin Biewen and Stefanie Seifert.

main driver of gender differences in the career course. A number of studies have established a relationship between career interruptions due to child rearing and slower wage growth or even wage losses (for some recent examples, see Anderson et al., 2002; Lalive and Zweimüller, 2009; Bertrand et al., 2010; Fitzenberger et al., 2013; Drange and Rege, 2013).

While realized fertility is certainly a major candidate for explaining differences between men and women after the birth of a child, the effect of *potential* fertility on career transitions has received less attention. Different mechanisms may give rise to an effect of potential fertility on career transitions. The most obvious one is that employers could shy away from hiring or promoting women who have a high hazard of becoming a mother in the near future because they fear that these women might become unavailable for work because of child birth or that their productivity after child birth could suffer due to parenting duties (Lazear and Rosen, 1990). Such a mechanism follows the theory of statistical discrimination, i.e. employers might discriminate against women with a high observable pregnancy hazard, no matter whether a given woman will actually give birth to a child or not. There may also be voluntary effects of a high pregnancy hazard on career transitions, i.e. at a time at which a woman considers the possibility to become a mother to be high, she may choose not to make certain career transitions. Effects of potential fertility on career transitions may also exist for men. Employers might interpret indicators of a high hazard of imminent parenthood (e.g. marital status) as a positive signal indicating high productivity and career commitment, or such men might voluntarily make or not make certain career transitions.

The aim of this paper is to directly investigate the relationship between the hazard of becoming a parent and the propensity for directional career movements, i.e. upward, downward and horizontal career transitions. To our best knowledge, this has not been done in this form in the literature before. We measure the career level of a person in terms of the number of subordinates directly supervised and, alternatively, by an occupational prestige score (in our case the Standard International Occupational Prestige Scale, SIOPS). We focus on career transitions of men and women before the birth of a first child in order to separate, as completely as possible,

the aspect of potential fertility from that of realized fertility. The more general research question of our study is the comparative analysis of directional career transitions for men and women. We pursue this research question in the framework of simultaneous hazards (Lillard, 1993), i.e. the hazards of directional career movements are modeled jointly with the individual hazard of becoming a parent, whereby the parenthood hazard directly enters the hazards of directional career movements as an explanatory variable. We also take account of a large number of potential other determinants of career transitions as well as of aspects such as state dependence, duration dependence and lagged duration dependence.

This paper is structured as follows. In section 3.2, we review some related literature. Section 3.3 describes our data. In section 3.4, we outline our econometric framework. Section 3.5 presents our empirical results. Section 3.6 concludes.

3.2 Related Literature

There is large literature on career development of men and women. Some studies focus on promotion, some on wage growth, while others analyze job mobility covering job-to-job movements irrespective of the rank. Summarizing results on promotions is difficult, because the term promotion covers a range of different processes depending on the data used (see Gibbons and Waldman, 1999, for a theoretical overview of the term promotion and Abele et al., 2011, on career success). Many studies using survey data rely on self-reported promotions (e.g. Booth et al., 2003; Blau and DeVaro, 2007), others use employer-provided or administrative information (e.g. Pekkarinen and Vartiainen, 2006). If promotion is measured as a change in job prestige covering a job-to-job change, one needs data that have comparable scales about the hierarchical level or the job task description (see Granqvist and Persson, 2005; Pekkarinen and Vartiainen, 2006; Kunze, 2013).

An important distinction is the one between internal and external promotions (Acosta, 2010). Internal promotions happen within the employment spell at the same employer, while external promotions refer to promotions in connection with job changes. Due to data restrictions, in this

paper we will only study job-to-job movements (for more details, see below). Each transition is defined as either an upward, a downward or a horizontal movement. While upward movements can be interpreted as promotions, horizontal transitions come closer to what is labeled as job mobility in the literature. Promotions are often considered to be a main driver of wage growth (e.g. McCue, 1996). However, job mobility is theoretically and empirically also found to be closely connected to wage growth. According to the 'job shopping' theory, employees benefit from early job mobility (see e.g. Johnson, 1978; Topel and Ward, 1992; Schmelzer, 2012; Bagger et al., 2014). An important implication is that, in the possible case of employer discrimination against women, reduced early job mobility may have more long-term consequences on the likelihood of upward and horizontal transitions.

Theoretically, lower career transition probabilities for women might be due to employers' behavior in processes of promotion and hiring, described by the theory of statistical discrimination (Becker, 1971; Phelps, 1972).[1] According to this argument, *all* women face lower promotion probabilities compared to men because *some* women will interrupt their employment as a consequence of giving birth to a child. Following Aigner and Cain (1977) this would not necessarily result in an unwarranted discrimination of women as a group because employers need to take account of the higher separation risk of women in their hiring and promotion decisions, leading to the situation that women who do give birth later are granted a higher-than-warranted promotion probability at the expense of other women who face a promotion probability that is too low given their probability of quitting. However, in a life-cycle perspective, the women who do quit for fertility reasons later will not actually benefit from their earlier 'preferential' treatment, so that there may be a net loss for the group of women as a whole. Moreover, for many, the idea that a given individual should be 'penalized' for group characteristics or for tasks considered to be essential for the reproduction of society may seem questionable.

The central theoretical contribution in the literature modeling the consequences of higher female separation rates for job promotions is Lazear and Rosen (1990). In their model, women are as-

[1] For the following, see also the discussion in Winter-Ebmer and Zweimüller (1997).

sumed to have more out-of-work possibilities than men and are therefore more likely to quit in their later employment path. Employers take this into account in their hiring and promotion decisions with the consequence that women have to be more able than men to get promoted to the next career stage. As a consequence, the final career rank and compensation is lower for women than for men, even under the assumption of an equal ability distribution for men and women.

The existing empirical literature generally shows that women are underrepresented in top-management and executive positions and have lower unconditional promotion rates (e.g. Cobb-Clark, 2001; Blau and DeVaro, 2007; Smith et al., 2013; Kunze and Miller, 2014). The picture becomes less clear with respect to conditional promotion probabilities. Maassen van den Brink and Groot (1996) find that women are less frequently in jobs that offer promotion possibilities, but if they are, they do not face lower promotion probabilities. The results in Blau and DeVaro (2007) suggest lower probabilities of promotion for women, but no gender differences in wage growth with or without promotions. Booth et al. (2003) present a theory and empirical evidence for the 'sticky floor' hypothesis. According to their model, women are as likely as men to get promoted but they end up at the bottom of the pay scale in the new grade. Other representative examples of literature are Hersch and Viscusi (1996), Cobb-Clark (2001), Francesconi (2001) and Johnston and Lee (2012). Results on job mobility confirm the 'job shopping' hypothesis and reveal substantial gender differences. Schmelzer (2012) finds positive wage effects of direct job mobility in the early career. According to Carrillo-Tudela et al. (2016) voluntary moves tend to be upward and connected to wage gains.

Focusing on gender differences in more detail, Granqvist and Persson (2005) show that family-related factors, such as being married, have contradictory effects on men's and women's transition probabilities to higher ranked jobs. They also find negative effects of career interruptions due to child birth on women's career mobility. The result that especially variables related to family responsibilities affect men and women in a different way is also confirmed in Kunze (2013), who finds that the probability of progressing on the career ladder is reduced through children for

women but not for men. On the contrary, men with one or two children are most likely to climb the career ladder. Related to these findings, there may also be effects of partnership on career progression. The hypotheses that men benefit from being in a relationship while women's career courses are negatively affected by cohabitation are often referred to as 'marriage premium' and 'marriage penalty' respectively. The theoretical arguments are based on human capital theory, but empirical evidence is mixed (Verbakel and De Graaf, 2008). Finally, Kunze and Troske (2012) exploit firm closures as a natural experiment in order to investigate gender differences in job search behavior. Their results suggest that gender differences in job search and mobility are related to fertility decisions and are apparent in prime-childbearing years.

As indicated above, most of the empirical literature focuses on the effects of realized but not on potential or future fertility on career paths. Exceptions are Francesconi (2002) and Adda et al. (2011), who present theoretical and empirical models of intertemporal career decisions and fertility behavior. Our more modest goal in this paper is to directly investigate the potential link between the contemporaneous probability of becoming a parent and the probabilities for different career movements. To our best knowledge, this has not been done in this form in the literature before. The study that comes closest to what we have in mind is Winter-Ebmer and Zweimüller (1997) who investigate the determinants of the current career *rank* of men and women, and who include as an explanatory variable aggregate fertility indicators for women. Winter-Ebmer and Zweimüller (1997) do not consider transitions between ranks or potential fertility effects on men's career outcomes, and they do not explicitly model individual fertility hazards. There are also two experimental studies based on artificial job applications whose implicit research questions resemble the one considered by us.

Petit (2007) presents evidence for hiring discrimination against women aged 25 applying for high-skilled administrative jobs but no discrimination of women among single and childless applicants aged 37. Baert (2014) finds evidence for discrimination of young heterosexual women (compared to homosexual women) when applying for job vacancies. Compared to the cited articles, our goal is to explicitly model the relationship between the individual hazard of becom-

ing a mother or a father and the hazards for different career movements in a joint way using the simultaneous hazards approach introduced by Lillard (1993).[2] In view of the literature, our hypothesis is that the probability of upward and horizontal career transitions is negatively related to the parenthood hazard for women, while we conjecture that high contemporaneous parenthood hazards might constitute a positive career signal for men. We further expect (other) family-related variables to differently affect men's and women's career transitions.

3.3 Data

For our analysis, we need data covering personal employment, partnership and fertility information in one data set. For this purpose, we use the survey 'Working and Learning in a Changing World' (ALWA) provided by the Institute for Employment Research (IAB) at the German Federal Employment Agency[3] which contains life-cycle information of more than 10,400 individuals (Kleinert et al., 2011). Besides information on schooling and training, the data set includes detailed monthly information on labor market behavior as well as on processes of family formation and regional mobility. In addition, we merged variables on aggregate and regional unemployment, employment and fertility available from the statistical offices to our data set. The employment history is reported per episode, with a new episode defined by a change of employer, a change in the task performed or by an employment interruption such as unemployment, parental leave or military service. As a preparatory step, we first generated a complete employment history for every individual for which we adjusted parallel spells by defining main and secondary employment resolving cases of overlapping schooling or training spells. In our final data set, every month from age fifteen onwards is uniquely identified as either an employment or a non-employment spell. In certain cases, e.g. if an employment spell was followed by a short interruptive spell of search unemployment, we extended the first spell to also include the short intermediate spell. We did this in order to avoid an employment spell to be classified as

[2] Applications of this approach are, for example, Lillard and Waite (1993), and Aassve et al. (2006) who model the hazard of conception along with the hazard of marital disruption for married couples.

[3] This study uses the factually anonymous data of the Study 'Working and Learning in a Changing World' (ALWA). Data access was provided via a Scientific Use File supplied by the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB).

censored, although from a substantive point of view, there was a career transition to a subsequent employment spell. If an employment spell was artificially extended, we controlled for this and the exact reason why it was extended in our hazard model estimates. Employment spells that were followed by non-employment spells were treated as being censored.

For every employment episode we have information on the occupational task performed by a person as well as on individual and establishment characteristics. In order to classify job changes as upward, downward or horizontal transitions, we defined the career level during a given job spell by the number of subordinates supervised by the person in question. A change in this number by three or more people defines an upward or a downward movement. In the case of no change or a change by no more than two subordinates, an employment transition was classified as a 'horizontal' career movement. We experimented with different definitions of upward/downward movements but found this definition to be a good compromise between the substantive concept of an upward/downward transition and the resulting number of transitions.

As an alternative indicator of the career level, we used the Standard International Occupational Prestige Scale (SIOPS) which was designed for coding internationally comparable measures of occupational status based on the International Standard Classification of Occupation 1988 (ISCO88). The SIOPS scale, originally developed by Treiman (1977), ranges from 0 to 100. Its construction is based on results from national surveys on the rating of different occupations in terms of rank (for a detailed description of the coding procedures see Ganzeboom and Treiman, 1996). We define upward and downward transitions as any upward or downward change in the SIOPS score.

We restrict our sample to the birth cohorts 1956 to 1988 and to individuals living in West Germany or East Germany after 1990. We only consider individuals (men and women) before they become parents for the first time. We do this in order to exclusively focus on the effects of potential rather than of realized fertility. Moreover, in this way we avoid difficult problems of sample selection as the group of individuals who continue to work after first birth is likely to be highly selective (especially for women). Our final sample includes 2,883 women and 2,734 men.

We observe 2.2 career spells per individual on average. Table 3.1 shows descriptive statistics on the number and duration of employment spells. Descriptive statistics of all relevant variables are summarized in table B.1 in the appendix.

Table 3.1: Career spell durations in months

Dependent variable: number of subordinates						
	Women			Men		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N
All spells	67.61	73.23	5482	62.59	72.62	6194
Up	33.32	31.89	377	34.66	35.34	716
Down	45.49	45.63	248	40.27	39.18	364
Horizontal	30.35	36.60	1730	29.41	31.05	1961
Censored	94.11	81.99	3127	92.15	86.65	3153
Dependent variable: SIOPS						
	Women			Men		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N
All spells	67.63	73.23	5480	62.58	72.57	6190
Up	29.49	32.98	539	31.81	35.63	685
Down	31.97	33.55	403	30.91	31.25	480
Horizontal	33.24	38.39	1407	32.07	32.55	1869
Censored	94.24	82.10	3131	92.14	86.58	3156

Source: ALWA, own calculation.

For the 2,883 (2,734) women (men) in our sample we observe 5,482 (6,194) job spells. 2,355 (3,041) of those end with a transition to a subsequent job episode that can be characterized as an upward, downward or horizontal transition as measured by a change in the number of subordinates (see top panel of table 3.1). Censored spells are followed by an episode without employment which could be unemployment, educational spells or other interruptions. Censored spells are on average three times as long as spells ending in an upward or horizontal transition and twice as long as spells leading to a downward transition. This pattern is observed for both women and men. It suggests that individuals who 'climb the career ladder' do so very quickly, while those who plan to exit the labor market or to step down on the career ladder remain longer in their current position. The numbers for changes in the SIOPS shown in the lower panel of table 3.1 are slightly different due to differential missing values and due to the different definition of transitions. In order to figure out whether these transitions are driven by a pattern

of duration dependence, or whether and which other factors influence the duration or exit route of a job spell, further covariates have to be considered in a multivariate setup.

3.4 Econometric Framework

Mixed Multivariate Proportional Hazard Model

Our goal is to model the pregnancy hazard – or more generally the parenthood hazard[4] – simultaneously with the hazards of making an upward, downward or horizontal career transition. For this purpose, we estimate a multivariate proportional hazard model with competing risks, in which the parenthood hazard enters as an explanatory variable in the hazards for making one of the three career transitions (see Van den Berg, 2001; Lillard, 1993).

Our simultaneous model looks as follows:

$$\ln h^p(t|x_{it}, z_{it}) = x_{it}\gamma_x^p + z_{it}\gamma_z^p \tag{3.1}$$

$$\ln h^u(t|x_{it}, v_i) = x_{it}\beta^u + \delta^u \ln h^p(t|x_{it}, z_{it}) + v_i^u \tag{3.2}$$

$$\ln h^d(t|x_{it}, v_i) = x_{it}\beta^d + \delta^d \ln h^p(t|x_{it}, z_{it}) + v_i^d \tag{3.3}$$

$$\ln h^h(t|x_{it}, v_i) = x_{it}\beta^h + \delta^h \ln h^p(t|x_{it}, z_{it}) + v_i^h \tag{3.4}$$

In this model, $h^p(t|x_{it}, z_{it})$ denotes individual i's hazard of starting parenthood at time t given characteristics x_{it} and z_{it}. The variables x_{it} and z_{it} used to predict this hazard are assumed to be observable information available in a CV in order to mimic employers' predictions of how likely it is for a person with characteristics x_{it} and z_{it} to start parenthood at time t, where z_{it} is assumed to contain variables that do not appear in the hazards for the different career transitions. The terms $h^u(t|x_{it}, v_i)$, $h^d(t|x_{it}, v_i)$, $h^h(t|x_{it}, v_i)$ denote the hazards of making an upward, downward or horizontal career transition at time t given explanatory variables x_{it} and conditional on unobserved heterogeneity $v_i = (v_i^u, v_i^d, v_i^h)$.

As explanatory variables x_{it} we consider socioeconomic information (educational and employ-

[4] We define the observed time of birth of a child minus nine months as the beginning of parenthood. In this way we also cover the time of pregnancy, which seems to make most sense especially in the case of women.

ment history, age, experience, partner information, employer characteristics) as well as regional information based on the person's residential history (see below for more details). We also consider the dependence of career transitions on the time already spent at the given or in previous career levels (duration dependence and lagged duration dependence). In addition, the contemporaneous parenthood hazard $h^p(t|x_{it}, z_{it})$ enters as an explanatory variable in each of the three directional career hazards. The vector $v_i = (v_i^u, v_i^d, v_i^h)$ denotes individual-specific terms that capture potentially correlated unobserved characteristics v_i^u, v_i^d and v_i^h influencing certain career movements. Such unobserved heterogeneity may arise if different types of persons with time-constant preferences for career transitions exist, i.e. individuals who are generally more or less mobile, or more upwards or downwards mobile conditional on observed characteristics x_{it}. Given the structure of the model, we include instrumental variables z_{it} in the equation for the pregnancy hazard, which are, in our empirical implementation, the birthrate by year and federal state as well as the amount of potential child allowance in a given year. The full list of explanatory variables used in the four hazard equations is given in table 3.2.

Table 3.2: List of regressors

Variable	Description	Parenthood Hazard	Career Hazard
Age categories (base category: under 26 years)			
Age2-Age6	[26; 30], [31; 35], [36; 40], [41; 45]; [46+]	x	x
Education (base category: no formal degree)			
Educ.low	Vocational training and/or Abitur	x	x
Educ.high	University of applied sciences or University degree	x	
Exper	Work experience in months	x	x
East	Dummy East Germany	x	x
Religion	Dummy for being religious (self reported)	x	x
Married	Dummy for being married	x	
Birthrate	Birth rate per 1,000 inhabitants by year and federal state	x	
Potca	Potential child allowance	x	
Preghaz	Pregnancy/parenthood hazard		x

... table 3.2 continued

Variable	Description	Parenthood Hazard	Career Hazard
Partner high	Partner with university degree		x
Partner low	Partner without degree		x
Duration dependence employment spell in years (base category: less than 3 years)			
Car2-4	$[3;5), [5;7), [7+]$		x
Mobil	Mobility indicator		x
LDnosub	Lagged duration dependence: cumulated spells without supervisory responsibilities (in months)		x
LDsub	Lagged duration dependence: cumulated spells with supervisory responsibilities (in months)		x
Current number of subordinates (base category: none)			
Level2-5	$[1;3], [4;9], [10;24], [25+]$		x
Sector Dummies (base category: retailing)			
Manufacturing	Manufacturing		x
Construction	Construction		x
Agriculture	Agricultural		x
Service	Service		x
Social	Social		x
Pubsec	Dummy for job in public service		x
Comp.maths	Competence measure maths (high values=low competence)		x
Comp.verbal	Verbal competence measure (high values=low competence)		x
Unempl	Regional unemployment rate		x
Unempl.dev	Deviation unemployment rate from smooth trend		x
Fem.emplyoment	Female labor market participation at federal state[1]		x
Firmsize	Firm size		x
Year	(Quadratic) time trend		x
INTER*	Indicators for short interruptive intervals		x
Parttime	Indicator for part-time work		x
#inter	Number if interruptions before current job spell		x
#pastjobs	Number if jobs held before current job spell		x

[1] Included in female sample to account for differences in female labor market behavior between federal states.

For the three career hazards we assume a competing risks structure, i.e. the probability of making a particular career transition at time t is computed as the product of the probability of making this transition at t and the probability of not making any of the other two career transitions until t. The resulting likelihood contribution for month t of individual i is given by

$$\begin{aligned}\mathcal{L}(t|x_{it},v_i) &= h^u(t|x_{it},v_i^u)^{up_{it}} \times h^d(t|x_{it},v_i^d)^{down_{it}} \times h^h(t|x_{it},v_i^h)^{horiz_{it}} \times h^p(t|x_{it},z_{it})^{p_{it}} \\ &\quad \times exp\{-\sum_{j=u,d,h}\int_{t-1}^{t} h^j(t|x_{it},v_i^j)\} \times exp\{-\int_{t-1}^{t} h^p(t|x_{it},z_{it})\}, \end{aligned} \tag{3.5}$$

where $up_{it}, down_{it}, horiz_{it}$ and p_{it} are dummies indicating an upward, downward, horizontal or parenthood transition at the end of month t. In order to integrate out the unobserved effect $v = (v^u, v^d, v^h)$ we assume a discrete mass point distribution $A^*(v)$ with two mass points leading to the likelihood conditional on observed information

$$\mathcal{L}(t|x_{it}) = \int_v \mathcal{L}(t|x_{it},v)\, dA^*(v). \tag{3.6}$$

Fixed Effects SUR Model

We also consider a fixed effects panel data model in which we jointly model the monthly probabilities of upward, downward and horizontal career transitions along with the monthly probability of starting parenthood. This addresses the aspect that the individual hazard of becoming a mother or father may be correlated with unobserved individual characteristics (such as time-constant preferences).

The resulting model is given by

$$p_{it} = x_{it}\gamma_x^p + z_{it}\gamma_z^p + \epsilon_{it}^p, \quad \hat{h_{it}^p} = x_{it}\gamma_x^p + z_{it}\gamma_z^p \tag{3.7}$$

$$up_{it} = x_{it}\beta^u + \delta^u \hat{h_{it}^p} + \epsilon_{it}^u + c_i^u \tag{3.8}$$

$$down_{it} = x_{it}\beta^d + \delta^d \hat{h_{it}^p} + \epsilon_{it}^d + c_i^d \tag{3.9}$$

$$horiz_{it} = x_{it}\beta^h + \delta^h \hat{h_{it}^p} + \epsilon_{it}^h + c_i^h, \tag{3.10}$$

where c_i^e $(e = u, d, h)$ denote time-constant person-specific fixed effects for the different career directions and ϵ_{it}^e $(e = p, u, d, h)$ are idiosyncratic error terms.

Demeaning the explanatory variables in the career equations leads to the following system of equations which we estimate by efficient NLSUR (e.g. Greene, 2012):

$$p_{it} = x_{it}\gamma_x^p + z_{it}\gamma_z^p + \epsilon_{it}^p \tag{3.11}$$

$$(up_{it} - \overline{up}_i) = (x_{it} - \bar{x}_i)\beta^u + \delta^u(\hat{h}_{it}^p - \overline{\hat{h}_i^p}) + (\epsilon_{it}^u - \overline{\epsilon_i^u}) \tag{3.12}$$

$$(down_{it} - \overline{down}_i) = (x_{it} - \bar{x}_i)\beta^d + \delta^d(\hat{h}_{it}^p - \overline{\hat{h}_i^p}) + (\epsilon_{it}^d - \overline{\epsilon_i^d}) \tag{3.13}$$

$$(horiz_{it} - \overline{horiz}_i) = (x_{it} - \bar{x}_i)\beta^h + \delta^h(\hat{h}_{it}^p - \overline{\hat{h}_i^p}) + (\epsilon_{it}^h - \overline{\epsilon_i^h}). \tag{3.14}$$

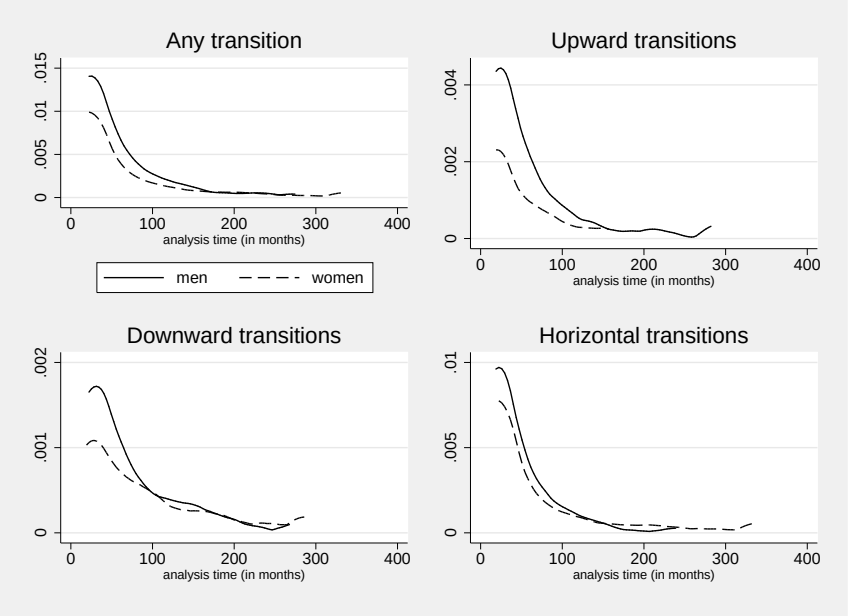
The model has the straightforward interpretation that we measure, within individuals' career trajectories, to what extent the probability of making a particular career transition is above or below its individual-specific average at times at which the individual's pregnancy hazard is above or below its individual-specific average. As a variation, we consider spell fixed effects, i.e. c_i^e $(e = u, d, h)$ are assumed to be constant within career spells, but may be different across career spells. We compute standard errors clustered at the level of the individual throughout all our estimations.

3.5 Empirical Results

Figure 3.1 presents the unconditional hazard rates for the different exit routes separately for men and women for the case in which we measure career status by the number of subordinates. The graphs generally suggest lower career mobility for women than for men, especially with respect to upward and horizontal movements.

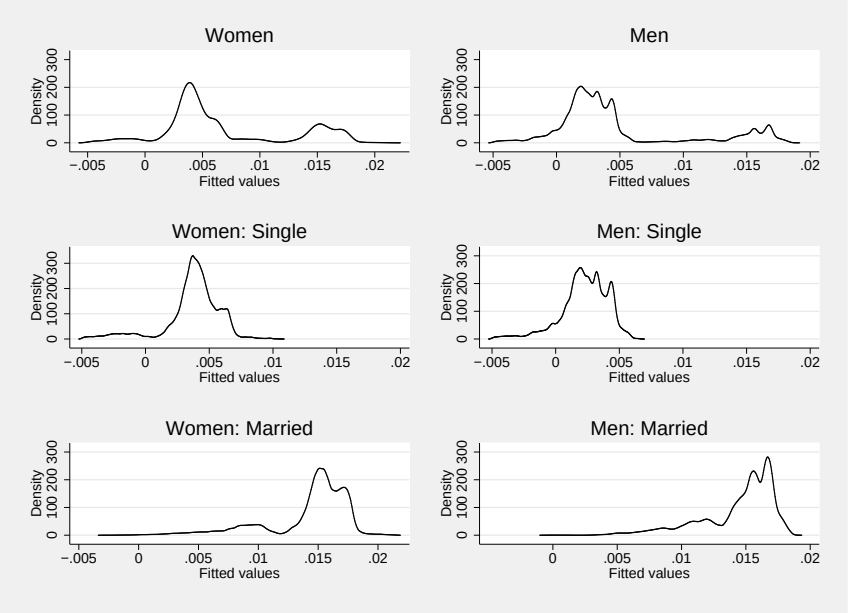
In order to identify the influence of certain regressors on the hazard rates of the different career directions, we estimate the models described in the previous section. Our main regressor of interest is the contemporaneous probability of parenthood, which is modeled as a conditional hazard rate. Figure 3.2 illustrates the distribution of predicted parenthood hazards as estimated

by (3.7). For both men and women, the distribution of predicted parenthood hazards has two peaks which turn out to be the masses of married and unmarried individuals.



Source: ALWA, own calculation.

Figure 3.1: Unconditional hazard rate (number of subordinates)



Source: ALWA, own calculation.

Figure 3.2: Parenthood hazard

Table 3.3 reports the determinants of the parenthood hazard as estimated in (3.1) for the case in which we measure career status by the number of subordinates.[5] We find a nonlinear relationship between the parenthood hazard and age. For women, no births are reported in our data for individuals older than 45 years, thus we group the last two age categories in order to avoid perfect predictions. The results also suggest a concave experience pattern in the probability of parenthood as well as significant and strong effects of religion, the regional birth rate, being married and living in East Germany.

Table 3.3: Mixed multivariate proportional hazard model: parenthood hazard

	Women		Men	
Age2	0.123^{*}	(0.0688)	0.244^{***}	(0.0916)
Age3	0.0399	(0.107)	0.208^{*}	(0.123)
Age4	-0.517^{***}	(0.194)	-0.332^{*}	(0.183)
Age5/6	-3.281^{***}	(1.020)	-1.136^{***}	(0.331)
Age6			-1.824^{**}	(0.767)
Educ.low	−0.0317	(0.0994)	0.184	(0.149)
Educ.high	−0.0892	(0.126)	0.491^{***}	(0.171)
Exper	0.0101^{***}	(0.00194)	0.00804^{***}	(0.00185)
Exper squared	-0.000062^{***}	$(9.96e-06)$	-0.000036^{***}	$(8.16e-06)$
East	0.830^{***}	(0.132)	0.481^{***}	(0.157)
Religion	0.272^{***}	(0.0720)	0.239^{***}	(0.0707)
Birthrate	0.109^{***}	(0.0258)	0.0666^{***}	(0.0253)
Potca	0.0309^{*}	(0.0187)	−0.0151	(0.0209)
Married	1.414^{***}	(0.0512)	1.824^{***}	(0.0616)
Constant	-7.264^{***}	(0.299)	-7.505^{***}	(0.307)
N	273207		276443	

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: ALWA, own calculation.

While the effects on the timing of first birth are relatively similar in the male and female subsample, gender differences are more prevalent in the estimated coefficients of the career hazard equations. We find that many of the effects on the three transition directions are different

[5]The results from the estimation based on changes in the occupational rank as described by the SIOPS were almost identical.

between men and women, both in significance and magnitude. Especially variables related to fertility turn out to interact with the career development in different ways. The results for the mixed multivariate proportional hazard model are shown in table 3.4.

Table 3.4: Mixed multivariate proportional hazard model (number of subordinates)

	Women			Men		
	Up	Down	Horizontal	Up	Down	Horizontal
ln(preghaz)	−0.122	0.0401	−0.175***	0.199***	0.00460	−0.0368
	(0.107)	(0.136)	(0.0541)	(0.0633)	(0.0899)	(0.0475)
Partner high	0.335**	0.0244	0.0467	0.286*	0.0300	−0.00708
	(0.154)	(0.214)	(0.0849)	(0.152)	(0.203)	(0.117)
Partner low	−0.464***	−0.263	−0.146**	0.242**	−0.149	0.0937
	(0.147)	(0.184)	(0.0647)	(0.102)	(0.142)	(0.0633)
Car2	0.00562	−0.118	−0.273***	0.0571	0.0609	−0.0921
	(0.178)	(0.211)	(0.0847)	(0.125)	(0.161)	(0.0838)
Car3	0.257	−0.179	−0.565***	0.00567	−0.541**	−0.230*
	(0.235)	(0.267)	(0.123)	(0.173)	(0.239)	(0.121)
Car4	−0.136	−0.719*	−0.667***	−0.653**	−0.693*	−0.447**
	(0.379)	(0.396)	(0.173)	(0.291)	(0.354)	(0.181)
Exper	−0.00395	−0.00186	−0.000904	−0.00119	0.00624	−0.00471**
	(0.00472)	(0.00552)	(0.00217)	(0.00346)	(0.00455)	(0.00201)
Exper squared	−0.000027	0.00000705	−0.00000912	$6.025e-06$	−0.0000241	$6.35e-06$
	(0.0000187)	(0.0000185)	(0.00000802)	(0.0000131)	(0.0000158)	$(7.61e-06)$
Mobil	0.266***	0.380***	0.187***	0.346***	0.314***	0.0303
	(0.0996)	(0.133)	(0.0494)	(0.0740)	(0.0993)	(0.0538)
LDnosub	−0.00125	0.00276	0.000340	−0.00371	−0.00741**	−0.00235
	(0.00356)	(0.00324)	(0.00149)	(0.00284)	(0.00311)	(0.00162)
LDsub	0.00565*	0.00145	−0.000913	0.000214	−0.00931***	0.0000500
	(0.00302)	(0.00325)	(0.00142)	(0.00252)	(0.00329)	(0.00160)
Pubsec	−0.544***	−0.0838	−0.389***	−0.295	−0.252	−0.345***
	(0.192)	(0.242)	(0.0915)	(0.183)	(0.280)	(0.116)
Educ.low	−0.126	0.861*	0.532***	1.0928***	0.487	0.133
	(0.273)	(0.479)	(0.147)	(0.318)	(0.411)	(0.110)
Educ.high	−0.0733	0.841	0.808***	1.453***	0.635	0.407
	(0.319)	(0.530)	(0.171)	(0.350)	(0.452)	(0.148)
East	−0.683	−1.132*	−0.212	−0.212	−0.723**	−0.186
	(0.433)	(0.620)	(0.205)	(0.247)	(0.331)	(0.131)

Continued on next page...

... table 3.4 continued

	Women			Men		
	Up	Down	Horizontal	Up	Down	Horizontal
Manufacturing	−0.253	0.164	−0.134	0.0218	−0.0255	−0.186***
	(0.201)	(0.274)	(0.0891)	(0.130)	(0.194)	(0.0721)
Construction	0.245	0.332	0.0370	0.0164	0.337	−0.0883
	(0.329)	(0.431)	(0.155)	(0.153)	(0.211)	(0.0789)
Agriculture	0.316	0.416	−0.233	0.123	0.202	−0.123
	(0.316)	(0.366)	(0.169)	(0.201)	(0.299)	(0.113)
Service	0.107	0.179	−0.0867	0.137	0.0325	−0.0248
	0.162	(0.212)	(0.0747)	(0.139)	(0.202)	(0.0792)
Social	−0.0261	−0.260	−0.106	−0.256	0.213	−0.107
	(0.207)	(0.271)	(0.093)	(0.226)	(0.315)	(0.134)
Religion	−0.505***	−0.441**	−0.151**	−0.0570	−0.126	−0.0674
	(0.137)	(0.188)	(0.0729)	(0.0980)	(0.138)	(0.0578)
Comp.maths	−0.144***	−0.0107	−0.00498	−0.0910**	0.0817	−0.0217
	(0.0516)	(0.0695)	(0.0247)	(0.0448)	(0.0630)	(0.0251)
Comp.verbal	−0.366***	0.00164	−0.0360	−0.152***	0.0865	−0.00675
	(0.0726)	(0.0939)	(0.0321)	(0.0483)	(0.0653)	(0.0274)
Unempl	−0.00605	0.0454	−0.00845	−0.0157	0.0313	0.0121
	(0.0317)	(0.0430)	(0.0156)	(0.0195)	(0.0259)	(0.0113)
Unempl.dev	−0.0159	−0.169***	−0.0720***	−0.000941	−0.0202	−0.00144
	(0.0496)	(0.0638)	(0.0237)	(0.0349)	(0.0497)	(0.0206)
Fem.emplyoment	−0.00377	0.0208	0.00696			
	(0.0142)	(0.0193)	(0.00656)			
Firmsize	−0.0494	−0.121**	−0.114***	−0.0448*	−0.110***	−0.0952***
	(0.0325)	(0.0483)	(0.0157)	(0.0242)	(0.0390)	(0.0140)
Year	0.116**	−0.0217	0.0128	0.0364	0.0486	−0.00887
	(0.0476)	(0.0610)	(0.0203)	(0.0317)	(0.00299)	(0.0171)
Year squared	−0.00198**	0.000252	−0.000283	−0.000793	0.000979	0.000276
	(0.000939)	(0.00118)	(0.000406)	(0.000664)	(0.000432)	(0.000362)
Level2	−0.581***		−0.399***	−0.597***		−0.208
	(0.147)		(0.0644)	(0.119)		(0.0615)
Level3	−0.438**	0.100	−1.133***	−0.668***	0.140	−0.865***
	(0.177)	(0.187)	(0.116)	(0.125)	(0.173)	(0.0897)
Level4	−0.689***	0.0846	−1.503***	−1.168***	0.310*	−1.235***
	(0.247)	(0.217)	(0.184)	(0.174)	(0.184)	(0.132)
Level5	−1.191**	0.149	−2.747***	−1.462***	0.649***	−1.652***
	(0.467)	(0.295)	(0.582)	(0.266)	(0.215)	(0.247)

Continued on next page...

... table 3.4 continued

	Women			Men		
	Up	Down	Horizontal	Up	Down	Horizontal
Age2	0.231	−0.0293	0.0445	−0.167	−0.103	−0.0934
	(0.159)	(0.220)	(0.0795)	(0.125)	(0.179)	(0.0778)
Age3	0.108	0.144	−0.285**	−0.238	0.00475	−0.0997
	(0.260)	(0.336)	(0.139)	(0.186)	(0.253)	(0.118)
Age4	0.396	0.735	0.132	−0.468	0.110	−0.500***
	(0.389)	(0.470)	(0.198)	(0.292)	(0.348)	(0.187)
Age56	0.350	0.306	−0.479	−0.665	0.121	−0.680**
	(0.707)	(0.894)	(0.395)	(0.487)	(0.528)	(0.306)
Age6				−1.666	0.0537	−0.940*
				(1.154)	(0.974)	(0.507)
INTERunempl	2.245***	3.374***	2.789***			
	(0.163)	(0.202)	(0.0699)			
INTERser.oth	−0.660	1.501**	1.308***			
	(1.004)	(0.600)	(0.193)			
INTERany[1]				1.446***	2.308***	2.439***
				(0.106)	(0.146)	(0.0518)
Parttime	−0.106	0.107	0.235*	0.351	1.0418***	0.683***
	(0.305)	(0.484)	(0.128)	(0.321)	(0.398)	(0.176)
#inter	−0.104	−0.372	−0.134	−0.203*	0.00411	−0.144**
	(0.207)	(0.301)	(0.107)	(0.119)	(0.139)	(0.0618)
#pastjobs	−0.0320	−0.287***	−0.0741*	0.0641	0.155***	0.185***
	(0.072)	(0.103)	(0.0432)	(0.0478)	(0.0561)	(0.0239)
v^1	−6.335***	−6.978***	−5.838***	−4.758***	−6.871***	−4.843***
	(1.085)	(1.479)	(0.516)	(0.673)	(0.975)	(0.413)
v^2	−4.990***	−5.211***	−4.817***	−6.514***	−9.139***	−4.431***
	(1.110)	(1.478)	(0.532)	(0.961)	(1.743)	(0.417)
$p = Prob(v = v^1)$		0.891***			0.663***	
		(0.0332)			(0.120)	
N		273207			276443	

[1] Summarizes interruptions due to military service, unemployment and other in male sample

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; Source: ALWA, own calculation.

For our main variable of interest, the results suggest that the parenthood hazard is significantly negatively related to women's horizontal job mobility. Given the log-log specification, a one percent higher parenthood hazard is associated with a 0.18 percent lower hazard for horizontal career transitions. For upward transitions, we find a negative but statistically insignificant re-

lationship. For downward transitions, the association is small and positive but also statistically insignificant. For men, the results suggest a significant positive association of the parenthood hazard with upward transitions and insignificant effects for downward and horizontal transitions. The results imply that for men, a one percent higher parenthood hazard translates into a 0.20 percent higher hazard for climbing up the career ladder. These results are consistent with the hypothesis that for employers, anticipated parental responsibilities of a male employee may be a positive signal of reliability and stability, fostering job transitions to higher hierarchical levels. For women, the results suggest that horizontal (but not upward) mobility is hampered by a high probability of becoming a mother in the near future.

Table 3.4 also shows other interesting effects. To identify the effect of cohabitation we use individuals with no partner as the reference category compared to those with partners with high or low education. The education variable is supposed to capture differences in human capital (Verbakel and De Graaf, 2008). It turns out that cohabiting with a partner with low education decreases women's propensity to change to a job with a higher level of personnel responsibility, while it makes an upward transition for men more likely. For women, the same relationship is observed for horizontal transitions, but of a smaller magnitude. This asymmetry may reflect that men are often unwilling to be 'overtaken' by their female partners. By contrast, cohabiting with a highly educated partner increases the likelihood of upward career transitions for men and women. These cases may reflect career competition within relationships or support through the high level of human capital of the partner. We find no age effects when it comes to upward or downward career movements after we control for the parenthood hazard. A stable result across all equations and both genders is the significant effect of the mobility indicator (i.e. number of residential changes in the last 24 months). This effect is likely to pick up the potential link between career changes and residential mobility.

The likelihood of making an upward, downward or horizontal transition strongly depends on the current position in the career hierarchy. We find strong effects of negative state dependence (*Level*) for upward and horizontal transitions for both men and women. This mostly reflects the

fact that with increasing personnel responsibility further improvements become harder because the number of vacancies at higher hierarchical levels is smaller. For men, we additionally find a positive state dependence at higher ranks for downward transitions. As to the effect of duration dependence (*Car*), we observe no strong duration dependence effects for upward or downward transitions for women, suggesting that no 'career automatism' exists. If anything, we observe negative duration dependence for the horizontal transitions. For men, the negative duration dependence can be observed for all transition types. This indicates that career mobility is stronger in the early phase of an employment spell, whereas individuals tend to become less mobile with rising tenure. We also consider effects of lagged duration dependence (*LDsub, LDnosub*). We do so separately for past spells with and without personnel responsibility. Having already worked in a job with subordinates is weakly positively related to the hazard of upward transitions for women. This suggests dynamic effects in career paths implying that earlier disadvantages (such as the negative parenthood effect for women's horizontal transitions) have additional long-term consequences. For men, we find a generally negative effect of past spell lengths with downward movements, irrespective of whether they were with or without subordinates.

As to the effect of educational qualifications on career transitions, our results suggest that the likelihood of making horizontal transitions increases with the degree of formal education for women. For men, we find that the likelihood of upward transitions rises with a higher educational level. For horizontal movements we especially find a positive association with tertiary education. Our results for the self-reported indicators of maths skills and verbal abilities conform to prior expectations: individuals with higher ability are significantly more likely to climb up the career ladder, while we find no effects of our ability indicators on downward and horizontal transitions.[6] Interestingly, high verbal competence scores are much more important for upward transitions of women than for those of men. This directly corresponds to the well-known feature of Lazear and Rosen (1990)'s model that women have to pass a higher ability threshold than men in order to proceed to a higher career level.

[6]Note that in our data, high values of the competence score mean low ability.

We observe a positive association of the number of past jobs with downward and horizontal job changes for men, suggesting a general pattern of mobility or immobility respectively. However, for women, the number of past jobs is negatively related to downward and horizontal job movements, which may be interpreted as a career pattern in which mobility tends to decrease over time. For both men and women, we do not estimate a separate effect of the number of past jobs on the likelihood of upward movements. This may be interpreted as evidence against the hypothesis that 'job shopping' has positive effects on further career progression. The effects for the other covariates shown in table 3.4 are mostly in line with expectations and are therefore not discussed here.

Table 3.4 also shows our results for the two mass points of the unobserved heterogeneity term v.[7] Our results suggest two types of women, one with $v^1 = (v^u, v^d, v^h) = (-6.335, -6.978, -5.838)$ and one with $v^2 = (-4.990, -5.221, -4.817)$. The proportion of type 1 in the population of women is $p = 0.891$, that of type 2 is $(1 - p) = 0.109$. Type 2 is uniformly more mobile than type 1. There are no differential effects of unobserved heterogeneity with respect to the different mobility directions. This is remarkable as, in principle, it would be possible that one of the types is more upward but less downward mobile than the other type. The pattern of unobserved heterogeneity is slightly different for men. Here, type 1 with $v^1 = (-4.785, -6.871, -4.843)$ is more mobile than type 2 with $v^2 = (-6.514, -9.139, -4.431)$ except for the slightly stronger tendency of not changing to lower personnel responsibility.

Table 3.5: Mixed multivariate proportional hazard model (SIOPS)

	Women			Men		
	Up	Down	Horizontal	Up	Down	Horizontal
ln(preghaz)	−0.111	0.0521	−0.167***	0.184**	−0.0239	−0.0500
	(0.107)	(0.135)	(0.0538)	(0.066)	(0.095)	(0.060)
Partner high	0.348**	0.0106	0.0587	0.325*	0.196	−0.0821
	(0.154)	(0.212)	(0.0846)	(0.155)	(0.213)	(0.143)

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[7] We also experimented with more than two mass points but found it very hard to achieve convergence of our estimation routine. This is not surprising given the complexity of the estimated model and the large number of estimated parameters. In the cases in which we achieved convergence, there were usually two mass points which looked very similar indicating that we cannot identify more than two sufficiently different latent groups in our data.

... table 3.5 continued

	Women			Men		
	Up	Down	Horizontal	Up	Down	Horizontal
Partner low	−0.451***	−0.261	−0.136**	0.211	0.0134	0.0306
	(0.147)	(0.183)	(0.0649)	(0.110)	(0.152)	(0.086)
Car2	−0.0113	−0.143	−0.285***	0.07845	−0.0344	−0.00314
	(0.178)	(0.210)	(0.0848)	(0.130)	(0.178)	(0.105)
Car3	0.244	−0.178	−0.577***	0.0450	−0.510*	−0.0949
	(0.234)	(0.265)	(0.123)	(0.174)	(0.258)	(0.145)
Car4	−0.155	−0.672*	−0.666***	−0.549	−0.479	−0.351
	(0.379)	(0.395)	(0.173)	(0.290)	(0.372)	(0.220)
Exper	−0.00413	−0.00227	−0.00125	−0.000794	0.00683	−0.00927***
	(0.00469)	(0.00554)	(0.00215)	(0.003)	(0.005)	(0.002)
Exper squared	−0.0000249	0.00000899	−0.00000714	−0.0000053	−0.0000396*	0.0000196*
	(0.0000186)	(0.0000185)	(0.00000800)	(0.000)	(0.000)	(0.000)
Mobil	0.258***	0.374***	0.178***	0.277**	0.367***	0.183**
	(0.0999)	(0.133)	(0.0497)	(0.087)	(0.098)	(0.070)
LDnosub	−0.00128	0.00329	0.000306	0.000239	0.00227	−0.00161
	(0.00350)	(0.00322)	(0.00149)	(0.003)	(0.003)	(0.002)
LDsub	0.00560*	0.00177	−0.00102	0.00191	0.000727	−0.0000278
	(0.00301)	(0.00321)	(0.00144)	(0.002)	(0.003)	(0.002)
Pubsec	−0.574***	−0.129	−0.402***	−0.336	−0.426	−0.613***
	(0.191)	(0.241)	(0.0915)	(0.195)	(0.280)	(0.162)
Educ.low†	−0.107	0.889*	0.541***	0.0875*	0.0152	0.0551
	(0.274)	(0.473)	(0.148)	(0.042)	(0.058)	(0.035)
Educ.high	−0.0437	0.931*	0.813***			
	(0.319)	(0.522)	(0.171)			
East	−0.634	−1.016	−0.161	−0.171	−0.556	−0.369
	(0.437)	(0.626)	(0.206)	(0.282)	(0.374)	(0.205)
Manufacturing	−0.215	0.214	−0.103	0.0275	−0.123	−0.389***
	(0.201)	(0.243)	(0.271)	(0.139)	(0.200)	(0.104)
Construction	0.266	0.296	0.0783	−0.0566	0.0511	−0.375**
	(0.329)	(0.424)	(0.154)	(0.168)	(0.230)	(0.123)
Agriculture	0.297	0.369	−0.244	−0.0277	−0.0380	−0.173
	(0.316)	(0.360)	(0.169)	(0.225)	(0.323)	(0.163)
Service	0.132	0.198	−0.0715	0.174	−0.0136	−0.181
	(0.162)	(0.210)	(0.0745)	(0.148)	(0.209)	(0.111)
Social	0.00000116	−0.226	−0.0937	−0.256	0.197	−0.192
	(0.206)	(0.269)	(0.0928)	(0.237)	(0.320)	(0.183)

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... table 3.5 continued

	Women			Men		
	Up	Down	Horizontal	Up	Down	Horizontal
Religion	−0.505***	−0.444**	−0.150**	−0.128	−0.0457	−0.119
	(0.136)	(0.184)	(0.0726)	(0.101)	(0.145)	(0.083)
Comp.maths	−0.148***	−0.00169	−0.00881	−0.0641	−0.00319	−0.00243
	(0.0515)	(0.0687)	(0.0246)	(0.047)	(0.065)	(0.037)
Comp.verbal	−0.361***	0.00661	−0.0323	−0.132**	−0.0403	−0.0333
	(0.0730)	(0.0930)	(0.0322)	(0.051)	(0.072)	(0.041)
Unempl	−0.00545	0.0426	−0.00669	−0.0417*	0.0300	0.0127
	(0.0320)	(0.0435)	(0.0157)	(0.021)	(0.028)	(0.017)
Unempl.dev	−0.00839	−0.153**	−0.0668***	0.0152	−0.0777	0.00426
	(0.0497)	(0.0639)	(0.0237)	(0.038)	(0.054)	(0.029)
Firmsize	−0.0620*	−0.130***	−0.126***	−0.0569*	−0.0797*	−0.166***
	(0.0325)	(0.0480)	(0.0157)	(0.026)	(0.039)	(0.020)
Year	0.117**	−0.0244	0.0150	0.0326	−0.0273	−0.0280
	(0.0476)	(0.0608)	(0.0203)	(0.036)	(0.054)	(0.025)
Year squared	−0.00196**	0.000333	−0.000301	−0.000733	0.000779	0.000553
	(0.000939)	(0.00118)	(0.000406)	(0.001)	(0.001)	(0.001)
Level2	−0.600***		−0.409***	−0.505***	0.761***	−0.511***
	(0.147)		(0.0645)	(0.127)	(0.217)	(0.091)
Level3	−0.460***	0.116	−1.145***	−0.512***	1.827***	−1.308***
	(0.177)	(0.185)	(0.116)	(0.125)	(0.173)	(0.130)
Level4	−0.688***	0.137	−1.491***	−0.964***	2.009***	−2.096***
	(0.247)	(0.214)	(0.184)	(0.178)	(0.183)	(0.238)
Level5‡	−1.187**	0.189	−2.738***			
	(0.468)	(0.290)	(0.582)			
Age2	0.209	−0.0822	0.0281	−0.230	−0.0259	−0.0334
	(0.158)	(0.216)	(0.0788)	(0.135)	(0.196)	(0.104)
Age3	0.0879	0.115	−0.292**	−0.263	0.0363	0.148
	(0.257)	(0.331)	(0.138)	(0.198)	(0.277)	(0.155)
Age4	0.369	0.693	0.130	−0.547	0.0347	−0.0984
	(0.387)	(0.464)	(0.198)	(0.312)	(0.380)	(0.242)
Age56	0.367	0.234	−0.495	−0.654	0.241	−0.412
	(0.707)	(0.885)	(0.395)	(0.521)	(0.554)	(0.387)
Age6				−1.217	−0.316	−0.530
				(1.162)	(1.187)	(0.628)
INTERser.oth.unempl.‡	2.128***	3.041***	2.532***			
	(0.159)	(0.191)	(0.0662)			

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... table 3.5 continued

	Women			Men		
	Up	Down	Horizontal	Up	Down	Horizontal
Parttime	−0.382	−0.287	0.0129	0.402	0.817*	0.671***
	(0.293)	(0.481)	(0.114)	(0.312)	(0.361)	(0.196)
#inter	−0.0381	−0.331	−0.0937	−0.210	0.00481	0.0133
	(0.208)	(0.295)	(0.106)	(0.121)	(0.135)	(0.086)
#pastjobs‡	−0.0369	−0.272***	−0.0726*			
	(0.0715)	(0.102)	(0.0414)			
femEMPLOYMENT	−0.00528	0.0194	0.00570			
	(0.0143)	(0.0193)	(0.00659)			
v^1	−6.182***	−6.791***	−5.720***	−4.0463***	−7.598***	−3.009***
	(1.089)	(1.471)	(0.518)	(0.687)	(1.015)	(0.539)
v^2	−4.760***	−5.047***	−4.639***	−3.980***	−7.822***	−4.428***
	(1.112)	(1.471)	(0.532)	(0.654)	(0.978)	(0.599)
$p = Prob(v = v^1)$		0.906***			0.416***	
		(0.0283)			(0.145)	
N		273162			263374	

† Education was included as an ordinal variable with six categories in male sample to avoid convergence problems

‡ These variables had to be dropped in male sample to avoid convergence problems

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; Source: ALWA, own calculation.

Table 3.5 shows the mixed multivariate proportional hazard estimates for the specification with changes in the occupational rank described by the SIOPS. With very few exceptions, the results are remarkably consistent with the ones obtained in the model with the number of subordinates as the dependent variable. This is particularly true for the estimated association of the parenthood hazard with the likelihood for different career transitions. As in the specification with the number of subordinates, we find a statistically significant negative association of the likelihood of becoming a parent with horizontal job movements for women, and a significantly positive association with upward mobility for men. Note that the effects of the parenthood hazard on job transitions from this specification and from all other specifications estimated by us are reproduced in table 3.6.

Table 3.6: Pregnancy hazard: model comparison

	Women					
	Up		Down		Horizontal	
MMPHM	−0.122	(0.107)	0.040	(0.136)	−0.175***	(0.054)
Person FE	−0.035	(0.028)	−0.017	(0.072)	−0.243***	(0.056)
Spell FE	−0.055**	(0.022)	0.044	(0.075)	−0.191***	(0.048)
MMPHM (SIOPS)	−0.111	(0.107)	0.052	(0.135)	−0.167***	(0.054)
Person FE (SIOPS)	−0.081***	(0.030)	−0.002	(0.040)	−0.214***	(0.050)
Spell FE (SIOPS)	−0.056**	(0.026)	−0.010	(0.040)	−0.183***	(0.046)
	Men					
	Up		Down		Horizontal	
MMPHM	0.199***	(0.063)	0.005	(0.090)	−0.037	(0.048)
Person FE	0.082***	(0.038)	−0.039	(0.054)	−0.026	(0.049)
Spell FE	0.117***	(0.039)	0.040	(0.057)	0.039	(0.046)
MMPHM (SIOPS)	0.184**	(0.066)	−0.024	(0.095)	−0.050	(0.060)
Person FE (SIOPS)	0.042	(0.031)	−0.003	(0.031)	−0.058	(0.050)
Spell FE (SIOPS)	0.080**	(0.035)	0.008	(0.035)	0.029	(0.047)

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: ALWA, own calculation.

We now turn to the fixed effects approach to estimating our system of hazard equations. The advantage of the fixed effects model (3.7) to (3.10) is that the parenthood hazard (and all other explanatory variables) may be arbitrarily correlated with unobserved time-constant (or, alternatively, spell-constant) determinants of individual career transitions. In this way, we difference out unobserved person-specific characteristics such as time-constant personal preferences or personal circumstances, which may also influence career transitions. Results for these estimations are given in table B.2 in the appendix.

The most important result in these estimations is that our main findings concerning the effect of the parenthood hazard on career transitions also survive in a fixed effects setting. The estimates for women based on the number of subordinates suggest that the monthly probability of a horizontal job transition is significantly negatively related to the monthly probability of starting parenthood. More concretely, if the probability of becoming a mother is increased by one percentage point, the probability of a horizontal job transition is reduced by 0.24 percentage points. It is not significantly related to upward or downward transitions. For men, the parent-

hood hazard is significantly positively related to upward transitions but unrelated to downward or horizontal transitions. In particular, the probability of an upward transition is increased by about 0.08 percentage points if the parenthood hazard is raised by one percentage point. Note that many of the other estimated effects in table B.2 are relatively insignificant, which is a typical result for within-estimates of explanatory variables with limited temporal variation.

The results for the case in which we allow the fixed effects to vary over career spells are given in table B.3 in the appendix. The main effects are reproduced in table 3.6. In this specification, there may be person-specific effects that are constant within career spells, but different across career spells. Again, the results confirm our previous findings about the relationship between the parenthood hazard and career transitions. As before, a higher parenthood hazard for women is significantly related to lower horizontal career mobility. Moreover, the (smaller) negative relationship between the parenthood hazard and upward transitions, which appeared in similar form in the mixed multivariate proportional hazard model and in the model with person-specific fixed effects, turns significant in the model with spell-specific fixed effects. For men, the results confirm the finding of the mixed multivariate proportional hazard model and the model with person-specific fixed effects that a higher parenthood hazard is positively associated with a higher likelihood of upward transitions.

Table 3.6 also shows the fixed effects results based on changes in the SIOPS as the dependent variable (the full results for these specifications are available upon request). Both in the person fixed effects and in the spell fixed effects case, we obtain a negative association of the parenthood hazard with horizontal transitions for women which is of the same magnitude as in the specification with changes in the number of subordinates as the dependent variable. Moreover, in the SIOPS fixed effects case the (much smaller) negative effect of the parenthood hazard on women's upward transitions becomes statistically significant. For men, the fixed effects results for the SIOPS case look more mixed and are much less significant.

Taken together, the results in table 3.6 suggest a robust and statistically significant positive relationship between the probability of parenthood and horizontal job changes for women. In

some specifications, we also observe a smaller negative relationship between the likelihood of becoming a mother and upward mobility. For men, the results suggest a significant positive relationship between the parenthood hazard and upward mobility which is robust across almost all specifications.

3.6 Conclusion

This paper analyzes career progression patterns of childless men and women in Germany. The descriptive analysis of career transition hazards confirms previous findings in the literature that women generally exhibit lower career mobility than men. In order to investigate the determinants of individual career transitions in more detail, we estimated a mixed multivariate proportional hazard model with competing risks for upward, downward and horizontal job transitions while simultaneously modeling the hazard of first births and its effect on career transitions. As an alternative specification, we considered a fixed effects approach. Our results suggest that a high contemporaneous probability of becoming a parent significantly lowers horizontal but not upward or downward career mobility for women. In some specifications we also find a significant but smaller negative association with female upward career mobility. For men, we find that a higher contemporaneous probability of becoming a parent increases the likelihood of upward but not of downward or horizontal career transitions. These results persist if we allow for a correlation of parenthood hazards with unobserved individual characteristics such as time- or spell-constant personal preferences in a fixed effects model.

We believe that our findings contribute to the literature on the relationship between fertility hazards and career transition patterns. To the extent that our estimations net out unobserved differences in preferences, our results are consistent with the hypothesis that women's career mobility is to a certain extent hampered by the hazard of becoming a mother while that of men is increased by a high probability of becoming a father. We would certainly not go so far as to interpret these findings as clear evidence for employer discrimination. Such an interpretation would rest, among other things, on the assumption that career preferences are time-

or spell-constant, which would be hard to defend. Incorporating time-varying preferences into an empirical analysis seems extremely hard but might be an interesting challenge for future research. On the other hand, in the case of substantial employer discrimination, we would probably expect the association of fertility hazards with female horizontal or upward job mobility to be more pronounced. Independent of the sources of the effects measured by us, we obtain the important result that there are clear gender differences in the relationship between potential fertility and individual career patterns. This is a highly relevant point for labor market policy. Regardless of whether employer discrimination exists, in the labor market studied by us even *prospective* fertility is not gender neutral with respect to further career progression.

Appendix B: Additional Tables

Table B.1: Summary statistics: female and male sample

	Female		Male	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Age2	0.278	0.448	0.288	0.453
Age3	0.141	0.348	0.186	0.389
Age4	0.074	0.262	0.101	0.301
Age5	0.038	0.192	0.047	0.212
Age6	0.014	0.117	0.016	0.125
Age	27.527	6.473	28.779	6.608
Educ.low	0.804	0.397	0.763	0.425
Educ.high	0.142	0.35	0.19	0.392
Exper	80.341	70.911	81.463	70.114
East	0.034	0.182	0.051	0.22
Religion	0.820	0.384	0.74	0.439
Birthrate	9.967	1.104	9.868	1.18
Potca	3.02	1.641	3.242	1.687
Married	0.287	0.453	0.198	0.398
Partner high	0.16	0.367	0.079	0.269
Partner low	0.353	0.478	0.311	0.463
Mobil	0.148	0.399	0.125	0.394
LDnosub	9.15	26.364	11.348	27.643
LDsub	8.283	27.615	8.85	25.483
Pubsec	0.292	0.455	0.193	0.395
Manufacturing	0.175	0.38	0.339	0.473
Construction	0.023	0.15	0.126	0.332
Agriculture	0.027	0.161	0.046	0.209
Service	0.285	0.452	0.192	0.394
Social	0.323	0.468	0.163	0.369
Comp.maths	2.713	1.067	2.207	0.96
Comp.verbal	2.033	0.836	2.179	0.882
Unempl	8.734	3.14	9.129	3.254
Unempl.dev	0.269	1.355	0.283	1.343

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... table B.1 continued

	Female		Male	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Fem.emplyoment	58.080	7.115	58.884	7.151
Firmsize	4.428	1.805	4.891	1.755
INTERunempl	0.011	0.104	0.028	0.164
INTERser.oth	0.004	0.066	0.006	0.075
Parttime	0.037	0.19	0.013	0.113
Level2	0.237	0.425	0.169	0.375
Level3	0.131	0.337	0.171	0.377
Level4	0.081	0.272	0.117	0.322
Level5	0.029	0.168	0.059	0.236
#inter	0.101	0.342	0.183	0.475
#pastjobs	0.881	1.213	1.155	1.386
Number of subordinates	4.425	17.928	9.908	100.0853
SIOPS	44.400	10.295	43.388	11.419
N	273207		276443	

Person-month observations, Source: ALWA, own calculation.

Table B.2: Person fixed effects estimation (number of subordinates)

	Women			Men		
	Up	Down	Horizontal	Up	Down	Horizontal
preghaz	−0.0351	−0.0172	−0.243***	0.0820**	−0.0390	−0.0264
	(0.0284)	(0.0717)	(0.0560)	(0.0375)	(0.0538)	(0.0485)
Partner high	0.00101*	0.00106	0.00122	0.000415	−0.00127	−0.000143
	(0.000572)	(0.00119)	(0.00108)	(0.000873)	(0.00128)	(0.00113)
Partner low	−0.000644**	0.0000609	0.000205	−0.000414	−0.000376	0.000318
	(0.000314)	(0.000850)	(0.000675)	(0.000395)	(0.000633)	(0.000613)
Car2	−0.000307	−0.000612	−0.00189***	−0.0000754	0.000414	−0.000343
	(0.000273)	(0.000720)	(0.000568)	(0.000353)	(0.000617)	(0.000519)
Car3	−0.000722*	−0.00202**	−0.00510***	−0.000950**	−0.00197***	−0.00195***
	(0.000387)	(0.000996)	(0.000821)	(0.000432)	(0.000750)	(0.000711)
Car4	−0.00235***	−0.00575***	−0.0106***	−0.00356***	−0.00476***	−0.00492***
	(0.000532)	(0.00144)	(0.00134)	(0.000577)	(0.00112)	(0.00116)
Exper	0.0000763***	0.000154*	0.000152**	0.0000585**	0.000193***	−0.000201***
	(0.0000234)	(0.0000881)	(0.0000653)	(0.0000230)	(0.0000472)	(0.0000604)
Exper squared	$-8.14e-08$***	−0.00000018***	−0.00000033***	−0.00000011***	−0.00000019***	$-9.55e-08$*
	$(2.95e-08)$	$(6.51e-08)$	$(7.15e-08)$	$(2.63e-08)$	$(5.57e-08)$	$(5.20e-08)$
Mobil	0.000219	0.000685	0.00134**	0.00116***	0.000440	−0.0000553
	(0.000286)	(0.000805)	(0.000615)	(0.000424)	(0.000518)	(0.000604)
LDnosub	0.0000230***	−0.0000135	0.000129***	0.0000551***	−0.0000959***	0.0000305*
	(0.00000849)	(0.0000245)	(0.0000266)	(0.0000122)	(0.0000168)	(0.0000177)
LDsub	−0.0000744***	0.00000885	0.000105***	−0.0000924***	−0.0000595***	0.0000849***
	(0.0000102)	(0.0000185)	(0.0000193)	(0.00000970)	(0.0000140)	(0.0000155)
Pubsec	−0.00114	−0.00186	−0.00462**	0.0000747	0.000634	−0.00527**
	(0.00112)	(0.00327)	(0.00221)	(0.00150)	(0.00354)	(0.00259)
Educ.low	0.000960	0.0156*	−0.00522	0.000876	0.00655	−0.00896
	(0.00409)	(0.00823)	(0.0180)	(0.00375)	(0.00624)	(0.00846)
Educ.high	0.000617	0.00397	−0.00727	0.00163	0.00674	−0.0244**
	(0.00468)	(0.0115)	(0.0194)	(0.00496)	(0.00831)	(0.0100)
East	0.00101	−0.00157	−0.00250	−0.00628**	−0.00619**	0.00231
	(0.00225)	(0.0204)	(0.00526)	(0.00259)	(0.00299)	(0.00506)
Manufacturing	0.00137	−0.00642*	−0.00708***	−0.000360	0.000614	−0.00479**
	(0.00105)	(0.00362)	(0.00271)	(0.00112)	(0.00229)	(0.00217)
Construction	0.00104	0.00365	−0.000612	0.000679	0.00610**	−0.00197
	(0.00185)	(0.00520)	(0.00364)	(0.00127)	(0.00309)	(0.00235)
Agriculture	0.00425*	0.00381	−0.00339	−0.000489	−0.000801	−0.00669*
	(0.00221)	(0.00789)	(0.00486)	(0.00189)	(0.00404)	(0.00363)

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... table B.2 continued

	Women			Men		
	Up	Down	Horizontal	Up	Down	Horizontal
Service	0.00113	−0.00393	−0.00354	−0.00106	0.000754	−0.00239
	(0.00116)	(0.00348)	(0.00238)	(0.00122)	(0.00285)	(0.00232)
Social	0.000615	−0.00674	−0.00569*	−0.00289*	0.00162	−0.00406
	(0.00150)	(0.00472)	(0.00312)	(0.00174)	(0.00392)	(0.00336)
Unempl	−0.000128	0.000605	−0.000618	0.000286	0.000573	0.000656*
	(0.000231)	(0.000855)	(0.000550)	(0.000239)	(0.000434)	(0.000349)
Unempl.dev	−0.0000179	−0.000978	0.0000846	−0.000421	−0.000694	−0.000689*
	(0.000247)	(0.000851)	(0.000574)	(0.000257)	(0.000462)	(0.000376)
Fem.emplyoment	−0.0000845	0.000165	0.000243			
	(0.0000807)	(0.000195)	(0.000178)			
Firmsize	−0.000324*	−0.00115**	−0.000770*	−0.000453**	−0.000388	−0.00119***
	(0.000195)	(0.000581)	(0.000431)	(0.000229)	(0.000418)	(0.000379)
Year	−0.000215	−0.000996	0.000476	0.000170	−0.00166***	0.00367***
	(0.000287)	(0.00112)	(0.000835)	(0.000292)	(0.000598)	(0.000769)
Year squared	−0.00000174	0.00000511	−0.00000372	$7.12e-07$	0.0000119*	0.00000133
	(0.00000305)	(0.00000884)	(0.00000710)	$(3.63e-06)$	(0.00000637)	(0.00000622)
Level2	−0.00696***		−0.00868***	−0.00959***		−0.00320**
	(0.000948)		(0.00185)	(0.00107)		(0.00163)
Level3	−0.0154***	0.0172***	−0.00730***	−0.0168***	0.0161***	−0.00242*
	(0.00122)	(0.00190)	(0.00199)	(0.00111)	(0.00147)	(0.00132)
Level4	−0.0213***	0.0216***	−0.00509**	−0.0226***	0.0204***	0.000680
	(0.00158)	(0.00198)	(0.00201)	(0.00142)	(0.00169)	(0.00162)
Level5	−0.0239***	0.0258***	0.00367	−0.0258***	0.0245***	0.000493
	(0.00226)	(0.00281)	(0.00297)	(0.00174)	(0.00190)	(0.00168)
Age2	0.000456	0.0000192	0.000994	−0.000299	0.000193	−0.00116*
	(0.000341)	(0.000842)	(0.000679)	(0.000471)	(0.000764)	(0.000705)
Age3	−0.0000313	0.000254	−0.000195	−0.000791	0.000338	−0.00282**
	(0.000579)	(0.00144)	(0.00112)	(0.000761)	(0.00123)	(0.00118)
Age4	−0.000204	0.00228	0.000208	−0.00158	0.000546	−0.00682***
	(0.000830)	(0.00228)	(0.00175)	(0.00103)	(0.00169)	(0.00168)
Age5	0.000171	0.00149	−0.000140	−0.00224*	−0.0000502	−0.0101***
	(0.00128)	(0.00309)	(0.00259)	(0.00136)	(0.00237)	(0.00232)
Age6	0.0000717	0.00366	−0.00194	−0.00245	−0.000169	−0.0135***
	(0.00171)	(0.00464)	(0.00371)	(0.00177)	(0.00317)	(0.00325)
INTERunempl	0.0157***	0.0662***	0.106***	0.0222***	0.0669***	0.0968***
	(0.00259)	(0.0118)	(0.00684)	(0.00277)	(0.00894)	(0.00608)

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... table B.2 continued

	Women			Men		
	Up	Down	Horizontal	Up	Down	Horizontal
INTERservice				0.00197**	0.000534	0.0479***
				(0.000909)	(0.00199)	(0.00223)
INTERoth[1]	−0.000796	0.0113	0.0197***	0.000657	0.00230	0.0323***
	(0.00103)	(0.00700)	(0.00478)	(0.00155)	(0.00220)	(0.00506)
Parttime	0.00115	0.00343	0.00284	0.00173	−0.00428	0.0145***
	(0.00110)	(0.00314)	(0.00260)	(0.00269)	(0.00575)	(0.00484)
#inter	0.00485***	0.0111***	0.0212***	0.00383***	0.0113***	0.0152***
	(0.000993)	(0.00320)	(0.00229)	(0.000849)	(0.00186)	(0.00169)
#pastjobs	−0.00203***	−0.00963***	−0.0199***	−0.00241***	−0.0054***	−0.0125***
	(0.000411)	(0.00121)	(0.00118)	(0.000323)	(0.000770)	(0.000785)
N		273207			276443	

[1] Summarizes interruptions due to service and other in female sample

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; Source: ALWA, own calculation.

Table B.3: Spell fixed effects estimation (number of subordinates)

	Women			Men		
	Up	Down	Horizontal	Up	Down	Horizontal
preghaz	−0.0546**	0.0441	−0.191***	0.117***	0.0403	0.0388
	(0.0224)	(0.0745)	(0.0479)	(0.0386)	(0.0570)	(0.0463)
Partner high	0.000775	0.000907	0.00211**	0.000923	0.000197	−0.000298
	(0.000586)	(0.00146)	(0.00102)	(0.000879)	(0.00139)	(0.00105)
Partner low	−0.000448*	0.000192	0.00103	−0.000364	−0.000101	0.000206
	(0.000273)	(0.000805)	(0.000631)	(0.000410)	(0.000649)	(0.000588)
Car2	−0.000172	0.00000510	−0.00131**	0.000441	0.000991	−0.000821*
	(0.000241)	(0.000683)	(0.000532)	(0.000382)	(0.000642)	(0.000499)
Car3	−0.000862**	−0.00156	−0.00618***	−0.000912*	−0.00176**	−0.00428***
	(0.000336)	(0.000991)	(0.000760)	(0.000480)	(0.000816)	(0.000689)
Car4	−0.00255***	−0.00494***	−0.0121***	−0.00424***	−0.00428***	−0.00959***
	(0.000457)	(0.00149)	(0.00114)	(0.000650)	(0.00121)	(0.00107)
Exper	0.000122***	0.000245***	0.000445***	0.000188***	0.000251***	−0.000260***
	(0.0000219)	(0.0000624)	(0.0000500)	(0.0000309)	(0.0000544)	(0.0000599)
Exper squared	−0.00000018***	−0.00000035***	−0.00000072***	−0.00000025***	−0.00000030***	−0.00000046***
	$(2.25e-08)$	$(6.69e-08)$	$(5.39e-08)$	$(2.71e-08)$	$(5.56e-08)$	$(4.49e-08)$
Mobil	0.0000386	0.000512	0.00252***	0.00154***	−0.000504	−0.0000107
	(0.000282)	(0.000958)	(0.000553)	(0.000436)	(0.000555)	(0.000595)
East	0.00454	−0.0408	0.00215	−0.00506	−0.00757***	−0.00892
	(0.00434)	(0.0689)	(0.0102)	(0.00392)	(0.00285)	(0.00816)
Unempl	0.000170	−0.00141**	−0.000428	0.000330	0.00107	0.000742
	(0.000221)	(0.000612)	(0.000507)	(0.000371)	(0.000684)	(0.000556)
Unempl.dev	−0.000305	0.00109*	−0.000220	−0.000506	−0.00113	−0.000936*
	(0.000236)	(0.000634)	(0.000530)	(0.000378)	(0.000688)	(0.000561)
Fem.emplyoment	−0.0000581	−0.0000467	0.000217			
	(0.0000995)	(0.000255)	(0.000181)			
Year	−0.000937***	−0.000727	−0.00149**	−0.000851**	−0.00236***	0.00540***
	(0.000272)	(0.000821)	(0.000630)	(0.000428)	(0.000739)	(0.000775)
Year squared	0.00000910***	−0.00000597	0.000000424	0.00000139	0.0000195**	0.00000575
	(0.00000286)	(0.00000694)	(0.00000610)	(0.00000462)	(0.00000804)	(0.00000655)
Age2	0.000465	−0.00110	−0.00151**	−0.000843*	0.000222	0.000566
	(0.000338)	(0.000821)	(0.000614)	(0.000455)	(0.000855)	(0.000708)
Age3	−0.000255	−0.00101	−0.00548***	−0.00121*	−0.000521	0.000577
	(0.000553)	(0.00145)	(0.000968)	(0.000734)	(0.00132)	(0.00112)
Age4	−0.00121	0.000556	−0.00692***	−0.00182*	−0.00105	−0.000415
	(0.000815)	(0.00224)	(0.00145)	(0.000995)	(0.00179)	(0.00152)

Continued on next page...

... table B.3 continued

	Women			Men		
	Up	Down	Horizontal	Up	Down	Horizontal
Age5	−0.000483	0.00165	−0.00541***	−0.00181	−0.000966	0.000360
	(0.00119)	(0.00286)	(0.00210)	(0.00129)	(0.00249)	(0.00199)
Age6	0.0000735	0.00608	−0.00202	−0.00138	−0.000492	0.00220
	(0.00151)	(0.00469)	(0.00278)	(0.00160)	(0.00326)	(0.00253)
INTERunempl	0.0186***	0.0766***	0.116***	0.0243***	0.0746***	0.108***
	(0.00275)	(0.0129)	(0.00741)	(0.00292)	(0.00962)	(0.00663)
INTERservice				0.00617***	0.00669***	0.0651***
				(0.00104)	(0.00194)	(0.00331)
INTERoth[1]	0.000586	0.0106	0.0251***	0.00262	0.00122	0.0343***
	(0.00104)	(0.00689)	(0.00507)	(0.00169)	(0.00230)	(0.00564)
N	273207			276443		

[1] Summarizes interruptions due to service and other in female sample

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; Source: ALWA, own calculation.

Chapter 4

Mind the Gap - Gender Wage Gap and Unemployment Rate in Local Labor Markets

4.1 Introduction

The gender wage gap is one of the most widely researched phenomena of all gender differences in labor market outcomes. Differences in pay do not only reflect ongoing inequalities in the labor market, they are also related to long term outcomes such as the gender pension gap. A central issue in existing theories and empirical applications is the attempt to pin down the factors that cause the wage gap and to identify the extent to which wage differentials are a result of discrimination. Gender differences in preferences and non-cognitive skills are another possible explanation considered recently (see Blau and Kahn, 2016). This paper offers a new view on explaining the gender wage gap by incorporating the influence of local labor market conditions, particularly the local unemployment rate and gender-specific responses to changes in the unemployment rate.

Generally, wages and unemployment are two of the most important quantities in economics. Their relationship is described in different theories, and their empirical investigation remains

an area of active research. The wage curve, introduced by the seminal paper of Blanchflower and Oswald (1994) describes the inverse relationship between the level of local unemployment and the level of wages. It is empirically found that differences in the wage curves of various subpopulations exist according to their bargaining power, whereby men's wages are more elastic than women's. Despite the fact that the relationship between wages and unemployment is intensively discussed in economic literature, to my best knowledge the gender wage *gap* has not been analyzed in this context. This paper is motivated by the idea that if men's and women's wages respond differently to changes in unemployment, the wage gap is expected to be affected analogously. The goal of this paper is to derive a relationship between the gender wage gap and the level of local unemployment. This contributes to the literature, since the share of the gender wage gap that cannot fully be accounted for by observable characteristics is not necessarily attributed to discrimination, but can be partly explained by gender differences in the elasticity of wages with respect to unemployment.

Based on theoretical considerations, I state hypotheses on the association between the unemployment rate and the gender wage gap in local labor markets. I further consider spatial spillover effects of unemployment and investigate the relationship between the gender wage gap and the unemployment rate in the commuting area. Using a German linked employer-employee data set (LIAB from the IAB), I apply decomposition techniques to calculate a human capital-adjusted gender wage gap based on district- and time-specific wage functions. At the district level, I calculate the adjusted gap at the mean as well as at different parts of the distribution. Additionally, I construct intra-firm wage gaps using district- and time-specific wage functions with firm fixed effects. The resulting adjusted wage gaps are then related to the local unemployment rate by means of regression analysis. The spatial unemployment rate is considered as an additional regressor. In case of the intra-firm gender wage gap, I control for a range of firm characteristics that already capture a substantial part of the observed heterogeneity in the wage differentials. The results suggest that the gender wage gap is negatively associated with the local unemployment rate and positively correlated with spatial unemployment. Firm characteristics affect the intra-firm gender wage gap and moderate the effect of the unemployment rate. Additionally, I

conduct several robustness checks. The negative relationship between the local unemployment rate and the gender wage gap is also found for different specifications of the adjusted gap as well as for the raw gender wage gap. Moreover, the positive association of spatial unemployment retains with different measures of the wage gap. However, a spatial unemployment rate that is calculated regardless of existing commuting structures is not significantly related to the gender wage gap.

The remainder of this paper is divided into five sections: Section 4.2 summarizes the existing literature, section 4.3 introduces the data, in section 4.4 theoretical considerations and the econometric framework are described and section 4.5 presents the results. Finally, section 4.6 concludes.

4.2 Related Literature

The gender wage gap has been subject to economic research for a number of decades and it remains of high interest to researchers and policymakers. Blau and Kahn (2016) give an overview over the extent and development of the gender wage differential in the U.S. labor market and provide an excellent summary of theoretical explanations and empirical evidence. A meta-analysis of international studies between the 1960s and the 1990s is carried out by Weichselbaumer and Winter-Ebmer (2005). In general, a reduction of the gender gap as a long-term trend in economically advanced nations can be observed, yet considerable gender wage differentials exist.

Gender differences in human capital and labor force attachment are central for understanding this phenomenon. Human capital theory suggests that women have more discontinuous employment trajectories and therefore fewer opportunities and lower incentives to invest in human capital. Penalties for workforce interruptions are more of a concern for women than for men. The same is true for part-time work. Moreover, differences in occupational choices considerably contribute to the gender wage gap. However, also within occupations, gender differences exist in the representation along hierarchies leading to 'glass ceiling' effects. Summarizing empirical evidence, one can say that a substantial part of the wage gap can be attributed to observable dif-

ferences in human capital characteristics and labor force attachment. Yet, a non-negligible share remains which is not fully understood and requires more research. Alternative explanations for gender wage differentials are offered by theories on social norms and psychological attributes such as personality traits and non-cognitive skills. Discrimination theory provides an explanation for the part of the gender wage gap that cannot fully be accounted for by productivity differences, human capital or other observed factors (see the concept of taste based discrimination described by Becker, 1971, or statistical discrimination introduced by Phelps, 1972). Regional and macro economic conditions such as the local unemployment rate have been neglected so far in theoretical and empirical explanations of the gender wage gap. To my best knowledge, one of the few exceptions is Hirsch et al. (2013) who find empirical evidence on regional differences in the gender wage gap.

An overview of the wage gap in Germany is given by Boll and Leppin (2015). In 2014, women earned on average 22 percent less than men. This gap is more pronounced in West Germany than in East Germany. During the last decade the raw gap in earnings has been relatively stable and has been above the European average, which was around 15 percent in 2010 (see Boll et al., 2016). Gartner (2016) summarizes the development of gender-specific wages based on linked employer-employee data from the Institute for Employment Research. According to these data, the mean wage differential between 1993 and 2010 was about 24 percent in West Germany. Differences in human capital cannot fully account for this, but given the same age and qualification the wage gap shrinks to 17 percent.

Various studies try to unravel this effect and to identify the main drivers. In general, empirical evidence is mostly based on regression methods and decomposition techniques. The residual resulting from methods like the Oaxaca-Blinder decomposition may reflect differences in human capital that are not accounted for. Yet, it is also often taken as an estimate of labor market discrimination. More advanced techniques have been developed to disentangle the detailed contribution of individual factors, to look at distributional characteristics other than the mean or to account for selection bias into the labor force (recent examples are Antonczyk et al., 2010, or

Grimm et al., 2015, for Germany, and Albrecht et al., 2009, for the Netherlands).

While most studies focus on employee characteristics to explain the gender gap, some authors call attention to employer's and organizational attributes. Hirsch (2013) finds an impact of female management representation on the within-job gender pay gap. Hirsch and Mueller (2014) investigate the differences in the unexplained gender pay gap between firms run by managers and firms run by the owner. Other studies explore the effect of segregation into lower-paying firms (Javdani, 2015) or the relationship between the gender wage gap and firm characteristics such as the existence of a works council and collective bargaining (Heinze and Wolf, 2010; Grimm et al., 2015). In the case of Heinze and Wolf (2010), special attention is drawn to within-firm wage differentials. Their results suggest that the intra-firm wage differential is lower than the overall gap, which means that women tend to select into lower-paying firms. Concerning organizational characteristics, they find evidence that firms with a works council and those covered by collective wage agreements have smaller gender wage gaps on average. In general, studies on the effect of organizational characteristics on the gender wage gap (e.g. Heinze and Wolf, 2010; Javdani, 2015) show that firm heterogeneity explains a substantial amount of the variation in intra-firm wage gaps.

In the following, I review contributions from the wage curve literature that are relevant for my analysis. The wage curve was introduced by the seminal paper of Blanchflower and Oswald (1994). It describes the inverse relationship between the local unemployment rate and the level of wages. This stands in contrast to the well-known Phillips curve, which describes the relationship between unemployment and the rate of change of wages. While the Phillips curve uses macroeconomic time series data, the wage curve is estimated based on pooled cross sectional microeconomic data. The estimation procedure corresponds to a standard wage equation, where the log of the local unemployment rate is added as additional regressor. Blanchflower and Oswald (1994) use data from several countries and find a relationship between log wages and log unemployment, which is remarkably stable around -0.1. This can be interpreted in the way that a doubling of the unemployment rate in a given region implies a ten percent drop in the level

of wages. Among others, they consider a bargaining model and an efficiency wage approach as theoretical explanations to rationalize their empirical findings. The bargaining model describes a situation where employees are scared by a high level of unemployment in their regional labor market, which in turn may lead to unions being more concerned about unemployment than about the negotiation of the wage level. An alternative explanation is based on the efficiency wage model. Here, firms pay above market wages to avoid turnover and shirking. The higher the level of unemployment, the lower this efficiency wage has to be because workers put in more effort under such circumstances, even if wages are lower.

Since the seminal paper of Blanchflower and Oswald (1994), the wage curve has been reconsidered in numerous empirical and theoretical works (see Nijkamp and Poot, 2005, for a review). As the present paper considers the German labor market, I review related work for Germany. Based on a random sample from the IAB employment sample from 1981 to 1990, Baltagi and Blien (1998) find evidence for a German wage curve. Their sample covers 40,852 observations in 142 administrative districts. The elasticity of wages with respect to unemployment is estimated as -0.07 but varies among subgroups and specifications. Studies on U.S. data find that men's wages are more responsive to the unemployment rate than women's wages (e.g. Card, 1995). Baltagi and Blien (1998)'s results confirm this finding for Germany. Baltagi et al. (2009) reconsider the wage curve for West Germany for the years 1980 to 2004. Their data base covers almost one million employees in 326 regions. In contrast to Blanchflower and Oswald (1994), who do not find significant effects of the lagged wages in their model, Baltagi et al. (2009) use a dynamic approach. Based on a two step approach, they conclude that the wage regression is highly autoregressive, still far from unit root. The estimated elasticities vary between subgroups, showing higher elasticities for those with the weaker bargaining power.

Another aspect considered in the literature is the effect of spatial interactions. Baltagi et al. (2012) consider spatial spillover effects between regions. The data base is as in Baltagi et al. (2009). Again, their findings confirm the existence of a dynamic wage curve and subgroup-specific elasticities with men's wages being more sensitive to the unemployment rate than

women's wages. However, in most of the specifications, spatial unemployment is not significantly related to the level of wages in the West German regions. Other studies using a spatial approach are Longhi et al. (2006) or Pannenberg and Schwarze (2000). Another extension of the wage curve is done by using subsample-specific unemployment rates, as suggested by Card (1995). An application of gender-specific unemployment rates is Baltagi and Rokicki (2014) for the case of Poland. The concept of the wage curve is applied to others than just the level of market wages. Blien et al. (2012) study the relationship between reservation wages and regional unemployment. They use a large German panel survey with information on regional reservation wages and find evidence for a reservation wage curve. Just as the paid wages, reservation wages are sensitive to the level of regional unemployment. They respond even stronger than market wages. In line with the studies mentioned before, Blien et al. (2012) find evidence that men's reservation wages seem to be more elastic than women's.

4.3 Data

This study uses the Linked Employer-Employee Data (LIAB) (cross-sectional model 2) from the IAB[1]. The data set combines information from the establishment panel with individual data from the Federal Employment Agency. The establishment panel is a representative employer survey on around 16,000 establishments. It covers all branches and sizes. The yearly survey captures questions on the number of employees, wage policies, training, investments, innovation and other employment policies. In addition, questions on specific topics are asked on an irregular basis. Data are available as of 1993 for West Germany and as of 1996 for East Germany. The location of each establishment is reported at the district level (*Kreise* and *Kreisfreie Städte*), which allows one carrying out detailed analyses at the level of local labor markets. Due to administrative reforms, the affiliation of municipalities to districts is not constant over time. In almost all relevant cases, municipalities have been merged with neighboring districts, implying that the level of analysis becomes slightly coarser. For my analysis, I apply the structure of the latest district information to all survey waves considered. For the years before district mergers,

[1]Data access was provided via on-site use at the Research Data Center (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently remote data access.

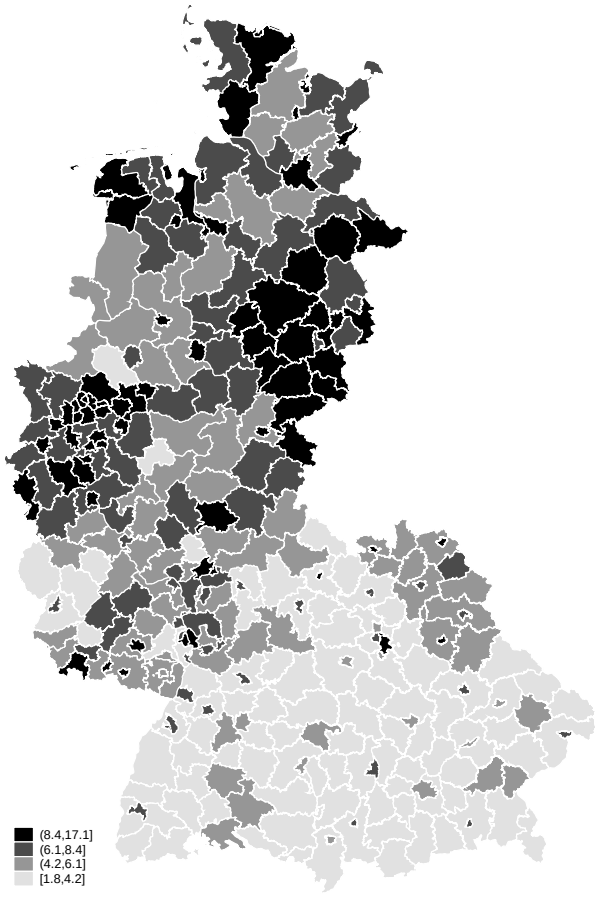
I use the mean unemployment rate over the respective districts. Still, the number of districts varies over the years because some districts drop out of the analysis if too few observations are available in a given year.

The individual wage data, that are linked via a unique establishment identifier, originate from labor administration and social security data processing. They include a number of individual characteristics as well as information on employment and wages.[2] Most important for my purpose is the information on the daily gross wage, which is right-censored at the assessment ceiling (*Beitragsbemessungsgrenze*). Therefore, a wage imputation procedure following Gartner (2005) is applied. Another limitation is that no exact information on working time is provided. I therefore restrict my sample to full-time workers. Due to data constraints, the final sample is further restricted to establishments in West Germany and to the years 2002 to 2008. For the firm level analysis, only establishments with at least 20 male and 20 female employees are considered. The final sample covers around 8 million person-year observations, which are summarized in table C.2 in the appendix. The calculation of the adjusted gender wage gap is based on the individual level data and results in 2,192 district-year observations and 13,202 firm-year observations. These data are then linked to organizational characteristics taken from the establishment panel and to further regional information. Tables C.4 and C.3 in the appendix report the summary statistics for all variables used in the regression analysis.

Information on unemployment rates (at the district level and separated by gender) is available from the Federal Employment Agency. During the observation period, the district level unemployment rates show a variation between 1.8 (Eichstätt, Bavaria in 2010) and 24.6 (Bremerhaven in 2005). Figure 4.1 exemplarily illustrates the regional variation in 2008. Since I additionally consider spatial spillover effects of unemployment in the analysis, I need to apply a measure of spatial unemployment. For this purpose, I define the mean unemployment rate in the commuting area in which a district is located as the spatial unemployment rate. As commuting area I use regional planning units (*Raumordnungsregionen*), which are composed of one or sev-

[2]For a detailed description of the data, see Heining et al. (2013)

eral districts and reflect regional commuting flows. During the observation period, there are 97 regional planning units in Germany, 75 of which are located in West Germany. I calculate a population weighted average of the local unemployment rates of all districts in the commuting area, excluding the own district, and define the resulting rate as spatial unemployment rate. Alternatively, I calculate a spatial unemployment rate that is the population weighted average of all first neighbors, i.e. of all districts that have a common border with the district of interest. This measure does not account for commuting flows and is used for the purpose of robustness checks.



Source: Federal Statistical Office, own calculation.

Figure 4.1: Local unemployment rates, West Germany 2008

4.4 Econometric Framework

Theoretical considerations

In the literature cited in chapter 4.2, one repeatedly finds that men's wages respond stronger to changes in the local unemployment rate than women's wages. This implies that the gender wage gap is also potentially related to the level of unemployment. In a situation where a wage gap in favor of men exists, an increase in the level of unemployment would stronger affect men's wages and should therefore reduce the wage differential. Consequently, I expect a negative relationship between the local unemployment rate and the gender wage gap. My theoretical considerations are thereby based on two assumptions that I derive from the literature outlined in section 4.2.

A1 The local unemployment rate and the level of wages are negatively correlated (Blanchflower and Oswald, 1994)

A2 Men's wages respond stronger to changes in the unemployment rate than women's wages (Baltagi and Blien, 1998)

Based on the assumptions (A1) that the unemployment rate and the level of wages are negatively correlated, and (A2) that men's wages are more elastic, one can rewrite the gender-specific wage curves (equations 4.1 and 4.2) as the difference in mean wages as follows

$$\ln(w_{ir}^m) = X_{ir}^m \beta^m + \gamma^m \ln(U_r) + \epsilon_{ir}^m \tag{4.1}$$

$$\ln(w_{ir}^f) = X_{ir}^f \beta^f + \gamma^f \ln(U_r) + \epsilon_{ir}^f \tag{4.2}$$

$$\overline{\ln(w_r^m)} - \overline{\ln(w_r^f)} = \overline{X_r^m}\beta^m - \overline{X_r^f}\beta^f + \underbrace{(\gamma^m - \gamma^f)}_{<0 \text{ if A1,A2: } \gamma^m < \gamma^f} \overline{\ln(U_r)} + \overline{\epsilon_r^m} - \overline{\epsilon_r^f}. \tag{4.3}$$

In the notation, $ln(w_{ir}^m)$ $\left(ln(w_{ir}^f)\right)$ denotes the log wage of men (women). i is an individual subscript and r a regional one. X_i^m (X_i^f) are male (female) characteristics and ϵ_i^m (ϵ_i^f) is the error term in the wage regression. γ^m (γ^f) describes the effect of unemployment on men's (women's) wages. Writing the gap as the differential between mean wages $\left(\overline{\ln(w_r^{m/f})}\right)$ as in

equation (4.3), the resulting negative coefficient, $(\gamma^m - \gamma^f) < 0$, makes sense if we built on the assumptions of the efficiency wage theory: In times of high unemployment the wage premium can be reduced because fewer vacancies in the labor market go along with diminished outside options and may weaken the negotiation power of employees. If men's wages are more elastic than women's, employers may pay a lower wage premium for men, while for women's wages the adjustment is less pronounced. Therefore the gender-specific wage differential narrows.

As shown in the wage curve literature, not only the local unemployment rate is theoretically supposed to affect the wage level, but also the spatial unemployment rate might influence wages. This is particularly true if we look at small labor markets with strongly marked commuting structures to adjacent regions. Thus, I hypothesize that a relationship between the spatial unemployment rate and the gender wage differential exists both at the regional level as well as within firms. The direction of the effect is theoretically less clear and will be investigated empirically in this paper. Moreover, in case of the intra-firm gender wage gap, organizational characteristics should be influential as well. Especially variables related to the wage setting process such as the existence of a works council and collective bargaining could moderate the effect of the unemployment rate.

Calculation of the gender wage gap

To investigate the theoretical considerations, I define measures for the gender wage gap at the district and firm level, which are later used as dependent variables in regression models. The simplest measure for the gender wage gap is the raw gender wage gap, i.e. the observed gap between gender-specific mean wages. At the regional level this is given for the $r = 1, \ldots, R$ districts in $t = 1, \ldots, T$ years by

$$\text{raw gap}_{rt} = \overline{\ln(w^m_{rt})} - \overline{\ln(w^f_{rt})}. \tag{4.4}$$

The intra-firm wage gap is calculated analogously for the $j = 1, \ldots, J$ firms in year $t = 1, \ldots, T$ as

$$\text{raw gap}_{jrt} = \overline{\ln(w^m_{jrt})} - \overline{\ln(w^f_{jrt})}. \tag{4.5}$$

Part of this observed gap may be due to differences in the employees' human capital endowments across districts or firms. Using the method introduced by the seminal papers of Oaxaca (1973) and Blinder (1973), I decompose the raw gender gap in the mean wages into a part resulting from differences in observable characteristics (explained part) and a part that reflects different evaluations of these characteristics (unexplained part). The unexplained part can be interpreted as the share of the gap resulting from different wage functions. It reflects the gender wage gap that would result if women had the same observable characteristics as men, i.e. the human capital-adjusted gender wage gap. The decomposition can generally be written as

$$\underbrace{\hat{\Delta}^O}_{\text{Overall difference}} = \underbrace{\hat{\Delta}^S}_{\text{Unexplained}} + \underbrace{\hat{\Delta}^X}_{\text{Explained}} . \tag{4.6}$$

At the district level, the adjusted wage gap results from

$$\text{adj. gap}_{rt} = \hat{\Delta}^S_{rt} = \left(\hat{\beta}^m_{rt} - \hat{\beta}^f_{rt}\right) \overline{X^f_{rt}} = \left(\overline{\ln(w^m_{rt})} - \overline{\ln(w^f_{rt})}\right) - \left(\hat{\beta}^m_{rt}\overline{X^m_{rt}} - \hat{\beta}^m_{rt}\overline{X^f_{rt}}\right) \tag{4.7}$$

for the $r = 1, \ldots, R$ administrative districts (*Kreise/Kreisfreie Städte*). It is calculated separately for each year t and results in $R \cdot T$ different wage gaps. The $\hat{\beta}^m_{rt}$ are estimated in a Mincer regression at the district level

$$\ln(w^m_{itr}) = \beta_0 + \beta^m_{rt} X_{irt} + \epsilon_{irt}, \qquad \text{for } r = 1, \ldots, R \text{ and } t = 1, \ldots, T. \tag{4.8}$$

As explanatory variables, I use education, experience (quadratic), job tenure, occupational group, firm size and sector.

The intra-firm gender wage gap is decomposed analogously for the $j = 1, \ldots, J$ firms in each year $t = 1, \ldots, T$. The underlying wage function is estimated in gender-specific wage regressions at the district level with additional firm fixed effects λ_{jrt}

$$\ln(w^m_{ijrt}) = \beta_0 + \beta^m_{rt} X_{ijrt} + \lambda^m_{jrt} + \epsilon_{ijrt}, \qquad \text{for } r = 1, \ldots, R \text{ and } t = 1, \ldots, T. \tag{4.9}$$

The human capital-adjusted intra-firm wage gap is then calculated as

$$\text{adj. gap}_{jrt} = \hat{\Delta}^S_{jrt} = (\hat{\beta}^m_{rt} - \hat{\beta}^f_{rt})\overline{X^f_{jrt}} + (\lambda^m_{jrt} - \lambda^f_{jrt}) = \left(\overline{\ln(w^m_{jrt})} - \overline{\ln(w^f_{jrt})}\right) - \left(\hat{\beta}^m_{rt}\overline{X^m_{jrt}} - \hat{\beta}^m_{rt}\overline{X^f_{jrt}}\right). \tag{4.10}$$

The control variables include human capital characteristics as in equation (4.8), but the information on firm size and sector is omitted as both are constant within firms. This procedure results in a sample of $T \cdot J$ intra-firm gender wage gaps.

Econometric literature offers a wide range of methods to go beyond the decomposition of the mean (see Fortin et al., 2011, for an overview). I calculate the gender wage gap at different quantiles along the distribution following the reweighting method introduced by DiNardo et al. (1996). The decomposition in (4.6) can be more generally written in terms of differences in any distributional statistic ν

$$\underbrace{\nu(F_{mm}) - \nu(F_{ff})}_{\text{Overall difference}} = \underbrace{\nu(F_{mm}) - \nu(F_{fm})}_{\text{Unexplained}} + \underbrace{\nu(F_{fm}) - \nu(F_{ff})}_{\text{Explained}}, \tag{4.11}$$

with F_{mm} (F_{ff}) being the distribution of wages for men (women) where both observable factors and the wage function are the one for men (women), and F_{mf} is the counterfactual distribution resulting from the women's wage function with observable characteristics of men. The counterfactual distribution is calculated using the following reweighting approach with the reweighting factor $\Psi(x)$.

$$F_{fm} = \int_x \Psi(x) \cdot F(\ln(w)|x, m = 1) \cdot dF(x|m = 1) \tag{4.12}$$

$$\Psi(x) = \frac{P(m = 0|x)}{P(m = 1|x)} \cdot \frac{P(m = 1)}{P(m = 0)} \tag{4.13}$$

Estimation strategy

The resulting human capital-adjusted gender wage gaps ($\hat{\Delta}^S$) from (4.7), (4.10) and (4.11) are in a second step regressed on the log of the local unemployment rate.

For the district level, the model is

$$\hat{\Delta}^S_{rt} = \beta_0 + \beta^r X_{rt} + \gamma^r \ln(U)_{rt} + \mu_c + \eta_t + \epsilon_{rt}, \tag{4.14}$$

with X_{rt} being regional characteristics, U_{rt} the local unemployment rate and μ_c, η_t commuting area and time fixed effects. The regression is estimated by ordinary least squares with standard errors clustered at the district level. The relationship between the gap at different quantiles resulting from (4.11) and the local unemployment rate is considered analogously.

At the firm level, I estimate

$$\hat{\Delta}^S_{jrt} = \beta_0 + \beta^r X_{rt} + \beta^j X_{jrt} + \gamma^r \ln(U)_{rt} + \mu_c + \eta_t + \epsilon_{jrt}, \tag{4.15}$$

with X_{jrt} denoting firm characteristics, namely firm size (quadratic), sector, existence of a works council, female share in the workforce, legal structure, founding age and collective bargaining. The full list of regressors is described in table C.1 in the appendix. The estimation procedure, again, follows ordinary least squares with clustered standard errors at the firm level.

In order to test my hypothesis about the effect of the unemployment rate in the commuting area, I extend both models by the log of the spatial unemployment rate. In the case of the district level, I estimate

$$\hat{\Delta}^S_{rt} = \beta_0 + \beta^r X_{rt} + \gamma^r \ln(U)_{rt} + \gamma^c \ln(U)_{ct} + \mu_c + \eta_t + \epsilon_{rt}, \tag{4.16}$$

where U_{ct} denotes the spatial unemployment rate.

I further extend the model by accounting for gender-specific unemployment rates instead of the overall unemployment rates. For the intra-firm gender wage gap, I additionally include interactions of institutional characteristics and the unemployment rate to test whether the existence of a works council moderates the effect of unemployment on the wage gap.

The estimation procedure described above is characterized by the use of district- and time-specific wage functions. An alternative approach to investigating the relationship between the unemployment rate and the gender wage gap would be to directly control for the unemployment rate in the wage decomposition. However, this would come at the cost that the wage functions can no longer be estimated individually for every region and year, as the unemployment rate would be constant in a separate analysis for a given district at a time. To account for regional-specific wage functions, one would have to include interactions of explanatory variables and district dummies in the wage function for the pooled sample of individuals over regions and years. Due to the high number of districts and categories of sectors and occupations, this procedure would result in a model of high dimension. Due to computational restrictions it was not possible to estimate this via remote data access. As a robustness check to my main analysis, I also estimated a model including district dummies but without interactions. The results of the detailed decomposition show a negative relationship between local unemployment rate and the gender wage gap at the district level. These results are available on request.

4.5 Empirical Results

The gender wage gap at district and firm level

At the district level I find a mean raw gap of about 0.246, which can be decomposed into an explained part of around 0.034 and an unexplained part of 0.211 on average. These numbers result from the Oaxaca Blinder decomposition as described in equations (4.4) and (4.10) using education, experience (quadratic), tenure, occupation, sector and firm size as explanatory variables. Tables 4.1, 4.2 and 4.3 report the mean gender wage gaps over regions by year. On average, the regional gender wage gap is relatively stable over time, but considerable variation between the districts exists. The distribution of the raw gap and the adjusted gap are shown in figure 4.2.

Table 4.1: Raw gap across districts

Year	Mean	Std. Dev.	Min.	Max.	N
2002	0.235	0.090	−0.007	0.608	316
2003	0.247	0.094	−0.019	0.687	314
2004	0.247	0.099	−0.027	0.698	315
2005	0.247	0.099	−0.001	0.691	314
2006	0.249	0.104	−0.060	0.830	313
2007	0.249	0.110	−0.126	0.763	311
2008	0.244	0.110	−0.109	0.735	309
overall	0.246	0.101	−0.126	0.830	2192

Source: LIAB 2002-2008, own calculation.

Table 4.2: Unexplained part across districts

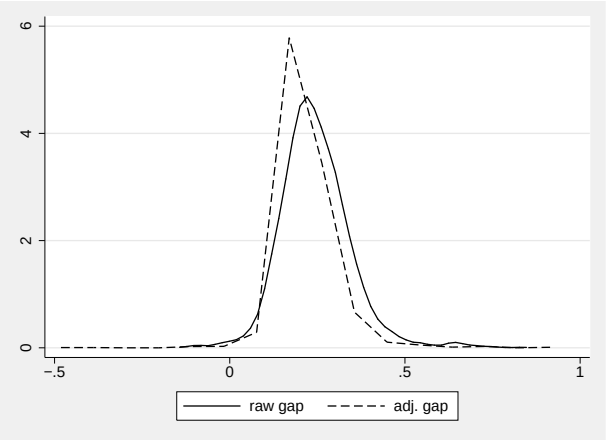
Year	Mean	Std. Dev.	Min.	Max.	N
2002	0.216	0.108	−0.069	1.180	316
2003	0.220	0.080	−0.173	0.770	314
2004	0.207	0.088	−0.461	0.542	315
2005	0.215	0.101	−0.414	1.058	314
2006	0.210	0.091	−0.694	0.628	313
2007	0.203	0.169	−2.424	0.545	311
2008	0.207	0.202	−1.788	2.112	309
overall	0.211	0.127	−2.424	2.112	2192

Source: LIAB 2002-2008, own calculation.

Table 4.3: Explained part across districts

Year	Mean	Std. Dev.	Min.	Max.	N
2002	0.019	0.110	−0.902	0.404	316
2003	0.027	0.090	−0.398	0.474	314
2004	0.040	0.103	−0.232	0.707	315
2005	0.032	0.116	−0.684	0.594	314
2006	0.040	0.103	−0.313	0.888	313
2007	0.047	0.184	−0.478	2.684	311
2008	0.037	0.220	−1.897	2.088	309
overall	0.034	0.140	−1.897	2.684	2192

Source: LIAB 2002-2008, own calculation.



Source: LIAB 2002-2008, own calculation.

Figure 4.2: Distribution of raw gap and adjusted gap across districts

For the intra-firm wage gap, I find a raw gap that is 0.213 on average, with a mean unexplained part of 0.195. The intra-firm wage gap is therefore smaller on average than the mean gender wage gap at the district level. This finding is in line with the results of previous studies (e.g. Heinze and Wolf, 2010) and can be interpreted to mean that women select into lower paying firms[3]. Tables 4.4, 4.5 and 4.6 show the decomposition results by year. Compared to the results of previous studies such as Heinze and Wolf (2010), the magnitude of the unexplained gap is rather at the upper bound. This seems to be driven by the fact that I additionally consider the occupational group as regressor in the decomposition analysis. Leaving out this category reproduces the results by Heinze and Wolf (2010).[4] Figure 4.3 shows the distribution of the raw and adjusted intra-firm gap over the observation period.

[3]The mean district level wage gap, however, is comparable in magnitude to the overall gap for the German labor market. Selection does therefore only appear at the firm level while a selection into regions is not suggested by the data.

[4]I decided to use occupational groups in the wage regression to control for occupational sorting as a potential source of the gender gap. The choice of occupation is possibly related to unobserved characteristics such as risk aversion that may influence the wage level (see Blau and Kahn, 2016). On the other hand, the choice of industry or occupation can be affected by discrimination; see also Gartner (2016) for the relationship between occupation and wage in the LIAB data. To account for possible endogeneity problems, I additionally calculate the wage gap without controlling for occupation and use it in the regression analysis as robustness check (see below). The results turn out to be robust along the different approaches used.

Table 4.4: Intra-firm raw gap

Year	Mean	Std. Dev.	Min.	Max.	N
2002	0.211	0.125	−0.256	0.823	2148
2003	0.217	0.125	−0.161	0.858	1924
2004	0.218	0.130	−0.233	1.004	2040
2005	0.214	0.133	−0.280	0.795	2044
2006	0.214	0.137	−0.381	1.031	1926
2007	0.210	0.138	−0.424	1.083	1788
2008	0.206	0.140	−0.924	1.113	1748
overall	0.213	0.132	−0.924	1.113	13618

Source: LIAB 2002-2008, own calculation.

Table 4.5: Unexplained part of intra-firm gap

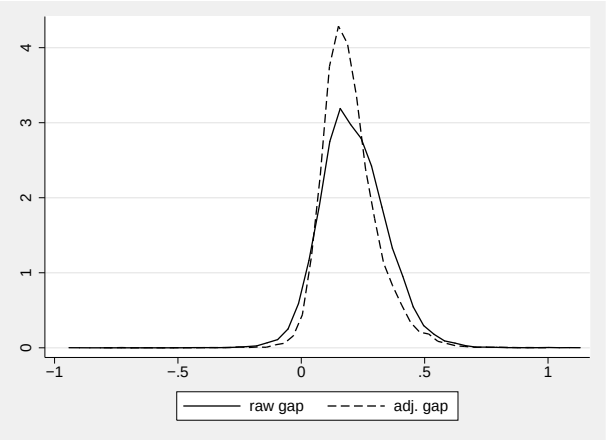
Year	Mean	Std. Dev.	Min.	Max.	N
2002	0.191	0.105	−0.248	0.839	2148
2003	0.199	0.104	−0.101	0.792	1924
2004	0.196	0.108	−0.398	0.788	2040
2005	0.197	0.113	−0.734	0.954	2044
2006	0.196	0.116	−0.738	0.886	1926
2007	0.195	0.119	−0.502	0.979	1788
2008	0.190	0.121	−0.788	0.924	1748
overall	0.195	0.112	−0.788	0.979	13618

Source: LIAB 2002-2008, own calculation.

Table 4.6: Explained part of intra-firm gap

Year	Mean	Std. Dev.	Min.	Max.	N
2002	0.021	0.090	−0.318	0.462	2148
2003	0.018	0.094	−0.340	0.353	1924
2004	0.022	0.098	−0.414	0.861	2040
2005	0.017	0.096	−0.417	0.922	2044
2006	0.018	0.100	−0.622	0.924	1926
2007	0.015	0.100	−0.738	1.067	1788
2008	0.017	0.108	−0.591	0.937	1748
overall	0.018	0.098	−0.738	1.067	13618

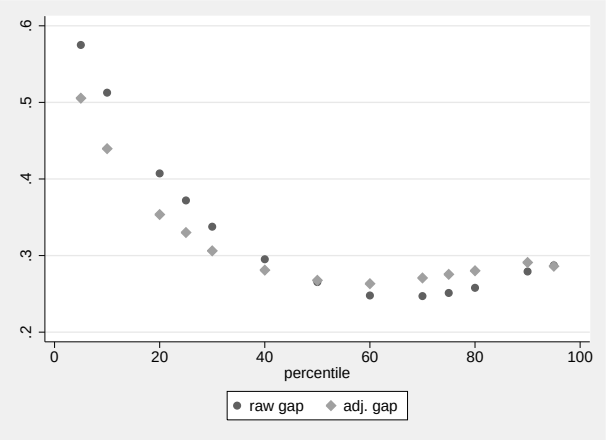
Source: LIAB 2002-2008, own calculation.



Source: LIAB 2002-2008, own calculation.

Figure 4.3: Distribution of raw gap and adjusted gap across firms

The results of the decomposition along the distribution following equation (4.12) are presented in figure 4.4. It can be seen that the raw gender wage gap is highest at the lower part of the distribution. This is in line with results from current studies on the German labor market, as Boll and Leppin (2015).



Source: LIAB 2002-2008, own calculation.

Figure 4.4: Mean raw gap and adjusted gap at different quantiles, district level

Local unemployment and the district level wage gap

The adjusted gender wage gap that results from equation (4.7) is now regressed on the local unemployment rate and further explanatory variables following (4.14). I control for time trends, commuting area fixed effects, and an indicator for growing or shrinking labor markets. As can be seen from in 4.7, the local unemployment rate is negatively associated with the gender wage gap at the district level. The estimated coefficient is -0.057 and highly significant, implying that a doubling of the unemployment rate is associated with a 6 points drop in the adjusted gender wage gap at the district level. Since the wage gap is measured as the difference in log wages, a 6 point decrease can therefore approximately be interpreted as a decline in the adjusted wage differential of 6 percentage points. This is substantial given that the mean gap is about 21 percentage points.

The estimated negative coefficient is in line with the theoretical considerations outlined in section 4.4. According to the wage curve literature, an increase in the unemployment rate goes along with lower wages. Yet, this effect is expected to be more pronounced for men. This provides the intuition for the negative relationship between the unemployment rate and the wage gap. Theoretically, a drop in the wage gap can be rationalized by the efficiency wage theory: In times of high unemployment, employers may pay a lower wage premium for men while for women's wages the adjustment is less pronounced as both groups face different outside options.

The observed negative association of local unemployment with the adjusted wage gap also holds if group-specific unemployment rates are considered. Model (2) in table 4.7 shows a negative relationship of the gender wage gap and the male unemployment rate. In model (3), I consider solely the female unemployment rate and observe a negative coefficient as well. Finally, in model (4), both gender-specific unemployment rates are included simultaneously. The negative coefficient of the male unemployment rate remains significant. The female unemployment rate is now positively, though not significantly, related to the gender wage gap. Following the efficiency wage theory, this seems plausible. The coefficient of the female unemployment rate has to be interpreted ceteris paribus. If the male unemployment rate is held constant, but the female

unemployment rate increases, mainly female wages will adjust, i.e. decrease, which leads to a growing wage gap. However, the fact that only the male unemployment rate is significantly related to the wage gap may be due to a multicollinearity problem caused by the high correlation of the two measures (around 0.9).

Table 4.7: Regression results district level (adj. gap)

	(1)	(2)	(3)	(4)	(5)
$\ln U$	-0.0569^{***}				-0.0454^{**}
	(0.0181)				(0.0186)
$\ln U^m$		-0.0508^{***}		-0.0646^{***}	
		(0.0147)		(0.0233)	
$\ln U^f$			-0.0548^{**}	0.0199	
			(0.0220)	(0.0390)	
Spatial $\ln U$					0.0691^{**}
					(0.0270)
Region FE	√	√	√	√	√
Time FE	√	√	√	√	√
Controls	√	√	√	√	√
N	2192	2192	2192	2192	2178
R^2	0.077	0.078	0.074	0.078	0.079

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Source: LIAB 2002-2008, own calculation.

I further extend the model by a measure for spatial unemployment as reported in model (5), table 4.7. I add the log of the mean unemployment rate in the commuting area (excluding the own district). As in the other models, the estimated effect of the local unemployment rate is negative. The coefficient is now -0.045 and the effect of the spatial unemployment rate is estimated as 0.069, both being statistically significant. To rationalize the positive effect of the spatial unemployment rate, one may consider the commuting behavior of individuals. Empirical studies suggest that men devote more time to commuting and commute longer distances than women (e.g. Gimenez-Nadal and Molina, 2015; Crane, 2007). This is theoretically rationalized by differences in the assignment of household activities within couples or different preferences in the degree of job specialization. Following the reasoning of the wage curve approach, an increase

in the unemployment rate in adjacent regions is expected to go along with lower wages there. Hence, we may expect an increasing number of individuals commuting into the observed local district. These commuting individuals are likely to be men with a relatively high (reservation) wage because longer commuting distances correspond to higher wages (Reichelt and Haas, 2015). Assuming that more high-earning men from neighboring regions commute into the local labor market, one can expect the gender-specific wage gap to increase.[5]

As to the decomposition results from the reweighting procedure, one can observe that not only the level of the gender wage gap varies over the distribution but also its relationship to the local unemployment rate. The results at selected percentiles are reported in table 4.8. The negative association with the unemployment rate can be found along the whole distribution, but it becomes weaker with increasing percentiles. A positive relationship with the spatial unemployment exists, yet being only significant in some parts of the distribution (see table 4.9).

Table 4.8: Regression results district level (adj. gap at different quantiles)

	p10	p25	p40	p50	p60	p75
$\ln U$	-0.225^{***}	-0.197^{***}	-0.154^{***}	-0.114^{***}	-0.0953^{***}	-0.0590^{**}
	(0.0521)	(0.0400)	(0.0310)	(0.0256)	(0.0238)	(0.0233)
Region FE	√	√	√	√	√	√
Time FE	√	√	√	√	√	√
Controls	√	√	√	√	√	√
N	2192	2192	2192	2192	2192	2192
R^2	0.094	0.134	0.125	0.114	0.135	0.162

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Source: LIAB 2002-2008, own calculation.

[5]This argumentation is based on the idea that individuals commute from adjacent regions into the local labor market. In the case of better labor market conditions in the neighboring regions compared to the local labor market, one would expect the commuting flow in the reverse direction. The theoretical considerations adjust accordingly: An increase in the unemployment rate in the other districts of the commuting area leads to a decreasing commuting flow and more high-earning men remain in the local labor market, which widens the wage gap.

Table 4.9: Regression results with spatial unemployment (adj. gap at different quantiles)

	p10	p25	p40	p50	p60	p75
$\ln U$	-0.209^{***}	-0.169^{***}	-0.132^{***}	-0.0961^{***}	-0.0841^{***}	-0.0505^{**}
	(0.0550)	(0.0422)	(0.0316)	(0.0263)	(0.0250)	(0.0242)
Spatial $\ln U$	0.0960	0.173^{**}	0.129^{**}	0.112^{**}	0.0692	0.0528
	(0.103)	(0.0734)	(0.0560)	(0.0510)	(0.0428)	(0.0396)
Region FE	√	√	√	√	√	√
Time FE	√	√	√	√	√	√
Controls	√	√	√	√	√	√
N	2178	2178	2178	2178	2178	2178
R^2	0.093	0.137	0.128	0.117	0.137	0.163

Standard errors in parentheses; $^{*}\ p < 0.1$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

Source: LIAB 2002-2008, own calculation.

Local unemployment and the intra-firm wage gap

For the intra-firm gender wage gap I observe a similar association with the unemployment rate as at the district level (see table 4.10[6]). The estimated relationship between the log unemployment rate and the adjusted gender wage gap is estimated as -0.037. The magnitude of the effect varies depending on the additional regressors used, but a negative and significant relationship is found throughout all specifications.

As to the effect of firm characteristics, which are controlled for to capture observed firm heterogeneity, the estimated coefficients are in line with previous findings in Heinze and Wolf (2010). Establishments with a works council show on average a lower gender wage gap, as can be seen throughout all models in table 4.10. This is also true for firms covered by collective bargaining (either industry-wide or company agreement) compared to those with no collective wage agreement. The coefficient for firm size is negative and the squared coefficient is positive. Taken together, the relationship between firm size and the gender wage gap is U-shaped with a turning point at around 11,000 employees. Establishments founded before 1990 are found to have larger gender wage differentials on average, which might be explained by differences in the organizational culture.

[6]Only relevant coefficients are reported in order to save space. The full list of coefficients can be found in table C.5 in the appendix.

As a variation of model (1), I use gender-specific unemployment rates instead of the overall rate. The results are in line with those found at the district level: Models (2) and (3) give negative and significant coefficients on the male- and female-specific unemployment rate respectively. Including both in model (4), I find a negative association with the male unemployment rate, but a positive one with the female-specific rate. As outlined in section 4.2, the relationship between unemployment and wage gap might differ according to firm characteristics. This can be seen in model (5) where an interaction term between works council and unemployment is added. The estimated coefficient of the interaction term turns out to be positive while the one for the works council retains its negative sign. This suggests that the otherwise negative effect of unemployment is moderated by the existence of a works council.

Model (6) includes further regressors on female representation in top management and second management positions. Unfortunately, questions concerning gender mainstreaming are only part of the 2004 and 2008 establishment panel questionnaire. This shrinks the sample to 3,361 observations. Although being based on a smaller sample, the estimated coefficient of local unemployment remains negative and significant. Female representation both in first and second management is negatively related to the gender wage gap. Yet, the female share in second level management positions appears to be more influential. This result is in line with earlier findings by Hirsch (2013). Thereby, Hirsch argues that second level managers are more likely to be involved in hiring or promotion decisions and have more direct interaction with non-managerial workers.

Finally, considering the spatial unemployment rate in model (7) leads to an estimated coefficient of -0.025 for the local unemployment rate and 0.050 for spatial unemployment. Again, the direction of the effects is in line with those at the district level. However, the estimated coefficients at the intra-firm level are smaller in magnitude.

Robustness checks

As introduced in section 4.4, the mean wage differential can result from gender differences in the human capital allocation across regions or firms. By using the human capital-adjusted gender

Table 4.10: Regression results firm level (adj. gap)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\ln U$	-0.0371^{***}				-0.0681^{***}	-0.0310^{***}	-0.0266^{***}
	(0.00727)				(0.0144)	(0.00883)	(0.00726)
Works council	-0.0236^{***}	-0.0235^{***}	-0.0237^{***}	-0.0232^{***}	-0.100^{***}	-0.0325^{***}	-0.0267^{***}
	(0.00609)	(0.00608)	(0.00611)	(0.00606)	(0.0300)	(0.00790)	(0.00641)
Works council$\times \ln U$					0.0358^{***}		
					(0.0136)		
$\ln U^m$		-0.0354^{***}		-0.0726^{***}			
		(0.00634)		(0.0136)			
$\ln U^f$			-0.0322^{***}	0.0548^{***}			
			(0.00793)	(0.0168)			
Spatial $\ln U$							0.0467^{***}
							(0.0130)
Female share							
Top management						-0.0194^{*}	
						(0.0110)	
2nd management						-0.0680^{***}	
						(0.0110)	
Region FE	√	√	√	√	√	√	√
Time FE	√	√	√	√	√	√	√
Firm characteristics	√	√	√	√	√	√	√
N	13202	13202	13202	13202	13202	3361	12253
R^2	0.270	0.271	0.268	0.272	0.271	0.293	0.271

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Source: LIAB 2002-2008 (model 6: 2004,2008), own calculation.

wage gap, I focus on the wage differential between women and men with the same observable characteristics. Still, the raw gap is worth having a look at. I replicate the described above analysis using the raw gap as dependent variable. The results are reported in table 4.11. The main results from the analysis based on the adjusted gender wage gap hold true for the raw gap. I observe a negative association between the raw gender wage gap and the local unemployment rate and a positive relationship with the spatial unemployment rate, both at the district level as well as within firms.[7]

Table 4.11: Regression results with raw differential as dependent variable

	district level		firm level	
$\ln U$	-0.0417^{**}	-0.0326^{*}	-0.0299^{***}	-0.0224^{***}
	(0.0176)	(0.186)	(0.00881)	(0.00863)
Spatial $\ln U$		0.0548^{*}		0.0335^{**}
		(0.0288)		(0.0149)
Region FE	√	√	√	√
Time FE	√	√	√	√
Firm characteristics			√	√
N	2192	2178	13202	12253
R^2	0.157	0.159	0.282	0.285

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Source: LIAB 2002-2008, own calculation.

Using the human capital-adjusted gender wage gap in the regression analysis may cause the results to depend on the covariates included in the original wage regression underlying the decomposition analysis. To account for this, I calculate different versions of the adjusted wage gap based on different wage functions. In the following, I present the results of the regression analysis with an adjusted gender wage gap resulting from a decomposition with no occupational control in the wage function. As we can see from table 4.12, the results compare with previous findings, irrespective of the choice of the underlying wage function.

[7] This is also true for the replication of the regressions with the gender wage gap at different quantiles (not reported, results are available on request).

Table 4.12: Regression results with different underlying wage functions

	district level		firm level	
$\ln U$	-0.0444^{***}	-0.0371^{***}	-0.0205^{***}	-0.0151^{**}
	(0.0122)	(0.0132)	(0.00733)	(0.00727)
Spatial $\ln U$		0.0438^{**}		0.0253^{*}
		(0.0199)		(0.0126)
Region FE	√	√	√	√
Time FE	√	√	√	√
Firm characteristics			√	√
N	2192	2178	13202	12253
R^2	0.081	0.082	0.266	0.272

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Source: LIAB 2002-2008, own calculation.

As further robustness check, I apply a different concept of spatial unemployment. What I called spatial unemployment so far was the population weighted average of the unemployment rates of districts in the same commuting area. Alternatively, I now calculate the mean unemployment rate of all districts with a common border (irrespective of commuting structures) using a contiguity matrix. Including this unemployment rate in the regression models leads to similar results for the coefficient on the local unemployment rate as reported in table 4.13.

Table 4.13: Regression results with different spatial unemployment rates

	district level		firm level	
$\ln U$	-0.0454^{**}	-0.0572^{***}	-0.0266^{***}	-0.0362^{***}
	(0.0186)	(0.0182)	(0.00726)	(0.00729)
Spatial $\ln U$	0.0691^{**}		0.0467^{***}	
(Commuting area)	(0.0270)		(0.0130)	
Spatial $\ln U$		0.0269		0.0197^{**}
(Direct neighbors)		(0.0180)		(0.00918)
Region FE	√	√	√	√
Time FE	√	√	√	√
Firm characteristics			√	√
N	2178	2185	12253	13163
R^2	0.079	0.078	0.271	0.271

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Source: LIAB 2002-2008, own calculation.

The estimated coefficient of the direct neighbors unemployment is smaller, yet not significant at the district level. At the firm level the effect remains significant, but it is also smaller in magnitude. This might be due to the fact that the unemployment rate based on direct neighbors does not account for commuting structures. The results support the theoretical considerations that the positive association between spatial unemployment and gender wage gap partly results from the commuting behavior of employees.

4.6 Conclusion

Based on data for West Germany from 2002 to 2008, I find a highly stable negative relationship between the gender wage gap and the local unemployment rate. Furthermore, there is a positive association with the unemployment rate in the commuting area. The relationship between the local unemployment rate and the wage gap is present both at the district level and at the firm level. The results are robust across different measures of the gender wage gap and across varieties of the regression specification. The relationship between unemployment rate and the raw gender wage gap follows the same direction as for the human-capital adjusted gap. In the latter case, it is stable throughout different wage functions underlying the decomposition analysis. The effect on the intra-firm gap is smaller than the one found at the district level, and it is moderated by firm characteristics such as the existence of a works council. The positive effect of the spatial unemployment rate can be rationalized by the commuting behavior of employees. This explanation is in line with the fact that I find stronger effects for a measure of spatial unemployment that accounts for commuting structures than for a measure based on regional proximity.

Taken together, I believe that my results contribute to the literature on the gender wage gap as, to my best knowledge, the implications of the wage curve approach have not been considered in this context so far. My results suggest that the differences in the gender-specific wage differential across regions and firms can partly be explained by characteristics of the local labor market and

the gender-specific reaction to changes in these measures. Furthermore, considering the local unemployment rate offers an explanation of the particular share of the gender wage gap that cannot fully be accounted for by productivity differences, human capital or other observed factors, and that is therefore often attributed to discrimination. Future research should focus on the underlying theory of the relationship between the gender wage gap and local as well as spatial unemployment rates and the mechanisms through which local labor market conditions influence wage differentials between men and women.

Appendix C: Additional Tables

Table C.1: List of regressors

Variables used in the decomposition analysis	
Log wage	Log of daily gross wage
Educational level: 6 categories	Lower Secondary Education
	Lower Secondary Education plus vocational training
	Abitur
	Abitur plus vocational training
	University of applied sciences degree
	University degree
Experience	Experience in days
Job tenure	Time with current employer (in days)
Occupational group: 19 categories	Agricultural professions
	Stone ceramics and glass manufactures
	Chemical workers and plastic processors
	Paper processors and printing professions
	Metal professions
	Electrical professions
	Textile/leather manufacturers and processors
	Nutrional/food professions
	Building/constructions and wood professions
	Engineering, technical and scientific professions
	Traders and service professions
	Transport and logistic professions
	Administrative professions and office workers
	Security and public order professions
	Media, humanistic and artistic professions
	Health professions
	Social and education-related professions
	Body caring, housekeepers and cleaners
	Other
Firm size	Number of employees

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... table C.1 continued

Regional control variables	
Shrinking	Indicator for growing or shrinking labor market region
	0 - strongly shrinking; 1 - shrinking
	2 - stable; 3 - growing; 4 - strongly growing
Region FE	Fixed effect for commuting area (regional planning unit)
Time FE	Year fixed effect
Firm control variables	
Works council	Existence of works council
Female share	Female share in workforce
Legal form: 6 categories	Individually-owned firm
	Partnership
	Limited liability company
	Company limited by shares
	Public corporation
	Other legal form
Collective bargaining: 3 categories	Industry-wide Wage agreement
	Company agreement
	No collective agreement
Firm age	Indicator: founded before 1990
Female share 1st	female share in first management
Female share 2nd	female share in second management
Sector: 41 categories	Agriculture/forestry
	Mining/energy
	Food/luxury
	Textiles/clothing
	Paper/printing
	Wood sector
	Chemical sector
	Plastics industry
	Glass/stones/ore extraction
	Metal production

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... table C.1 continued

	Recycling
	Metal goods/steel production
	Engineering
	Vehicle engineering
	Other vehicle production
	Electrical engineering
	Precision engineering/optics
	Furniture/jewelry/toys
	Main building sector
	Building/installation
	Car-rent/-reparation/gas-station
	Wholesale trade
	Retailing/reparation
	Traffic
	Telecommunication
	Financial sector
	Insurance
	Data processing
	Research/development
	Judiciary/advertising
	Realties/flats
	Renting
	Restaurants
	Educational institutions
	Health/social
	Waste-management
	Culture/sports/entertaining
	Other services
	Organisations
	Private households
	Civil service/social insurance

Table C.2: Summary statistics: individual characteristics used for wage regression

Variable	Men		Women	
	Mean	Std. Dev.	Mean	Std. Dev.
Log wage	4.757	0.373	4.510	0.416
Experience	6393.410	3245.414	5360.880	3263.595
Job tenure	4072.336	3166.544	3248.229	2928.810
Firm size	6569.400	12109.250	3667.018	8410.307
Educational level				
Lower Secondary Education	0.125	0.331	0.155	0.362
Lower Secondary Education and voc. training	0.652	0.476	0.614	0.487
Abitur	0.010	0.101	0.017	0.131
Abitur plus voc. training	0.049	0.216	0.102	0.302
University of applied sciences degree	0.065	0.247	0.035	0.183
University degree	0.097	0.297	0.077	0.267
Occupational group				
Agricultural professions	0.007	0.086	0.004	0.061
Stone ceramics and glass manufacturers	0.005	0.067	0.003	0.053
Chemical workers and plastic manufacturers	0.042	0.201	0.019	0.137
Paper processors and printing professions	0.013	0.114	0.005	0.073
Metal professions	0.186	0.389	0.015	0.122
Electrical professions	0.085	0.279	0.052	0.221
Textile/leather manufacturers	0.002	0.045	0.005	0.072
Nutritional/food professions	0.011	0.107	0.026	0.160
Building/constructions and wood professions	0.096	0.295	0.044	0.204
Engineering, technical and scientific professions	0.175	0.380	0.057	0.231
Traders and service professions	0.072	0.259	0.140	0.347
Transport and logistic professions	0.077	0.267	0.026	0.158
Administrative professions and office workers	0.137	0.344	0.349	0.477

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... table C.2 continued

Variable	Men		Women	
	Mean	Std. Dev.	Mean	Std. Dev.
Security and public order professions	0.019	0.135	0.007	0.084
Media, humanistic and artistic professions	0.006	0.076	0.012	0.108
Health professions	0.024	0.154	0.133	0.339
Social and education-related professions	0.021	0.144	0.068	0.251
Body caring, housekeepers and cleaners	0.011	0.102	0.034	0.181
Other	0.010	0.100	0.003	0.052
Oberservations	6114836		2088274	

Source: LIAB 2002-2008, own calculation.

Table C.3: Summary statistics: regional level

Variable	Mean	Std. Dev.	Min.	Max.	N
Unexplained	0.211	0.127	−2.424	2.112	2192
Explained	0.034	0.140	−1.897	2.684	2192
Raw gap	0.246	0.101	−0.126	0.830	2192
$\ln U$	2.071	0.391	0.588	3.203	2192
$\ln U^f$	2.091	0.349	0.956	3.250	2192
$\ln U^m$	2.043	0.454	0.182	3.258	2192
Spatial $\ln U$	2.087	0.330	0.787	3.048	2178
Shrinking	2.635	1.018	0	4	2192

District-year observations, Source: LIAB 2002-2008, own calculation.

Table C.4: Summary statistics: firm level

Variable	Mean	Std. Dev.	Min.	Max.	N
Unexplained	0.195	0.112	−0.788	0.979	13202
Explained	0.018	0.097	−0.738	1.067	13202
Raw gap	0.213	0.132	−0.924	1.113	13202
$\ln U$	2.182	0.365	0.588	3.203	13202
$\ln U^f$	2.162	0.323	0.956	3.250	13202
$\ln U^m$	2.191	0.424	0.182	3.258	13202
Spatial $\ln U$	2.103	0.309	0.787	3.048	12253
Works council	0.877	0.329	0	1	13202
Firm size	828.754	2115.379	46	50524	13202
Firm age	0.872	0.334	0	1	13202
Legal form:					
Individually-owned firm	0.006	0.076	0	1	13202
Partnership	0.033	0.178	0	1	13202
Limited liability company	0.504	0.500	0	1	13202
Company limited by shares	0.120	0.325	0	1	13202
Public corporation	0.257	0.437	0	1	13202
Other legal form	0.080	0.271	0	1	13202
Collective bargaining:					
Industry-wide wage agreement	0.723	0.447	0	1	13202
Company agreement	0.111	0.314	0	1	13202
No collective agreement	0.166	0.372	0	1	13202
Female share 1st	0.083	0.197	0	1	3604
Female share 2nd	0.175	0.212	0	1	3430

Firm-year observations, Source: LIAB 2002-2008, own calculation.

Table C.5: Full regression results firm level (adj. gap)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\ln U$	-0.0371^{***}				-0.0681^{***}	-0.0310^{***}	-0.0266^{***}
	(0.00727)				(0.0144)	(0.00883)	(0.00726)
Works council	-0.0236^{***}	-0.0235^{***}	-0.0237^{***}	-0.0232^{***}	-0.100^{***}	-0.0325^{***}	-0.0267^{***}
	(0.00609)	(0.00608)	(0.00611)	(0.00606)	(0.0300)	(0.00790)	(0.00641)
Works council$\times \ln U$					0.0358^{***}		
					(0.0136)		
$\ln U^m$		-0.0354^{***}		-0.0726^{***}			
		(0.00634)		(0.0136)			
$\ln U^f$			-0.0322^{***}	0.0548^{***}			
			(0.00793)	(0.0168)			
Spatial $\ln U$							0.0467^{***}
							(0.0130)
Female share 1st						-0.0194^{*}	
						(0.0110)	

Continued on next page...

... table C.5 continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female share 2nd						-0.0680^{***}	
						(0.0110)	
Firm size	-0.0335^{***}	-0.0337^{***}	-0.333^{***}	-0.0338^{***}	-0.0333^{***}	-0.0524^{***}	-0.0298^{**}
	(0.0120)	(0.0120)	(0.0120)	(0.0120)	(0.0120)	(0.0147)	(0.0127)
Firm size^2	0.00180^{**}	0.00182^{**}	0.00176^{*}	0.00182^{**}	0.00178^{**}	0.00299^{***}	0.00153
	(0.000900)	(0.000899)	(0.000902)	(0.000897)	(0.000898)	(0.00107)	(0.000951)
Female share	-0.0172	-0.0176	-0.0164	-0.0178	-0.0170	-0.00240	-0.0191
	(0.0118)	(0.0118)	(0.0118)	(0.0117)	(0.0117)	(0.0144)	(0.0125)
Legal form (base category : individually-owned firm							
Partnership	-0.0771^{**}	-0.0774^{**}	-0.0766^{**}	-0.0783^{**}	-0.0736^{**}	-0.0757	-0.0763^{**}
	(0.0365)	(0.0365)	(0.0366)	(0.0366)	(0.0367)	(0.0479)	(0.0369)
Limited liability	-0.0905^{**}	-0.0907^{**}	-0.0904^{**}	-0.0912^{**}	-0.0874^{**}	-0.0912^{**}	-0.0891^{**}
	(0.0356)	(0.0356)	(0.0357)	(0.0357)	(0.0357)	(0.0459)	(0.0359)
Limited shares	-0.119^{***}	-0.119^{***}	-0.120^{***}	-0.119^{***}	-0.116^{***}	-0.120^{***}	-0.120^{***}
	(0.0357)	(0.0357)	(0.0358)	(0.0358)	(0.0358)	(0.0461)	(0.0360)

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... table C.5 continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Public	-0.102^{***}	-0.102^{***}	-0.102^{***}	-0.102^{***}	-0.0986^{***}	-0.102^{**}	-0.104^{***}
	(0.0359)	(0.0359)	(0.0360)	(0.0360)	(0.0361)	(0.0465)	(0.0363)
Other	-0.0940^{***}	-0.0941^{***}	-0.0941^{***}	-0.0949^{***}	-0.0909^{**}	-0.0926^{**}	-0.0940^{**}
	(0.0362)	(0.0362)	(0.0363)	(0.0363)	(0.0363)	(0.0467)	(0.0365)
Collective bargaining (base category: no collective agreement)							
Industry wide agreement	-0.0261^{***}	-0.0262^{***}	-0.260^{***}	-0.0265^{***}	-0.0259^{***}	-0.0217^{***}	-0.0242^{***}
	(0.00478)	(0.00477)	(0.00479)	(0.00476)	(0.00477)	(0.00611)	(0.00494)
Company agreement	-0.0327^{***}	-0.0328^{***}	-0.0329^{***}	-0.0333^{***}	-0.0328^{***}	-0.0284^{***}	-0.0300^{***}
	(0.00597)	(0.00596)	(0.00599)	(0.00597)	(0.00595)	(0.00802)	(0.00622)
Firm age	0.0346^{***}	0.0345^{***}	0.0348^{***}	0.0346^{***}	0.0342^{***}	0.0381^{***}	0.0359^{***}
	(0.00428)	(0.00427)	(0.00429)	(0.00426)	(0.00429)	(0.00566)	(0.00450)
Shrinking (base category: 2)							
0	-0.0576	-0.0629	-0.0542	-0.0782^{*}	-0.0593		-0.0592
	(0.0455)	(0.0452)	(0.0456)	(0.0456)	(0.0457)		(0.0440)

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... table C.5 continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	−0.00708	−0.00783	−0.00656	−0.0100	−0.00728	−0.00566	−0.00763
	(0.00850)	(0.00848)	(0.00852)	(0.00848)	(0.00851)	(0.0103)	(0.00849)
3	−0.0138*	−0.0139*	−0.0136*	−0.0136*	−0.0142*	−0.0133	−0.0133*
	(0.00798)	(0.00797)	(0.00800)	(0.00794)	(0.00799)	(0.00944)	(0.00796)
4	−0.0287***	−0.0275***	−0.0296***	−0.0236**	−0.0289***	−0.0364***	−0.0275***
	(0.00929)	(0.00928)	(0.00931)	(0.00939)	(0.00929)	(0.0114)	(0.00929)
Constant	0.646***	0.647***	0.627***	0.621***	0.707***	0.691***	0.502***
	(0.0781)	(0.0775)	(0.0787)	(0.0787)	(0.0824)	(0.0927)	(0.0854)
Region FE	√	√	√	√	√	√	√
Time FE	√	√	√	√	√	√	√
Sector	√	√	√	√	√	√	√
N	13202	13202	13202	13202	13202	3361	12253
R^2	0.270	0.271	0.268	0.272	0.271	0.293	0.271

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Source: LIAB 2002-2008 (model 6: 2004, 2008), own calculation.

Chapter 5

Summary and Conclusion

This thesis is concerned with econometric analyses of gender differences in the German labor market. A particular focus is on the the role of organizations and the impact of organizational characteristics on intra-firm gender differences.

In chapter 2 the amount of horizontal segregation within establishments is investigated. We are interested in occupational gender segregation, i.e. the unequal distribution of men and women along occupational groups. Therefore, a corrected version of the dissimilarity index is calculated following Carrington and Troske (1997), which accounts for random allocation of men and women into small occupational groups. We show that the correction procedure particularly influences the firm level results, while the segregation index at the labor market level remains largely unchanged. At the firm level we find a substantial variation in the amount of segregation which varies according to organizational characteristics. A bivariate analysis shows that the amount of segregation crucially differs among industries and across firms with different proportions of women in the workforce. We apply different panel data models in order to disentangle the effect of individual organizational characteristics. Thereby, the presence of unobserved heterogeneity, e.g. in the form of corporate culture, has to be carefully considered. Based on random effects, pooled OLS and fractional response models, we validate the results of previous research, as we find a negative relationship between firm size and segregation or a significantly higher level of segregation in East German companies. As to the effect of part-time work, the results clearly

suggest that it has to be considered jointly with the female share in the establishment in order to get meaningful results. Further, we contribute to the literature by exploring the relationship between the implementation of gender mainstreaming measures and formalized recruitment procedures. Both turn out to be associated with lower levels of segregation. The use of fixed effects and correlated random effects techniques did not yield significant results, which is most likely due to missing time variation in the data. However, the effect of organizational demography on segregation, in particular the negative effect of the female share in the workforce, is confirmed by these models.

While chapter 2 focuses on horizontal segregation, chapter 3 is concerned with gender differences in career trajectories and is therefore closely related to the concept of vertical segregation. The main research questions are whether *potential* parenthood is a determinant of career transitions and whether gender differences exist in this context. Based on the ALWA data set we create complete employment histories of childless men and women in Germany. Each transition between two subsequent employment spells is defined as either upward, downward or horizontal movement according to the change in personnel responsibility or job prestige respectively. We estimate a mixed multivariate proportional hazard model with competing risks for the three transition equations while simultaneously modeling the hazard of first birth, which enters the other equations as the main regressor of interest. As an alternative specification, we apply a fixed effects framework. The regressors used to predict the parenthood hazard include only CV relevant information to mimic employers' prediction. We find that a higher contemporaneous probability of pregnancy corresponds to a decrease in women's job mobility in terms of horizontal transitions. As opposed to this, for men the propensity of upward transitions is significantly positively related to the likelihood of becoming a father. The results are robust along the different estimation methods and transition measures. Our results suggest that the perceived probability of parenthood differently effects men's and women's career trajectories. While it seems that women's career mobility is hampered by the hazard of becoming a mother, men even exhibit higher upward mobility if they have a high probability of being a father soon. Our data does not allow it to be seen whether the observed effects are driven by discriminating behaviors of

the employer or by prescient decisions of the employee. In either case, we can conclude that career transitions are not gender neutral with respect to effect of potential fertility.

Chapter 4 addresses gender differences in pay. The gender wage gap has been the subject of much theoretical and empirical literature. This study brings up a new aspect for explaining the wage gap, namely the effect of local labor market conditions. The local unemployment rate is considered as a potential driver of the gap. This hypothesis is derived from the wage curve literature. The existence of gender-specific wage curves, i.e. the fact that men's and women's wages adjust differently to changes in the local unemployment rate, suggests that the wage differential should also be related to the unemployment rate. I calculate a human capital-adjusted wage gap at the district level as well as intra-firm wage gaps. These are related to the log of the local unemployment rate and a measure of spatial unemployment by means of regression analysis. At the firm level, I also consider the effect of organizational characteristics. I consistently find a negative relationship between the wage gap and the local unemployment rate throughout all estimated models. This is in line with theoretical considerations based on the efficiency wage theory. The unemployment rate in the commuting area, however, is positively related to the wage gap. Furthermore, I find that organizational characteristics explain a substantial share of the variation in intra-firm wage gaps. From the very robust relationship between unemployment and the gender wage differential throughout all models, I conclude that gender-specific reactions to local labor market conditions should be considered, in addition to common factors when trying to explain the gender wage gap.

Summarizing, I can say that the studies presented in this thesis have two main common subjects: Firstly, the investigation of gender differences in the German labor market, and secondly, the consideration of organizational characteristics in the explanation of gender differences within and between establishments. With respect to gender differences in general, one can conclude that although men and women are legally equal and we observe convergence in their characteristics, such as educational levels or participation rates, one still finds considerable differences in labor market outcomes. Chapter 2 shows that women face barriers to the entry into an occupation

dominated by men, while men more easily integrate into female-dominated fields. Furthermore, as chapter 3 demonstrates, the effects of the perceived probability of parenthood works in opposite directions for men and women. Finally, chapter 4 does not only show the persistency of gender differences in pay, but also suggests that men and women are differently affected by local labor market conditions. Based on the results presented in this thesis, one has to admit that labor market mechanism seem to work in different ways for men and women. This is true regardless of whether the discussed effects are of a causal nature or not .

A second conclusion one can draw from my results, is that considering the organization as a social unit is a useful approach as firm characteristics play a major role in explaining the observed heterogeneity across firms. The results presented in chapter 2 show that variation in firm level segregation crucially varies by organizational characteristics. Also, substantial variation in the intra-firm wage gaps are found. As chapter 4 shows, organizational heterogeneity captures a lot of this variation. Thus, information on the relationship between organizational characteristics and gender differences are of high political relevance, as policy measures affecting the organizational level might help to promote gender equality in the labor market.

Nevertheless, analyses at the firm level suffer particularly from the existence of unobserved firm heterogeneity in the form of, e.g., corporate culture. In order to get closer to causal interpretations, future research should consider this carefully by using panel techniques and data with long time dimensions. As to the research questions covered in chapter 2, the LIAB data will hopefully provide information on gender mainstreaming in upcoming survey waves. This could solve the problem of absent time variation in the regressors and makes fixed effects estimation more promising. Chapter 3 gives interesting insight on gender differences in job transitions. To investigate the sources of vertical segregation in more detail, it would be desirable to expand the analysis to a definition of career transitions that also captures internal promotions. With respect to the research question in chapter 4, follow-up research should concentrate on the theoretical background of the unemployment rate as a driving factor of the wage gap. The empirical results suggest highly stable correlation patterns, that may be addressed more thoroughly in

a theoretical framework in the future. A joint investigation of the different fields of research covered in this thesis, namely horizontal segregation, career development, and the gender gap in pay, seems promising as well. For instance, segregation effects can be directly related to the gender wage gap, both at the horizontal and vertical level, but this should be subject to future research.

I conclude that gender differences in the labor market remain a topic of high political as well as social relevance. The development of more elaborated research techniques and the availability of linked employer-employee data open up the possibilities for future research. In summary, this thesis shows that despite all attempts of gender equalization policies, gender differences exist in the German labor market with respect to labor market dynamics and outcomes. The presented studies reveal possible mechanisms to foster gender equality and emphasize the impact of organizational characteristics in explaining firm level heterogeneity in segregation levels and intra-firm wage gaps.

Bibliography

Aassve, A., Burgess, S., Propper, C., and Dickson, M. (2006). Employment, family union and childbearing decisions in Great Britain. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, *169*(4), 781–804.

Abele, A. E., Spurk, D., and Volmer, J. (2011). The construct of career success: measurement issues and an empirical example. *Zeitschrift für Arbeitsmarktforschung*, *43*(3), 195–206.

Achatz, J. (2008). Die Integration von Frauen in Arbeitsmärkten und Organisationen. In *Geschlechterdifferenzen - Geschlechterdifferenzierungen. Ein Überblick über gesellschaftliche Entwicklungen und theoretische Positionen* , 105–138. Wiesbaden: VS Verlag für Sozialwissenschaften.

Achatz, J., Beblo, M., and Wolf, E. (2010). Berufliche Segregation. In Projektgruppe GiB (Ed.), *Geschlechterungleichheiten im Betrieb. Arbeit, Entlohnung und Gleichstellung in der Privatwirtschaft* , 89–140. Edition Sigma.

Acker, J. (1990). Hierarchies, jobs, bodies: A theory of gendered organizations. *Gender and society*, *4*(2), 139–158.

Acosta, P. (2010). Promotion dynamics the Peter Principle: Incumbents vs. external hires. *Labour Economics*, *17*(6), 975–986.

Adda, J., Dustmann, C., and Stevens, K. (2011). The career costs of children. Technical Report No. 6201, Discussion Paper series, Forschungsinstitut zur Zukunft der Arbeit.

Aigner, D. J. and Cain, G. G. (1977). Statistical theories of discrimination in labor markets. *Industrial and Labor relations review*, 175–187.

Albrecht, J., Bjorklund, A., and Vroman, S. (2003). Is There a Glass Ceiling in Sweden? *Journal of Labor Economics*, *21*(1), 145–177.

Albrecht, J., Van Vuuren, A., and Vroman, S. (2009). Counterfactual distributions with sample selection adjustments: Econometric theory and an application to the Netherlands. *Labour Economics*, *16*(4), 383–396.

Allmendinger, J. and Podsiadlowski, A. (2001). Segregation in Organisationen und Arbeitsgruppen. In B. Heintz (Ed.), *Geschlechtersoziologie* , 276–307. Wiesbaden: Westdeutscher Verlag.

Altonji, J. G. and Blank, R. M. (1999). Race and gender in the labor market. *Handbook of labor economics*, *3*, 3143–3259.

Anderson, D. J., Binder, M., and Krause, K. (2002). The motherhood wage penalty: Which mothers pay it and why? *The American Economic Review*, *92*(2), 354–358.

Antonczyk, D., Fitzenberger, B., and Sommerfeld, K. (2010). Rising wage inequality, the decline of collective bargaining, and the gender wage gap. *Labour Economics*, *17*(5), 835–847.

Arrow, K. J. (1973). The theory of discrimination. In O. Ashenfelter and A. Rees (Eds.), *Discrimination in labor markets* , 3–33. Princeton, N.J.: Princeton University Press.

Arulampalam, W., Booth, A. L., and Bryan, M. L. (2007). Is there a glass ceiling over Europe? Exploring the gender pay gap across the wage distribution. *Industrial and Labor Relations Review*, *60*(2), 163–186.

Azmat, G. (2014). Gender diversity in teams. *IZA World of Labor*.

Baert, S. (2014). Career lesbians. Getting hired for not having kids? *Industrial Relations Journal*, *45*(6), 543–561.

Baerts, A., Deschacht, N., and Guerry, M.-A. (2011). The role of the partner in promotions to top positions in Belgium. *European sociological review*, *27*(5), 654–668.

Bagger, J., Fontaine, F., Postel-Vinay, F., and Robin, J.-M. (2014). Tenure, experience, human capital, and wages: A tractable equilibrium search model of wage dynamics. *The American Economic Review*, *104*(6), 1551–1596.

Baltagi, B. H. and Blien, U. (1998). The German wage curve: evidence from the IAB employment sample. *Economics letters*, *61*(2), 135–142.

Baltagi, B. H., Blien, U., and Wolf, K. (2009). New evidence on the dynamic wage curve for Western Germany: 1980–2004. *Labour Economics*, *16*(1), 47–51.

Baltagi, B. H., Blien, U., and Wolf, K. (2012). A dynamic spatial panel data approach to the German wage curve. *Economic Modelling*, *29*(1), 12–21.

Baltagi, B. H. and Rokicki, B. (2014). The spatial Polish wage curve with gender effects: Evidence from the Polish Labor Survey. *Regional Science and Urban Economics*, *49*, 36–47.

Bansak, C., Graham, M. E., and Zebedee, A. A. (2012). Business cycles and gender diversification: An analysis of establishment-level gender dissimilarity. *The American Economic Review*, *102*(3), 561–565.

Baron, J. N. and Bielby, W. T. (1980). Bringing the firms back in: Stratification, segmentation, and the organization of work. *American Scientisto Review*, *45*, 737–765.

Beblo, M., Heinze, A., and Wolf, E. (2008). Entwicklung der beruflichen Segregation von Männern und Frauen zwischen 1996 und 2005 - Eine Bestandsaufnahme auf betrieblicher Ebene. *Zeitschrift für ArbeitsmarktForschung*, *41*(2/3), 181–198.

Becker, G. S. (1964). *Human Capital: a Theoretical and Empirical Analysis, with Special Reference to Education*. New York: Columbia University Press.

Becker, G. S. (1965). A theory of the allocation of time. *The Economic Journal*, *75*(299), 493–517.

Becker, G. S. (1971). *The Economics of Discrimination*. University of Chicago Press.

Bertrand, M., Goldin, C., and Katz, L. F. (2010). Dynamics of the Gender Gap for Young Professionals in the Financial and Corporate Sectors. *American Economic Journal: Applied Economics*, *2*(3), 228–255.

Bertrand, M. and Hallock, K. F. (2001). The gender gap in top corporate jobs. *Industrial and Labor Relations Review*, *55*(1), 3–21.

Blackburn, R. M., Browne, J., Brooks, B., and Jarman, J. (2002). Explaining gender segregation. *The British Journal of Sociology*, *53*(4), 513–536.

Blanchflower, D. G. and Oswald, A. J. (1994). *The wage curve*. MIT press.

Blau, F. and Kahn, L. (2000). Gender Differences in Pay. *Journal of Economic Perspectives*, *14*(4), 75–99.

Blau, F. D., Brummund, P., and Liu, A. Y.-H. (2013). Trends in occupational segregation by gender 1970–2009: Adjusting for the impact of changes in the occupational coding system. *Demography*, *50*(2), 471–492.

Blau, F. D. and DeVaro, J. (2007). New evidence on gender differences in promotion rates: An empirical analysis of a sample of new hires. *Industrial Relations: A Journal of Economy and Society*, *46*(3), 511–550.

Blau, F. D. and Kahn, L. M. (2016). The Gender Wage Gap: Extent, Trends, and Explanations. *forthcoming in: Journal of Economic Literature*.

Blien, U., Messmann, S., and Trappmann, M. (2012). Do reservation wages react to regional unemployment? Technical report, IAB Discussion Paper.

Blinder, A. S. (1973). Wage discrimination: reduced form and structural estimates. *Journal of Human resources*, *8*(4), 436–455.

Boll, C. and Leppin, J. S. (2015). Die geschlechtsspezifische Lohnlücke in Deutschland: Umfang, Ursachen und Interpretation. *Wirtschaftsdienst*, *95*(4), 249–254.

Boll, C., Leppin, J. S., Rossen, A., and Wolf, A. (2016). Magnitude and Impact Factors of the Gender Pay Gap in EU Countries. Technical report, European Commission - Directorate-General for Justice.

Booth, A. L., Francesconi, M., and Frank, J. (2003). A sticky floors model of promotion, pay, and gender. *European Economic Review*, *47*(2), 295–322.

Bundesagentur für Arbeit (2015). Der Arbeitsmarkt in Deutschland - Frauen und Männer am Arbeitsmarkt 2014. *Nürnberg: Statistik der Bundesagentur für Arbeit*.

Busch, A. (2013). *Die berufliche Geschlechtersegregation in Deutschland: Ursachen, Reproduktion, Folgen*. Springer-Verlag.

Card, D. (1995). The Wage Curve: A Review. *Journal of Economic Literature*, *33*(2), 785–799.

Carrillo-Tudela, C., Hobijn, B., She, P., and Visschers, L. (2016). The extent and cyclicality of career changes: Evidence for the U.K. *European Economic Review*, (84), 18–41.

Carrington, W. J. and Troske, K. R. (1997). On measuring segregation in samples with small units. *Journal of Business and Economic Statistics*, *15*(4), 402–409.

Cobb-Clark, D. A. (2001). Getting ahead: The determinants of and payoffs to internal promotion for young U.S. men and women. *Research in Labor Economics*, *20*, 339–372.

Crane, R. (2007). Is there a quiet revolution in women's travel? Revisiting the gender gap in commuting. *Journal of the American planning association*, *73*(3), 298–316.

DiNardo, J., Fortin, N. M., and Lemieux, T. (1996). Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach. *Econometrica*, *64*(5), 1001–1044.

Drange, N. and Rege, M. (2013). Trapped at home: The effect of mothers' temporary labor market exits on their subsequent work career. *Labour Economics*, *24*, 125–136.

Duncan, O. D. and Duncan, B. (1955). A Methodological Analysis of Segregation Indexes. *American Sociological Review*, *20*(2), 210–217.

European Commission (2010). Report on equality between women and men. Technical report, Office for Official Publications of the European Communities.

Falk, S. (2002). Geschlechtsspezifische berufliche Segregation in Ostdeutschland zwischen Persistenz, Verdrängung und Angleichung. Ein Vergleich mit Westdeutschland für die Jahre 1991-2000. *Mitteilungen aus der Arbeitsmarkt- und Berufsforschung*, *35*(1), 37–59.

Federal Statistical Office (2016). Verdienstunterschied zwischen Männern und Frauen. `https://www.destatis.de/DE/ZahlenFakten/GesamtwirtschaftUmwelt/VerdiensteArbeitskosten/VerdiensteVerdienstunterschiede/Tabellen/UGPG_02_Bundeslaender.html`. Accessed: 2016-07-06.

Filer, R. K. (1985). Male-Female Wage Differences: The Importance of Compensating Differentials. *Industrial and Labor Relations Review*, *38*(3), 426–437.

Fischer, G., Janik, F., Müller, D., and Schmucker, A. (2009). The IAB Establishment Panel - Things Users Should Know. *Schmollers Jahrbuch. Zeitschrift für Wirtschafts- und Sozialwissenschaften*, *Jg. 129*, 133–148.

Fitzenberger, B., Sommerfeld, K., and Steffes, S. (2013). Causal effects on employment after first birth - A dynamic treatment approach. *Labour Economics*, *25*, 49–62.

Flückiger, Y. and Silber, J. (1999). *The measurement of segregation in the labor force*. Heidelberg: Physica.

Fortin, N., Lemieux, T., and Firpo, S. (2011). Decomposition Methods in Economics. *Handbook of labor economics*, *4, Part A*, 1–102.

Francesconi, M. (2001). Determinants and consequences of promotions in Britain. *Oxford Bulletin of Economics and Statistics*, *63*(3), 279–310.

Francesconi, M. (2002). A joint dynamic model of fertility and work of married women. *Journal of Labor Economics*, *20*(2), 336–380.

Ganzeboom, H. B. and Treiman, D. J. (1996). Internationally comparable measures of occupational status for the 1988 International Standard Classification of Occupations. *Social science research*, *25*(3), 201–239.

Gartner, H. (2005). The imputation of wages above the contribution limit with the German IAB employment sample. *FDZ Methodenreport*, *2/2005*, 2005.

Gartner, H. (2016). Löhne von Frauen und Männern. *IAB Aktuelle Berichte*, *7/2016*.

Gartner, H. and Hinz, T. (2009). Geschlechtsspezifische Lohnungleichheit in Betrieben, Berufen und Jobzellen (1993–2006). *Berliner Journal für Soziologie*, *19*(4), 557–575.

Gibbons, R. and Waldman, M. (1999). A Theory of Wage and Promotion Dynamics inside Firms. *The Quarterly Journal of Economics*, *114*(4), 1321–1358.

Gimenez-Nadal, J. I. and Molina, J. A. (2015). Commuting time and household responsibilities: Evidence using propensity score matching. *Journal of Regional Science*, *56*(2), 332–359.

Granqvist, L. and Persson, H. (2005). Career mobility and gender on the Swedish labour market. *International Journal of Manpower*, *26*(2), 116–139.

Greene, W. (2012). *Econometric Analysis* (7th ed.). Upper Saddle River, NJ: Prentice Hall.

Grimm, V., Lang, J., and Stephan, G. (2015). Die Bedeutung von Tarifverträgen für den Gender Wage Gap: Eine empirische Untersuchung. *LASER Discussion Papers*, *Paper No.90*.

Hakim, C. (1998). Developing a sociology for the twenty-first century: Preference Theory. *The British Journal of Sociology*, *49*(1), 137–143.

Handl, J. (1984). Chancengleichheit und Segregation: Ein Vorschlag zur Messung ungleicher Chancenstrukturen und ihrer zeitlichen Entwicklung. *Zeitschrift für Soziologie*, *13*(4), 328–345.

Heining, J., Scholz, T., and Seth, S. (2013). Linked employer–employee data from the IAB: LIAB cross-sectional model 2, 1993–2010 (LIAB QM2 9310). *FDZ-Datenreport*, *2*, 2013.

Heinze, A. and Wolf, E. (2010). The intra-firm gender wage gap: a new view on wage differentials based on linked employer–employee data. *Journal of Population Economics*, *23*(3), 851–879.

Hersch, J. and Viscusi, W. (1996). Gender differences in promotions and wages. *Industrial Relations: A Journal of Economy and Society*, *35*(4), 461–472.

Hinz, T. and Schübel, T. (2001). Geschlechtersegregation in deutschen Betrieben. *Mitteilungen aus der Arbeitsmarkt- und Berufsforschung*, *34*(3), 286–301.

Hirsch, B. (2013). The impact of female managers on the gender pay gap: Evidence from linked employer–employee data for Germany. *Economics Letters*, *119*(3), 348–350.

Hirsch, B., König, M., and Möller, J. (2013). Is there a gap in the Gap? Regional differences in the gender pay gap. *Scottish Journal of Political Economy*, *60*(4), 412–439.

Hirsch, B. and Mueller, S. (2014). Firm leadership and the gender pay gap: do active owners discriminate more than hired managers? *Journal for Labour Market Research*, *47*(1-2), 129–142.

Holst, E. and Wieber, A. (2014). Bei der Erwerbstätigkeit der Frauen liegt Ostdeutschland vorn. *DIW-Wochenbericht*, *81*(40), 967–975.

Javdani, M. (2015). Glass ceilings or glass doors? The role of firms in male-female wage disparities. *Canadian Journal of Economics/Revue canadienne d'économique*, *48*(2), 529–560.

Joecks, J., Pull, K., and Vetter, K. (2013). Gender diversity in the boardroom and firm performance: What exactly constitutes a "critical mass?". *Journal of Business Ethics*, *118*(1), 61–72.

Johnson, W. R. (1978). A Theory of Job Shopping. *The Quarterly Journal of Economics*, *92*(2), 261–278.

Johnston, D. W. and Lee, W.-S. (2012). Climbing the job ladder: New evidence of gender inequity. *Industrial Relations: A Journal of Economy and Society*, *51*(1), 129–151.

Jürges, H. and Schneider, K. (2011). Why young boys stumble: Early tracking, age and gender bias in the German school system. *German Economic Review*, *12*(4), 371–394.

Kleinert, C., Matthes, B., Antoni, M., Drasch, K., Ruland, M., and Trahms, A. (2011). ALWA - New life course data for Germany. *Schmollers Jahrbuch. Zeitschrift für Wirtschafts- und Sozialwissenschaften*, *131*(4), 625–634.

Kunze, A. (2013). Gender differences in career progression: Does the effect of children capture low work effort? Number G17-V3 in Beiträge zur Jahrestagung des Vereins für Socialpolitik 2013: Wettbewerbspolitik und Regulierung in einer globalen Wirtschaftsordnung - Session: Women and the Labor Market, Kiel und Hamburg. ZBW - Deutsche Zentralbibliothek für Wirtschaftswissenschaften, Leibniz-Informationszentrum Wirtschaft.

Kunze, A. and Miller, A. R. (2014). Women helping women? Evidence from private sector data on workplace hierarchies. Technical report, National Bureau of Economic Research.

Kunze, A. and Troske, K. R. (2012). Life-cycle patterns in male/female differences in job search. *Labour Economics*, *19*(2), 176–185.

Lalive, R. and Zweimüller, J. (2009). How does parental leave affect fertility and return to work? Evidence from two natural experiments. *The Quarterly Journal of Economics*, *124*(3), 1363–1402.

Lazear, E. P. and Rosen, S. (1990). Male-Female Wage Differentials in Job Ladders. *Journal of Labor Economics*, *8*(1), S106–S123.

Lee, C. and Farh, J.-L. (2004). Joint Effects of Group Efficacy and Gender Diversity on Group Cohesion and Performance. *Applied Psychology: An International Review*, *53*(1), 136–154.

Leuze, K. and Strauß, S. (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*, 1–19.

Lillard, L. A. (1993). Simultaneous equations for hazards: Marriage duration and fertility timing. *Journal of Econometrics*, *56*(1/2), 189–217.

Lillard, L. A. and Waite, L. J. (1993). A Joint Model of Marital Childbearing and Marital Disruption. *Demography*, *30*(4), 653–681.

Longhi, S., Nijkamp, P., and Poot, J. (2006). Spatial heterogeneity and the wage curve revisited. *Journal of Regional Science*, *46*(4), 707–731.

Ludsteck, J. (2014). The impact of segregation and sorting on the gender wage gap: Evidence from German linked longitudinal employer-employee data. *Industrial and Labor Relations Review*, *67*(2), 362–394.

Maassen van den Brink, H. and Groot, W. (1996). Glass ceilings or dead ends: Job promotion of men and women compared. *Economics Letters*, *53*, 221–226.

Manning, A. and Swaffield, J. (2008). The gender gap in early-career wage growth. *The Economic Journal*, *118*(530), 983–1024.

McCue, K. (1996). Promotions and Wage Growth. *Journal of Labor Economics*, *14*(2), 175–209.

Mincer, J. (1962). Labor Force Participation of Married Women: A Study of Labor Supply. In *Aspects of labor economics* , 63–105. Princeton University Press.

Nijkamp, P. and Poot, J. (2005). The last word on the wage curve? *Journal of Economic Surveys*, *19*(3), 421–450.

Oaxaca, R. (1973). Male-Female Wage Differentials in Urban Labor Markets. *International economic review*, *14*(3), 693–709.

OECD (2012). Closing the Gender Gap: Act Now.

Pannenberg, M. and Schwarze, J. (2000). Wage dynamics and unemployment in Germany: evidence from regional panel data. *Labour*, *14*(4), 645–655.

Papke, L. E. and Wooldridge, J. M. (1996). Econometric Methods for Fractional Response Variables with an Application to 401(k) Plan Participation Rates. *Journal of Applied Econometrics*, *11*(6), 619–632.

Papke, L. E. and Wooldridge, J. M. (2008). Panel data methods for fractional response variables with an application to test pass rates. *Journal of Econometrics*, *145*(1), 121–133.

Pekkarinen, T. and Vartiainen, J. (2006). Gender differences in promotion on a job ladder: Evidence from Finnish metalworkers. *Industrial and Labor Relations Review*, *59*(2), 285–301.

Petit, P. (2007). The effects of age and family constraints on gender hiring discrimination: A field experiment in the French financial sector. *Labour Economics*, *14*(3), 371–391.

Phelps, E. S. (1972). The statistical theory of racism and sexism. *The American Economic Review*, *62*(4), 659–661.

Reichelt, M. and Haas, A. (2015). Commuting farther and earning more? How employment density moderates workers' commuting distance. *IAB Discussion Paper*, *33/2015*.

Reskin, B. F. and McBrier, D. B. (2000). Why not ascription? Organizations' Employment of Male and Female Managers. *American Sociological Review*, *65*(2), 210–233.

Rosenfeld, R. A., Trappe, H., and Gornick, J. C. (2004). Gender and Work in Germany: Before and After Reunification. *Annual Review of Sociology*, *30*, 103–124.

Schmelzer, P. (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.

Seifert, S. and Schlenker, E. (2014). Berufliche Geschlechtersegregation auf Betriebsebene– Ausmaß und der Zusammenhang mit Organisationsmerkmalen. In U. Busolt, S. Weber, W. Kronsbein, and C. Wiegel (Eds.), *Karriereverläufe in Forschung und Entwicklung - Bedingungen und Perspektiven im Spannungsfeld von Organisation und Individuum* , 90–109. Logos Verlag Berlin GmbH.

Sieben, B. and Bornheim, N. (2011). Intersektionalität und Diversity - Achsen der Differenz in Managementkonzepten und Managementförderung. In S. Smykalla and D. Vinz (Eds.), *Intersektionalität zwischen Gender und Diversity* , 93–110. Münster: Westfälisches Dampfboot.

Smith, N. and Smith, V. (2015). Women in top management positions - why so few? And does it matter? *Danish Journal of Management and Business*, *79*(1), 23–37.

Smith, N., Smith, V., and Verner, M. (2013). Why are so few females promoted into CEO and vice president positions? Danish empirical evidence, 1997-2007. *Industrial and Labor Relations Review*, *66*(2), 380–408.

Stainback, K. and Kwon, S. (2012). Female leaders, organizational power, and sex segregation. *The Annals of the American Academy of Political and Social Science*, *639*(1), 217–235.

Tomaskovic-Devey, D. and Skaggs, S. (2001). Führt Bürokratisierung zu geschlechtsspezifischer Segregation? In B. Heintz (Ed.), *Geschlechtersoziologie* , 276–307. Wiesbaden: Westdeutscher Verlag.

Topel, R. H. and Ward, M. P. (1992). Job Mobility and the Careers of Young Men. *The Quarterly Journal of Economics*, *107*(2), 439–479.

Trappe, H. and Rosenfeld, R. (2001). Geschlechtsspezifische Segregation in der DDR und der BRD: Im Verlauf der Zeit und im Lebensverlauf. In B. Heintz (Ed.), *Geschlechtersoziologie* , 152–181. Wiesbaden: Westdeutscher Verlag.

Treiman, D. J. (1977). *Occupational prestige in comparative perspective.* Academic Press, NewYork.

Van den Berg, G. (2001). Duration Models: Specification, Identification and Multiple Durations. In J. Heckman and E. Leamer (Eds.), *Handbook of Econometrics*, volume 5 , 3381–3460.

Verbakel, E. and De Graaf, P. M. (2008). Resources of the partner: Support or restriction in the occupational career? Developments in the Netherlands between 1940 and 2003. *European Sociological Review*, *24*(1), 81–95.

Weichselbaumer, D. and Winter-Ebmer, R. (2005). A meta-analysis of the international gender wage gap. *Journal of Economic Surveys*, *19*(3), 479–511.

Winter-Ebmer, R. and Zweimüller, J. (1997). Unequal assignment and unequal promotion in job ladders. *Journal of Labor Economics*, *15*(1), 43–71.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.

World Bank (2011). *World Development Report 2012: Gender Equality and Development*. Washington, DC.