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ABSTRACT

Technological Progress, Occupational Structure and Gender Gaps in the German Labour Market*

We analyze if technological progress and the corresponding change in the occupational structure have improved the relative position of women in the labour market. We show that the share of women rises most strongly in non-routine cognitive and manual occupations, but declines in routine occupations. While the share of women also rises relatively strongly in high-paying occupations, womens' individual-level wages lag behind which implies within-occupation gender wage gaps. A decomposition exercise shows that composition effects with respect to both individual and job characteristics can explain the rise of female shares in the top tier of the labour market to an extent. However, the unexplained part of the decomposition is sizeable, indicating that developments such as technological progress are relevant.

JEL Classification: J21, J31, O33

Keywords: female labour market participation, occupations, tasks, technological progress

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1. Introduction

The position of women in the labour market has been the subject of intense debate and scrutiny for a number of decades, especially in the context of the gender wage gap, but also with respect to relatively low female labour market participation. While the gender wage gap has substantially fallen over time in many industrialised countries, it is still sizeable, particularly at the top of the wage distribution (Blau and Kahn 2017); and although the labour market participation of women has increased strongly in many industrialised countries during the last decades, there is evidence for Germany that women tend to work in jobs with worse working conditions and in atypical employment (Bachmann et al. 2020). Therefore, gender equality in the labour market is still far from being realized.

Technological progress, however, could improve the labour-market situation of women. For example, decreasing demand for routine tasks and increasing demand for non-routine cognitive and social tasks has contributed positively to a reduction of the gender wage gap (Black and Spitz-Oener 2010, Yamaguchi 2018). In addition, the probability for a woman to work in non-routine cognitive and high-paying jobs has increased more than the labour supply of high-skilled women, while the probability for a man to work in such a job has decreased in the US in recent decades (Cortes et al. 2021). The increasing demand for non-routine cognitive and social tasks can be explained by their complementarity to technology. Women potentially benefit from this evolution more than men because of their comparative advantage in social tasks as found by the psychological and neuroscience literature (Greenberg et al. 2018; Chapman et al. 2006; Baron-Cohen et al. 2005).

In this paper, we analyze how changes in the occupational structure attributed to technological change have influenced the relative position of women in the German labour market in the time period 1985 to 2017. We answer three research questions. First, how has the change in occupational structure affected women differently than men? Second, how is this change in occupational structure related to wages at the occupational and at the individual level? Third, can composition effects, e.g. the increasing number of highly educated women in the labour market, provide a relevant alternative explanation for our findings on wages?

Our analysis provides evidence on both, the increasing participation of women in the top tier of the labour market due to shifts in the occupational structure caused by

technological change, and the evolution of wages at the individual level. Furthermore, we shed light on the role played by factors that are not directly related to technological progress but that have an influence on the labour market participation of women, such as the rising educational attainment of women or the increased use of part-time employment. We can therefore identify factors that contribute positively, but also factors that present barriers to the rise in female employment in the top tier of the labour market.

We contribute to the literature in two ways. First, we provide evidence on how the change in occupational structure driven by technology has affected the labour market performance of women in Germany. Up until now, only a limited number of studies has investigated the impact of technology on women in the labour market. For Germany, Back and Spitz-Oener (2010) analyse how technological change affects labour and skill demand for women relative to men. However, they exclude part-time and high-skilled workers and consider the period 1979 until 1999. By contrast, we focus on the top tier of the labour market where technological change is likely to be most beneficial for women, and we take into account part-time employees and a much longer time period, 1984-2017. Second, Cortes et al. (2021) show that changing skill requirements in the labour markets benefit women and lead to the sorting of women into high-paying occupations. Since we use individual-level data, we are able to explore if higher wages at the occupational level translate to higher wages at the individual level for women. Third, our analysis at the individual level allows us to analyse the role of the changing composition of employed women in this context.

Germany provides an interesting setting for the analysis since it is a technology frontier country in Europe, e.g. in terms of robot adoption (Dauth et al. 2021), and exhibits strong employment polarization (Bachmann et al. 2019). Between the 1980s and 1990s, polarization was even more pronounced for women than for men (Black and Spitz-Oener 2010). Furthermore, the share of women who are non-employed fell from 52% to 26% between 1985 and 2017, while the corresponding share of nonemployed men remained virtually unchanged. In our analysis, we therefore explicitly analyse composition effects since rising female labour market participation may have changed the characteristics of working women.

Our analysis is based on data from the Socio-Economic Panel (SOEP) for West Germany over the time period 1984-2017, and proceeds as follows. To analyse the

first research question, we start by investigating developments in the occupational structure related to labour market polarization. First, we provide evidence for the evolution of task groups by dividing occupations into routine, non-routine-cognitive (NRC) and non-routine manual (NRM). Second, we use the percentiles of the initial occupational wage distribution to divide occupations into high-wage and medium-/low-wage occupations, and analyse if the growing share of women in NRC occupations is correlated with a growing female share in high-paying occupations. Third, we perform a shift-share analysis to investigate the mechanisms behind the rise in female employment shares: on the one hand, a change in the occupational structure, i.e. the growth and decline of occupations, and on the other hand, a change in the task composition within occupations. To analyse the second research question, we explore if a higher share of female workers in high-paying occupations is accompanied by a corresponding increase of individual-level wages for women. to analyse the third research question, we use a Oaxaca-Blinder decomposition to explore whether composition effects, which are mainly unrelated to technological progress, can explain the increase of the female shares in the top tier of the labour market.

Our results show that the growth of the female share was indeed strongest in NRC and high-paying occupations. The shift-share analysis reveals that the overall increase in the female employment share in these occupation groups is about equally driven by a within-occupation effect and between-occupation effect. This indicates that changes in the occupational structure and in task requirements within occupations – changes potentially induced by technological progress - contribute to the increase in the female share in NRC and high-paying occupations.Our results also show that wages at the individual level do not fully reflect that women more often work in high-paying occupations. This implies significant gender wage gaps within occupations as many women apparently earn a relatively low wage, although they are working in high-paying occupations.

The decomposition exercise shows that while composition effects play a role, they cannot fully explain the increase of the female share in high-paying occupations and jobs. In our first decomposition, we analyse the shares of women in the top of the occupation- and individual-level wage distribution in total female employment. We find that higher educational attainment contributes positively to these shares , and that a higher average age contributes positively to the share of women in high-paying jobs.

In our second decomposition, we analyse the change in the female share, i.e. women relative to men, in high-paying occupations and jobs- We find that job characteristics, e.g. full-time work and work experience, are more important for composition effects than individual characteristics.

The paper is structured as follows. Section 2 summarises the relevant literature and Section 3 describes the data used. Section 4 presents the empirical analysis: first, we provide empirical evidence on the evolution of the distribution of employment with respect to task categories (NRM, NRC, routine) for women and men. Second, we examine the evolution of the female share in high-paying occupations; third, we analyse the individual-level wage distribution; and fourth, we explore the role of composition effects. Section 5 summarises the main results and concludes.

2. Literature

In this paper, we explore the link between the changing occupational structure of the labour market in the context of technological change on the one hand, and the evolution of female employment and wages on the other hand. We relate to three different literature strands that evaluate the impact of technological change on (i) labour market structures, (ii) changes in skill requirements, and (iii) the position of women in the labour market. In the following, we discuss these strands of the literature, as well as the few existing studies that examine the link between technological progress and the labour-market experience of women.

There is ample evidence on the polarization of labour markets which shows that the share of medium-skilled and medium-wage jobs has significantly declined in most industrial countries, while the share of high- and low-skilled jobs has increased (e.g. Bachmann et al. 2019 for Germany; Goos et al. 2009 for Europe; Autor et al. 2003 for the US). This development can be explained by a model of job tasks as in e.g. Autor et al. (2003). The model defines routine work as consisting of tasks that are clearly definable and that consist of a limited set of cognitive and manual activities. As these activities can be performed by following explicit rules, they can be more easily replaced by technology such as computers or robots. Therefore, technology acts as a substitute for routine jobs and as a complement for non-routine (cognitive) jobs, which explains a large part of the decreased demand for routine work and the increase in the demand for non-routine jobs.

One important implication of technological progress and labour market polarization has been a change in the importance of different types of skills and skill requirements, particularly for social skills. Evidence from the early 2000s already shows that occupations had become more complex, and that analytical and interactive tasks had gained importance since the early 1980s (Spitz-Oener 2006). This can be viewed as an important reason why the combination of specific skills, especially cognitive and social skills, has been found to be important for labour-market success (Deming and Kahn 2018; Weinberger 2014). This development is likely to be in line with a comparative advantage of women and could therefore improve their situation in the labour market.

The polarization of employment has also had an impact on wages. For the US labour market, it has been shown that wage growth was particularly strong for occupations that required a combination of cognitive analytical and cognitive interactive skills (Deming 2017). For Germany, Böhm et al. (2019) show that growing non-routine cognitive and manual occupations have seen an increase in skill prices. The effect on average occupational wages is however muted by a positive selection of occupation stayers and a lower skill level of occupation entrants and leavers.

Our study also relates to existing literature on gender gaps in the labour market. One of the main results of this literature is a substantial fall in the gender wage gap over the last few decades in many industrialised countries; the gap is however still sizeable. Data for the US suggest that this declining trend in the gender pay gap was especially strong in the 1980s but has slowed down thereafter (Blau and Kahn 2017). However, accounting for selection into the labour force, the raw and unexplained part of the gender gap declined significantly over the whole period 1980 – 2015 (Blau et al. 2021). Furthermore, there is some evidence on less convergence in the upper part of the wage distribution (Blau and Kahn 2017), since women in the upper part of the wage distribution often face a ‘glass ceiling’ (Arulampalam et al. 2007). In Germany, the gender gap has fallen from 30% to 19% for full-time employees over the last decades and is highest in the upper part of the skill distribution (Granados and Wrohlich 2018). The gap becomes smaller when accounting for education, work experience and choice of sector (Anger and Schmidt 2010; Bredtmann and Otten 2014).

Besides technological progress and labour-market polarization, other developments also played an important role for the labour-market situation of women. First, against the backdrop of a change in social norms regarding family and work, women increased their investment in formal education and acquired practical work experience leading to women entering higher-paying occupations (Fortin et al. 2015; Goldin 2006). Second, family formation significantly determines the participation gap between men and women (Olivetti and Petrongolo 2017; Fitzenberger et al. 2004 for Germany). In this context, the change in parental leave policies facilitated the return of mothers to the labour market (Kluve and Schmitz 2018; Schönberg and Ludsteck 2014; Kluve and Tamm 2013), but also innovations such as the birth control pill had a strong impact (Bailey 2006; Goldin and Katz 2002).

Third, changes in labour market institutions made part-time work and alternative work arrangements more accessible. In Germany, this is strongly related to the increase in female employment over the last decades (Bachmann et al. 2020; Fitzenberger et. al 2004). However, women working part-time often receive lower hourly wages than women working full-time (Manning and Petrongolo 2008).

The link between technological progress, the polarization of the labour market and changing skill requirements on the one hand, and the situation of women in the labour market on the other hand, has up until now only been investigated by a relatively small number of papers. Black and Spitz-Oener (2010) show that interactive and analytical tasks have become more important and routine tasks less important, and that skill requirements have changed more strongly for women than for men. These findings explain part of the decrease in the gender pay gap, and have been given different explanations. While Beaudry and Lewis (2014) stress the change in skill prices caused by PC adoption, Yamaguchi (2018) shows that a decrease in manual skill returns accounts for 40% of the narrowing of the gender wage gap.

There is some evidence on the role of shifts in the occupational structure for women's wages. Cortes et al. (2021) show that the increasing importance of social skills in high-paying occupations since the 1980s has been an important factor for the sorting of women into these occupations. Comparing the US and Portugal, Cortes et al. (2020) point out that the positive impact of the occupational structure on the gender wage gap, however, is partly muted by women's selection into occupations with more moderate wage growth. For Germany, Busch (2020) documents substantial wage gaps

between women in female- and male-type occupations and finds that women switching to male-type occupations experience stronger wage growth.

Focusing on changing sectoral patterns, Ngai and Petrongolo (2017) find for the US that structural change, and in particular the rise of the service economy, has led to a narrowing of the gender wage gap. Cerina et al. (2021) argue that the rise in low-skilled services is also driven by the entry of high-skilled women into the labour market who outsource home production to service providers.

3. Data

We use data from the German Socio-Economic Panel (SOEP) for the years 1984-2017. The SOEP is a representative annual panel survey of private households/persons in Germany (see Goebel et al. 2019 for a general data description and SOEP 2019 for details on the SOEP version used). For the analyses, we consider individuals between the age of 20 and 64. We exclude observations with missing employment status, occupation code or wage. Moreover, we drop apprentices, persons who are self-employed or who work in the army, in workshops for disabled people or in the sectors agriculture, forestry and fishery. In order to avoid structural breaks, we focus on persons working in West Germany. In addition, the labour market situation of women differs strongly between East and West Germany (Jochmann-Döll and Scheele 2020), which justifies a separate analysis. To fully capture the evolution of female employment we take into account all workers who are in full-time, part-time or marginal employment.

In order to identify occupations, we use the ISCO88 classification (International Standard Classification of Occupations) of the International Labour Organization (ILO). For the task categorization, we follow Cortes (2016) which goes back to Acemoglu and Autor (2011) on the basis of the Dictionary of Occupational Titles, and which has been applied to Germany in Bachmann et al. (2019). The occupations are divided into the categories routine, non-routine cognitive (NRC), and non-routine manual (NRM). The mapping of occupations into the task categories is exclusive and fixed over the period we analyse. Table A1 in the appendix shows how the occupations are assigned to each task category. Routine occupations consist of tasks that are easily programmable and follow a specific and limited set of rules. They include both routine cognitive and routine manual occupations as in Autor et al. (2003). NRC occupations

are those that are intellectually demanding, i.e. that require creativity and problem-solving skills. This category includes both analytical and social professions. NRM occupations are those occupations, mainly in the service sector, that are not primarily characterized by cognitively demanding tasks and manual occupations that are not very well programmable.

4. Empirical analysis

4.1. The occupational structure of employment

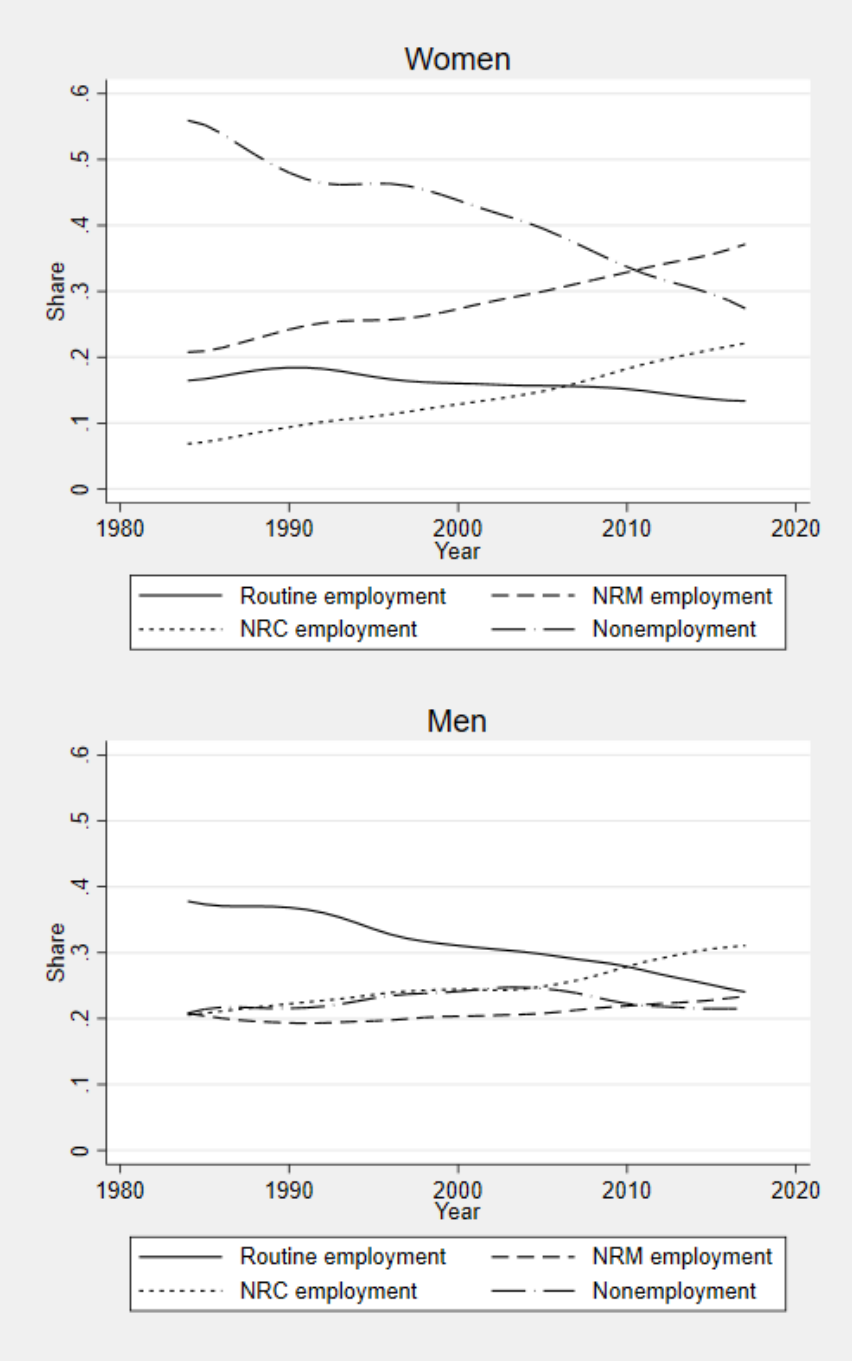
In this section, we provide stylized facts on the occupational structure of the German labour market separately for women and men. Figure 1 shows the development of the employment shares of the different task categories and non-employment for women and men separately. For women, non-employment has changed most: while more than half of all women of working age were not employed in 1984, this share falls below 30% by 2017. Furthermore, the share of NRC employment in women of working age increases strongly, as does the share of NRM employment, although from a higher initial level. Finally, we observe a small decrease in the share of routine employment in women of working age.

This stands in contrast to the evolution of male employment. First, the share of routine employment in men of working age declines strongly over time, from more than 35% to less than 25%. Second, the share of NRC employment in men of working age increases strongly, from slightly above 20% to more than 30%. Third, the share of NRM employment is relatively constant, as is the share of nonemployment amongst men. Fourth, the share of non-employed men of working age is relatively constant, fluctuating around 20%.

Overall, the picture for men is therefore consistent with employment polarization induced by technological change resulting in a de-routinsation of work and an increasing demand for NRC and NRM tasks which are not so easily substitutable by technology. For women, de-routinisation is less pronounced, mainly because routine occupations account for a much smaller employment share than is the case for men.

Figure 1

Employment task group and nonemployment shares by gender, 1984-2017



Source: SOEP v34, own calculation. – Notes: The graphs display the share of employment in task categories and nonemployment separately for working-age women and men. The shares within one graph sum up to 100%.

In order to focus more strongly on the relative position of women and men in the labour market, we compute the share of women relative to men, i.e. the female share, in the respective task and nonemployment categories. For ease of exposition, and to smooth out year effects, we compute the average shares for the first five years and the

last five years of our observation period, i.e. 1985-1989 and 2013-2017. It becomes apparent that between 1985-1989 and 2013-2017 the relative share of women in nonemployment dropped by 12.3 percentage points (pp) (Table 1). This reduction is accompanied by a disproportionate increase (14 pp) of NRC employment, and a smaller increase of the female share in NRM employment (8.3 pp).

Table 1

Female share for task categories and nonemployment, selected time periods

	1985-1989	**2013-2017**	**Difference**
Routine occupations	0.334	0.362	0.029
NRM occupations	0.538	0.621	0.083
NRC occupations	0.280	0.420	0.140
Nonemployment	0.714	0.592	-0.123

Source: SOEP v34, own calculation. – Notes: The table displays the female share in task categories and nonemployment. The female and male share in a task category add up to 100%.

The increase in the female share in NRC occupations is thus stronger than the increase in the female share in total employment and, accordingly, also stronger than the increase in routine and manual occupations. The development for NRC jobs is in line with the results of Cortes et. al (2021) who find that the share of women increased particularly strongly in NRC jobs that were characterized by a disproportionate increase in social tasks.

In order to better understand the changes in female employment by occupation, we identify the ten occupational groups at the 2-digit level in which the increase in the female share was particularly strong.[1] In order to do so, we again compute growth rates between the time periods 1985-1989 and 2013-2017.

The results in Table 2 show that six of the ten occupational groups with the highest growth rates in the female share belong to the NRC task category. Furthermore, some of these NRC occupations are characterized by having a high reputation and earnings potential as indicated by the percentile of the wage distribution. Moreover, many of these NRC occupations are intellectually challenging and require a high social competence where women often have a comparative advantage (Cortes et al. 2021). Examples are legislators and senior officials, ‘other professionals’ (the growth of this group is mainly driven by the subgroup ‘legal professionals’), teaching professionals,

[1] The results on 3-digit occupations mentioned below can be obtained from the authors upon request.

and corporate managers. These are occupations in which skills such as people management, teamwork and leadership are especially valuable.

Table 2

Top 10 occupations with the strongest increase in the female share between 1985-89 and 2013-17

Increase female share	**Task Group**	**Percentile Wage Distribution**	**ISCO code**	**Occupation title 2-digit** (main driver at 3-digit level)
35.98	NRC	70.8	11	Legislators and senior officials (Senior officials of special interest organisations)
27.38	NRC	83.3	24	Other professionals[2] (Legal professionals)
22.66	NRC	79.2	13	Managers of small enterprises (General Managers)
16.57	NRC	87.5	23	Teaching professionals (Special education teaching professionals)
14.81	NRC	91.7	12	Corporate managers (Directors and chief executives)
14.36	NRM	66.7	33	Teaching associate professionals (Special education teaching associate professionals)
11.3	NRC	100	21	Physical, mathematical and engineering science professionals (Physicits, chemists, and related professionals)
10.56	Routine	50.0	71	Extraction and building trade workers (Painters, building structure cleaners and related trade workers)
7.96	Routine	37.5	73	Precision, handcraft, printing and related trades workers (Printing and related trade workers)
7.92	NRM	62.5	34	Other associate professionals[3] (Police inspectors and detectives)

Source: SOEP v34, own calculation. – Notes: ISCO 2-digit. The percentiles of the wage distribution refer to hourly wages. "Main driver at 3-digit level" indicates the 3-digit occupation with the strongest increase in the female share within the 2-digit occupation group.

[2] 24 Other professionals: business professionals, legal professionals, archivists, librarians and related information professionals, social science and related professionals, writers and creative or performing artists, religious professionals

[3] 34 Other associate professionals: finance and sales associate professionals, business service agents and trade brokers, administrative associate professionals, customs, tax and related government associate

Finally, more than half of the top ten occupational groups typically require a university degree, pointing to the importance of increasing educational attainment. This factor is investigated in more detail in Section 4.4.

4.2. Female shares in the top tier of the labour market

The finding that the female share in total employment increased most strongly in the NRC category raises the question if this results in a stronger representation of women in high-paying occupations. The results presented in Table 2 already provide a first indication as they show that many of the NRC occupations with the strongest increase in the female share require a high degree of social competence and are located in the higher end of the wage distribution. Therefore, an increase in the female share in NRC occupations should translate into a higher share of women in high-paying occupations. This is in line with the hypothesis that the increasing demand for non-routine tasks intensive in social skills, due to its complementarity with technology, improves the relative labour market position of women.

To analyse this question in more detail, we provide evidence on how the change in the female share in an occupation is linked to the initial position of the respective occupation in the wage distribution. The analysis explicitly takes into account the size of the occupations. We calculate the change in the female share as described in Section 4.1. For the wage distribution, we use hourly wages to achieve comparability between the different contract types, i.e. workers in full-time, part-time or marginal employment. We compute the hourly wage using the information on the gross monthly wage and on working time. In addition to a variable for the weekly, contractual working time, the SOEP also contains a variable for the actual working time, i.e. the actual working time exceeding or falling short of the contractual working time. To reduce the number of missings, we calculate the hourly wage using the maximum of the two working time variables. For the initial position in the wage distribution, we use the percentile ranking of the average occupation's wage in the time period 1985 – 1989.

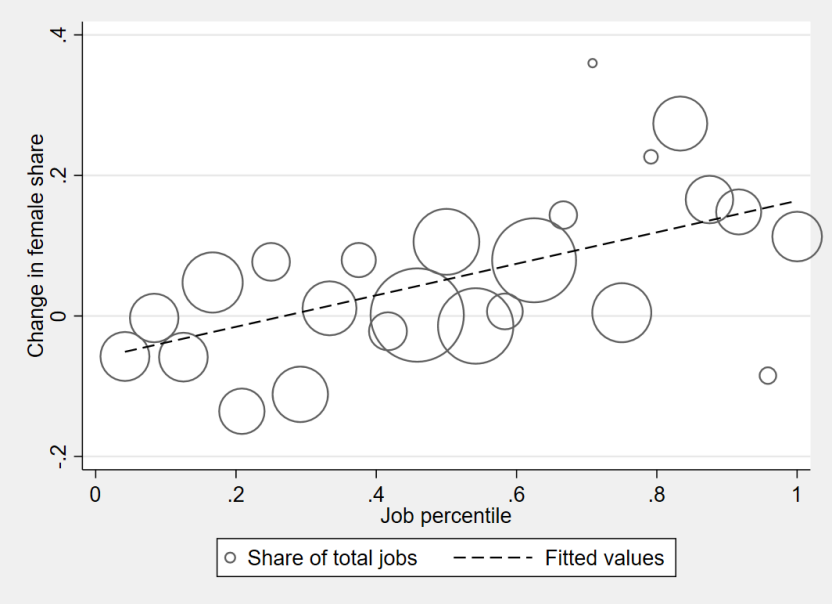
The results of this exercise are depicted in Figure 2, where the size of the bubbles in the graph reflects the proportion of the respective occupation in the total number of jobs. We can see a clear positive relationship between the percential rank and the

professionals, police inspectors and detectives, social work associate professionals, artistic, entertainment and sports associate professionals, religious associate professionals

following increase in the proportion of women in the occupation. Particularly in the highest areas of the percentile ranking, the female share has risen by between 10 and 20 pp in most occupations. At the 3-digit ISCO level, the development is similar (see appendix Figure A1).

Figure 2

Correlation between the change in the female share in an occupation and the wage ranking of the respective occupation



Source: SOEP v34, own calculation. – Notes: Analysis at ISCO 2-digit level. The size of the circles depicts the employment weight of the respective occupation in total employment.

Next, we conduct a shift-share analysis to disentangle two potential mechanisms behind the increase in the female share in NRC and high-paying occupations. On the one hand, the increase in the female share could be driven by a change in the occupational structure, with NRC occupations becoming relatively more important in the labour market. This change in the occupational structure would result in a higher female share if employment shifts towards occupations with a relatively high female share at the beginning of our observation period (between-effect). On the other hand, the female share could have increased within occupations, while the employment shares of occupations in total employment stayed relatively constant (within-effect).

For this analysis, we classify occupations into top 20% and bottom 80% occupations (at the ISCO 2-digit and 3-digit level). Therefore, occupations are ranked using the hourly wage and then classified into high-wage (top 20% occupation) and medium-/low-wage occupations (bottom 80% occupation). Comparing the

classification of occupations using the task and wage categorization shows that top 20% occupations present a subgroup of NRC occupations. At the 3-digit level, the only exception is the occupation group "Police inspectors and detectives" which belongs to the NRM group.

Our shift-share analysis decomposes the total observed difference in the female employment share over time into the two components described above (between-effect and within-effect). In this shift-share analysis, the between-effect accounts for the change in the employment share of occupations in total employment, holding the female share within occupations constant; the within-effect is driven by changes in the female share within occupations, holding the employment shares of occupations constant. The decomposition reads as follows:

$$\Delta FemaleShare = \sum_i \Delta OccShare_i * \overline{FemaleShare} + \sum_i \overline{OccShare} * \Delta FemaleShare_i \quad (1)$$

where $\Delta FemaleShare$ represents the difference in the overall female employment share in total employment between the two time periods 1985-89 and 2013-17, $\Delta OccShare_i$ denotes the change in the employment share of occupation i and $\Delta FemaleShare_i$ stands for the change in the female employment share in occupation. The bars denote the mean in the female share in occupation i and the mean in the employment share of occupation i over both time periods.

Table 3

Shift-share analysis of increase in the female employment share

	Total change (in pp)	**Within effect (in %)**	**Between effect (in %)**
NRC occupations, ISCO 2-digit	8.0	46.06	53.94
NRC occupations, ISCO 3-digit	8.0	47.52	52.49
Top 20% occupations, ISCO 2-digit	6.7	53.4	46.6
Top 20% occupations, ISCO 3-digit	5.7	58.6	41.4

Source: SOEP v34, own calculation.

Table 3 presents the results of the shift-share analysis for NRC and top 20% occupations. For NRC occupations, $FemaleShare_{it}$ measures female employment in NRC occupation i in total employment in period t and $OccShare_{it}$ is the employment share of NRC occupation i in period t in total employment. It becomes apparent that

the female share in NRC occupations at the ISCO 2-digit level (3-digit level) increased by 8.0 pp over the time period under consideration (row 1-2 row of Table 3). For NRC occupations, the within-effect accounts for 46,1% (47,5%), and the between-effect for 54,9% (52.5%). The between-effect is therefore slightly stronger than the within-effect, but both effects seem to play a relevant role for the increase in the female share in NRC occupations.

The relevance of the between-effect indicates that employment shifts towards NRC occupations with a relatively high initial female employment share. This means that the change in the occupational structure, captured by the between-effect, played an important role for the increase in the female employment share in NRC occupations. This change in occupational structure is in turn likely to be driven by technological progress leading to the de-routinisation of work and an increasing demand for non-routine cognitive occupations (see Section 4.1).

The relevance of the within-effect shows that the female employment share also inreased within NRC occupations. This increase within NRC occupations could be either evenly distributed across all NRC occupations or could be concentrated in certain NRC occupations. From the results in Table 2, the latter seems a more likely explanationas the increase in the female share is strongest in NRC occupations that require a high degree of social skills. This indicates that a change in the task structure induced by technological change, leading to a higher demand for social skills results in a comparative advantage of women in those NRC occupations.

For top 20% occupations, the female share increased by 6.7 pp at the 2-digit level and by 5.7 pp at the 3-digit level. Similarly to NRC occupations, both the within- and the between-effect play an important role for the increase in the female share in high-paying occupations, with the within-effect being slightly stronger.This result is in line with the results presented in Table 2 which show that NRC occupations with the strongest increase in the female share are not only intensive in social skills but are also located in the upper part of the wage distribution.

4.3. Occupation-level wages vs. individual-level wages

Given the general increase in the female share in NRC and top 20% occupations, this section investigates if this translates into wage gains at the individual level. Since we have established that top 20% occupations are a subgroup of NRC occupations, we will focus on top 20% occupations in the following. In addition, we introduce a

categorization based on the individual wage distribution – top 20% jobs. We compute the wage distribution of hourly wages at the worker level and assign each individual his or her percentile in the wage distribution. Again, we use this to construct a high-wage segment of the wage distribution (top 20% jobs) or the middle/bottom of the wage distribution (bottom 80% jobs) and compute the female share for each group.

The two categorizations allow us to assess whether the development with respect to wages at the occupational level and at the individual level is comparable, i.e. whether an increase of the share of women in top 20% occupations is associated with a corresponding increase of the share of women in top 20% jobs as measured by the individual wage distribution. As a robustness check, we also consider the top 10% and top 30% of the occupational- and individual-level wage distribution and obtain similar results (see Table A2-A5 in the appendix).

The development of the female share in the top 20% and bottom 80% of the occupation-level and individual-level wage over the years is relatively smooth (see appendix Figure A2). Therefore, we focus on the comparison of the two time periods 1985-89 and 2013-17 (Table 4). For the occupational wage distribution, one can see that the female share in top 20% occupations increased by 17 pp, i.e. it nearly doubled. In bottom 80% occupations, the female share increased by nearly 10 pp, leading to roughly equal female and male shares within this category. This shows that the female share increased more strongly in top 20% occupations than in bottom 80% occupations. These developments imply that increasing labour market participation of women led to relatively more women working in higher-paying occupations than in lower-paying occupations. However, the female share in top 20% occupations still only reaches 38.5%, i.e. men are still much more strongly represented in high-paying occupations.

Looking at the change in the female share for the individual-level wage categories, it becomes apparent that the strong increase of the female share in top 20% occupations is reflected in individual wage gains only to a limited extent (Table 4): on the one hand, the female share in top 20% jobs increased over time (+10.6 pp), but this is only slightly stronger than the increase in the female share in the bottom 80% jobs (+9.2 pp). On the other hand, the female share still only makes up less than 30% in the time period 2013-17. By contrast, the female share in the bottom 80% jobs rose to

53.1%, which means that there is a roughly equal share of women and men in the bottom 80% of the individual-level wage distribution.

Table 4

Female share in the top 20% and bottom 80% of the occupational and individual wage distribution

	1985-1989	2013-2017	Difference
Occupational level			
Top 20% occupations	0.215	0.385	0.170
Bottom 80% occupations	0.419	0.514	0.095
Individual level			
Top 20% jobs	0.188	0.293	0.106
Bottom 80% jobs	0.440	0.531	0.092

Source: SOEP v34, own calculation. – Notes: Occupation-level analysis at ISCO 2-digit level. The table displays the female share in wage categories. The female and male share in a wage category add up to 100%.

The pattern is similar when we focus on female employment only. Table 5 shows the change in employment shares of women in the top 20% and bottom 80% of the occupational and individual wage distribution, relative to total female employment. At the occupational level, women increased their share in top 20% occupations by 10.3 pp such that the share of female employment in top 20% occupations is close to 20% in the period 2013-17. Over the same period, female employment in bottom 80% occupations decreased by about the same amount. At the individual level, however, female employment in the top 20% increased by only 2.3 pp resulting in a female employment share of 11.9% in top 20% jobs which is significantly lower than the female employment share in top 20% occupations.

Taken together, we observe a disproportionate increase of women working in high-paying occupations. However, this increase did not fully translate into an equivalent increase in the female share in the top 20% of the individual-level wage distribution. This means that although women increasingly work in high-paying occupations, they do not experience an equivalent increase in individual wages. This implies that women earn lower wages than men within the same occupation.

Table 5

Share of women in top 20% and bottom 80% occupations/jobs in total female employment

	1985-1989	2013-2017	Difference
Occupational level			
Top 20% occupations	0.08	0.182	0.103
Bottom 80% occupations	0.92	0.812	-0.108
Individual (job) level			
Top 20% jobs	0.095	0.119	0.023
Bottom 80% jobs	0.905	0.881	-0.023

Source: SOEP v34, own calculation. – Notes: Occupation-level analysis at ISCO 2-digit level. The share of women in a wage category (occupational level/individual (job) level) add up to 100%. The wage classification at occupational level is based on the period 1985-89. Occupations with no observations in the year 1985-89 cannot be classified. Therefore, the shares at occupational level do not add up to 100% for the period 2013-2017.

4.4. The role of composition effects

While technological progress is likely to have played an important role for the change in the occupational structure and the increased presence of women in the top tier of the labour market, several other developments took place over the last decades, most notably a marked increase in the educational attainment of women (see Section 2). As a result, in more recent years there are more high-skilled women and more women with labour-market experience in the labour market, which may have contributed to the increased presence of women in high-paying occupations and in high-paying jobs. However, there are also potential obstacles which may have slowed down this increased presence, such as child-rearing responsibilities which are still predominantly performed by women. Finally, women may select into work arrangements such as part-time employment, which could have an effect on their labour-market success.

In the following, we therefore investigate the role of developments, other than technological progress, that may have contributed to the rise of the female share in the top 20% of the occupation- and individual-level wage distribution. To do so, we use a Oaxaca-Blinder type decomposition to quantify the contribution of observable characteristics for the change in these two female shares between the time periods 1985-89 and 2013-17.[4] This method allows us to dissect the difference in the two female shares between the two time periods into a part that is "explained", the

[4] This is similar in spirit to Bachmann and Sinning (2016) who decompose differences in labour market transition probabilities between economic booms and recessions.

composition effect, and a part that is "unexplained". The latter part is due to a difference in the estimated coefficients for the two time periods and can be viewed as the payoff or the penalty to the observable characteristics. In our setting, the payoff can be interpreted as the difference between the two time periods in the probability to be in a top 20% occupation or job considered for given characteristics, e.g. a given educational degree.

Using this decomposition method, we answer two research questions. First, how much of the increase in top 20% employment in total female employment can be explained by a change in characteristics of working women? Second, can the increase in the female share be explained by changing characteristics of men and women in top 20% occupations and jobs?

To answer these research questions, we decompose the employment shares displayed in Tables 4 and 5. In the first decomposition, we consider total female employment and decompose differences between women in top 20% occupations or jobs and women in bottom 80% occupations or jobs over time. The main dependent variable in the model is a binary indicator, measured at the individual level, which takes the value one if a woman works in the top 20% of the occupation- or individual-level wage distribution and the value zero if a woman works in the bottom 80%. This allows us to investigate how the characteristics of women in top 20% occupations, compared to women in bottom 80% occupations, changed over time, and how this change in characteristics contributed to the probability that women work in top 20% occupations rather than in bottom 80% occupations. We refer to this as the share of top 20% employment in total female employment. In the second decomposition, we consider women and men who work in the top 20% of the occupation- and individual-level wage distributions and decompose differences between men and women within the respective outcome category over time.

The results of the first decomposition, i.e. of the change in the share in top 20% employment in total female employment, are displayed in Table 6.[5] As discussed in Section 4.3, the raw gap in the employment shares is significantly larger at the occupational level (+ 10 pp) than at the individual level (+2.3 pp). The results of the

[5] The characteristics of women and men in top 20% (bottom 80%) occupations and top 20% (bottom 80%) jobs are presented in Table A7 in the appendix.

decomposition differ strongly for top 20% occupations and jobs. At the occupational level, the explained part accounts for only 28.2% of the increase in the share of top 20% employment in total female employment while the unexplained part accounts for 71.9% of the increase. This result indicates that a change in the characteristics of working women can only explain a small share of the increase in the share of women in top 20% occupations in total female employment.

At the individual level, the explained part accounts for more than 100% of the increase in the share in top 20% jobs in total female employment, whereas the unexplained part contributes negatively (-60.9%). As discussed in more detail below, this means that composition effects matter significantly for wages at the individual level. However, the negative contribution of the unexplained part indicates that women face barriers, potentially including discrimination, in the labour market which significantly lower their chances of working in a top 20% job.

For the explained part, which measures composition effects, rising educational attainment is the most important contributor for the share in top 20% occupations and top 20% jobs in total female employment. It accounts for around 45.3% of the increase in top 20% occupations and for even 137.4% of the increase in top 20% jobs. In addition, older women in the female workforce contribute strongly to a higher share of women in top 20% jobs, but only slightly to a higher share of women working in top 20% occupations.

Other factors contribute negatively to composition effects. This is true for the migration background, which contributes negatively for top 20% occupations (-9.0%) and top 20% jobs (-19.1%). Full-time employment (-12.1%) and experience (-4.9%) contribute negatively to the female share in top 20% occupations but are not associated with the female share in top 20% jobs. For top 20% occupations, this can be explained by the rise of part-time employment, which is negatively correlated with the probability to work in top 20% occupations.

Table 6

Decomposition of the change in the share of top 20% employment in total female employment, 1985-89 vs. 2013-17

	Top 20% Occupation Occupation-level wage distribution		**Top 20% Job** Individual-level wage distribution	
		(%)		(%)
Group: 1985-89	0.082***		0.096***	
	(0.004)		(0.004)	
Group: 2013-17	0.185***		0.120***	
	(0.004)		(0.003)	
Raw Difference	0.103***	100	0.024***	100
	(0.005)		(0.005)	
Explained		**28.1**		**160.9**
Family composition	0.001***	0.8	0.001***	4.1
	(0.000)		(0.000)	
Age	0.008***	7.9	0.010***	43.6
	(0.002)		(0.002)	
Education	0.047***	45.3	0.033***	137.4
	(0.003)		(0.002)	
Migration background	-0.009***	-9.0	-0.005***	-19.1
	(0.001)		(0.001)	
Full-time employment	-0.012***	-12.1	-0.001	-3.2
	(0.001)		(0.001)	
Experience	-0.005***	-4.9	-0.000	-1.9
	(0.001)		(0.002)	
Unexplained		**71.9**		**-60.9**
Family composition	0.010*	10.0	0.024***	100.7
	(0.006)		(0.006)	
Age	0.007*	6.8	0.003	11.3
	(0.004)		(0.005)	
Education	-0.009***	-9.2	-0.004	-17.3
	(0.003)		(0.003)	
Migration background	-0.010***	-9.7	-0.001	-5.5
	(0.002)		(0.002)	
Full-time employment	0.068***	66.3	0.048***	204.3
	(0.007)		(0.008)	
Experience	-0.053***	-51.7	-0.005	-19.8
	(0.010)		(0.012)	
Constant	0.061***	59.3	-0.079***	-334.6
	(0.017)		(0.018)	
Observations	35,217		35,336	

Source: SOEP v34, own calculation. – Notes: Results from a linear probability model. Robust standard errors are reported in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01. Family composition: number of children in the household, being married or in a registered civil partnership and cohabiting; age: 16-29, 30-54, 55-65; education: low, medium, high; experience includes both part-time and full-time work experience (in years). The categorical variables education and age are normalized for the decomposition.

The unexplained part of the decomposition contributes positively to the share of women in top 20% occupations, but negatively to the share of women in top 20% jobs. Nevetherless, the increase in payoff to full-time employment is the main positive contributor for both, top 20% occupations (+68.8%) and top 20% jobs (+198.1%). For top 20% jobs, the payoff to family composition is positive and captures the elimination of the penalty to being married and cohabiting with a partner.[6] However, the payoff to work experience has decreased and contributes negatively to top 20% occupations and jobs. Finally, the constant that captures factors not included in the decomposition contributes positively to top 20% occupations, but strongly negatively to top 20% jobs.

Taken together, these results imply that older women in the workforce are related to more women in top 20% jobs and, to a smaller extent, in top 20% occupations. Furthermore, the upskilling of women implies that more women enter top 20% occupations, as well as top 20% jobs. In addition, rising part-time employment contributes negatively in terms of composition effects to the share of women in top 20% occupations, but has no effect on top 20% jobs. However, the increasing payoff to full-time employment, i.e. the penalty to part-time employment, contributes positively for both groups. Overall, composition effects contribute more strongly to the increase in the share of women in top 20% jobs than in top 20% occupations. For top 20% occupations, the importance of the unexplained part indicates that other factors such as technological progress seem to be more relevant. In contrast, for top 20% jobs unexplained factors seem to mitigate the positive contribution of composition effects and hint towards barriers for or discrimination against women in the labour market.

The second decomposition considers the subsample of women and men who work in top 20% occupations and top 20% jobs and decomposes the change in the female share in these categories. These female shares are directly related to gender gaps in the top tier of the labour market. The raw differences in the female shares between 1985-89 and 2013-17 amount to 16.9 pp for top 20% occupations and 10.7 pp for top 20% jobs. These raw differences can mainly be attributed to composition effects, i.e. the explained part of the Oaxaca-Blinder decomposition: 57.4% for top 20% occupations and 74.4% for top 20% jobs (see appendix Table A6). This indicates that

[6] Table A8 and A9 in the appendix display the coefficients from separate regressions of the decomposition outcomes for the period 1985-89 and 2013-17.

composition effects are more important for the change in the female share in top 20% jobs than top 20% occupations. However, the unexplained part is relatively smaller for both outcomes and accounts for 42.6% for top 20% occupations and 25.6% for top 20% occupations. This shows that other developments such as technological progress have a relatively smaller contribution to the increase in the female share in top 20% employment. In addition, the negative contribution of the constant is an indication that only a change in the composition of the women working in the top tier of the labour market will not lead to gender equality in the labour market and that there are other factors that hinder the labour market success of women.

In contrast to the decomposition of top 20% occupations and jobs in total female employment, composition effects with respect to individual characteristics do not significantly contribute to the increase in the the female share, i.e. women relative to men, in top 20% occupations and jobs. The reason is that women and men in high-paying occupations and jobs are a highly selective group both in the 1980s and in the 2010s, and the composition with regard to education and age did not change significantly over time. However, composition effects with respect to occupational characteristics such as full-time employment and work experience seem to be more relevant for the female share in top 20% occupations and jobs. Although full-time employment is still less prevalent among women (<70%) than men (>90%) in top 20% employment, full-time employment decreased slightly for men while it stayed relatively constant for women (see appendix Table A7). Moreover, the increase in work experience for women, especially through work experience in part-time, contributed positively to the female share in top 20% occupations and jobs.

5. Conclusion

We analyse the change in the occupational structure of the German labour market during the last decades which were characterised by rapid technological progress and strongly increasing female employment rates. We focus on the question how this structural change is related to women's labour-market success and to the closing of the gender gap in the top tier of the labour market.

We show that since the mid-1980s, the increase in female employment occurred in NRM and especially in NRC occupations, whereas routine female employment declined. The occupations with the strongest increase in the female employment share,

such as legislators and senior officials or teaching professionals, are mainly NRC occupations requiring strong social skills. The growth of these occupations is therefore likely to be a result of technological growth raising the labour demand in NRC occupations, particularly for workers with strong social skills, which is likely to benefit women. The increase in NRC occupations also resulted in a higher share of women in the top 20% occupations of the wage distribution which is in line with results for the US (Cortes et al. 2021).

To understand potential explanations for these stylized facts, we use a shift-share analysis. We find that the increase in female employment in NRC occupations and top 20% occupations can be explained to a roughly equal extent by a within-effect, i.e. a growing proportion of women within NRC and high-paying occupations, and a between-effect, i.e. a shift of female employment towards NRC and high-paying occupations which already featured a high share of women at the beginning of the observation period. This implies that changing skill requirements, especially a higher demand for social skills, within occupations, but also the employment shift towards NRC occupations have benefitted women more than men.

While the share of women strongly increased in NRC and top 20% occupations, the share of women in the top 20% of the individual-level wage distribution increased at a lower rate. This shows that although women are increasingly represented in high-paying occupation, they do not fully participate in wage gains at the individual level. This implies significant gender gaps within occupations.

We conduct a Oaxaca-Blinder decomposition to investigate the role of developments other than technological progress, e.g. rising educational attainment. In our main specification, we decompose the change in top 20% employment within female employment. While composition effects are more important for top 20% jobs than for top 20% occupations, the negative contribution of the unexplained part for top 20% jobs indicates barriers for women in the labour market. Regarding specific explanatory variables, we find that the rising education level of female workers contributed strongly to the increase of the share of women in high-paying occupations and jobs, and that the ageing of the workforce contributed positively to a higher share of women in top 20% jobs.

In a second decomposition, we analyse the gap between women and men in high-paying occupations and jobs. It turns out that composition effects with respect to

individual characteristics play a small role for these gender gaps. The reason is that women in these top tier occupations were already a highly selected group in the mid-1980s. Instead, job-related characteristics such as part-time and full-time work and experience seem to be more relevant. Taken together, the decomposition analysis shows that composition effects cannot fully explain the increasing share of women in high-paying occupations and jobs. This is consistent with the other parts of our analysis pointing to the importance of technological progress.

Our results have important implications for our view on gender inequalities in the top tier of the labour market, and for our understanding of factors that may influence these gender inequalities, i.e. technology, composition effects with respect to individual characteristics such as education, and labour-market institutions such as part-time employment. The results on the increase of the female share in NRC and high-paying occupations can be seen as an indication that technological progress has the potential to benefit women. Our analysis of wages at the individual level, however, shows that this potential is not fully realized since the wages of women are not rising as strongly as one would expect given the increase in female employment in high-paying occupations. Therefore, potential benefits of technological progress leading to further structural change in the economy are unlikely to significantly reduce gender gaps in the labour market in the near future. Appropriate measures to reduce gender gaps should therefore stay high on the policy agenda.

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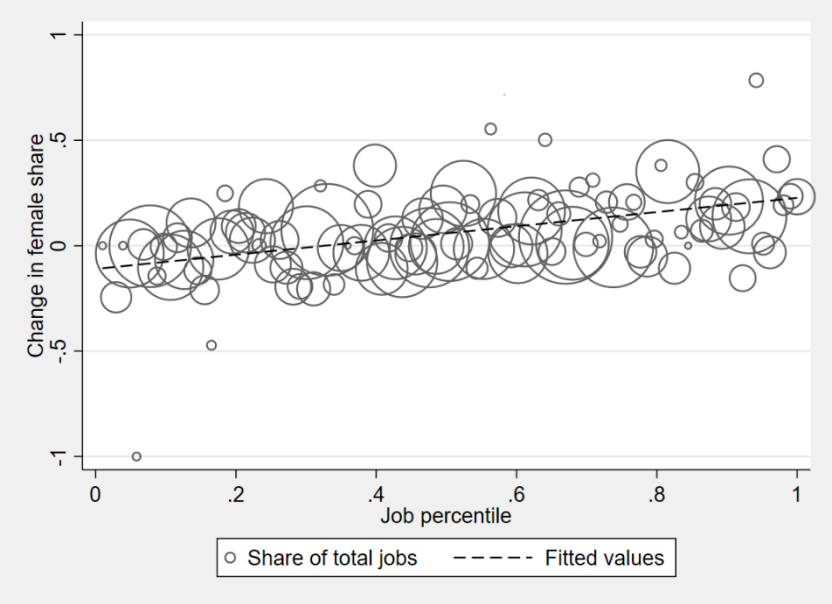
Appendix

Figure A1

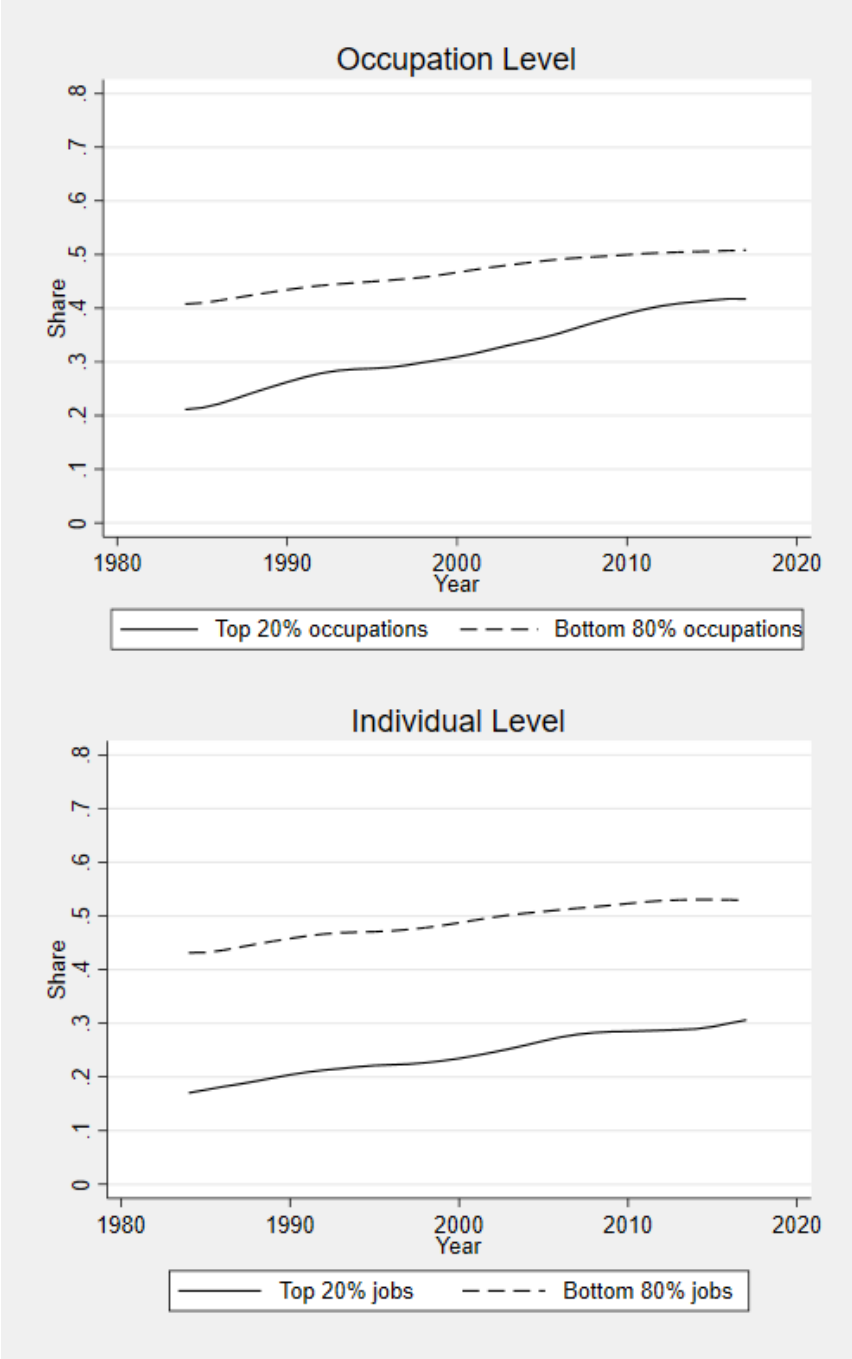
Correlation between the growth in the female share in an occupation and the wage ranking of the respective occupation



Source: SOEP 34, own calculation. - Notes: Analysis at the ISCO 3-digit level. The size of the circles depicts the employment weight of the respective occupation in total employment.

Figure A2

Female share in the top and bottom of the occupation-level and individual-level wage distributions (2-digit level)



Source: SOEP 34, own calculation. – Notes: Occupation-level analysis at ISCO 2-digit level. The table displays the female share in wage categories. The female and male share in a wage category add up to 100%.

Table A1

Mapping of ISCO groups to task categories

ISCO	Description	Task category
11	Members of legislative bodies and senior officials	NRC
12	Managing directors and divisional managers in large companies	NRC
13	Small business managers	NRC
21	Physicist, mathematician and engineers	NRC
22	Teaching professionals	NRC
23	University teachers	NRC
24	Other researchers and related professions	NRC
31	Technical experts	NRC
32	Life science and health professionals	NRC
33	Teaching associate professionals	NRM
34	Other skilled workers (medium qualification level)	NRM
41	Office clerks	Routine
42	Customer service clerks	Routine
51	Personal and protective service workers	NRM
52	Models, sales persons and demonstrators	NRM
71	Extraction and building trades workers	Routine
72	Metal, machinery, and related trades workers	Routine
73	Precision, handicraft, craft printing and related trades workers	Routine
74	Other craft and related trades workers	Routine
81	Stationary plant and related operators	Routine
82	Machine operators and assemblers	Routine
83	Drivers and mobile plant operators	NRM
91	Sales and services elementary occupations	NRM
93	Labourers in mining, construction manufacturing and transport	NRM

Table A2

Female share in the top 10% and bottom 90% of the occupational and individual wage distribution

	1985-1989	2013-2017	Difference
Occupational level			
Top 10% occupations	0.229	0.38	0.152
Bottom 90% occupations	0.405	0.5	0.095
Individual (job) level			
Top 10% jobs	0.152	0.247	0.095
Bottom 90% jobs	0.416	0.511	0.095

Source: SOEP 34, own calculation. – Notes: Occupation-level analysis at ISCO 2-digit level. The table displays the female share in wage categories. The female and male share in a wage category add up to 100%.

Table A3

Female share in the top 30% and bottom 70% of the occupational and individual wage distribution

	1985-1989	2013-2017	Difference
Occupational level			
Top 30% occupations	0.228	0.378	0.151
Bottom 70% occupations	0.432	0.533	0.101
Individual (job) level			
Top 30% jobs	0.209	0.327	0.118
Bottom 70% jobs	0.466	0.551	0.085

Source: SOEP v34, own calculation. – Notes: Occupation-level analysis at ISCO 2-digit level. The table displays the female share in wage categories. The female and male share in a wage category add up to 100%.

Table A4

Share of women in top 30% and bottom 70% occupations/jobs in total female employment

	1985-1989	2013-2017	Difference
Occupational level			
Top 10% occupations	0.05	0.103	0.052
Bottom 90% occupations	0.949	0.891	-0.058
Individual (job) level			
Top 10% jobs	0.039	0.051	0.012
Bottom 90% jobs	0.961	0.949	-0.012

Source: SOEP 34, own calculation. – Notes: Occupation-level analysis at ISCO 2-digit level. The table displays the female share in wage categories. The share of women in a wage category (occupational level/individual (job) level) add up to 100%. The wage classification at occupational level is based on the period 1985-89. Occupations with no observations in the year 1985-89 cannot be classified. Therefore, the shares at occupational level do not add up to 100% for the period 2013-2017.

Table A5

Share of women in top 30% and bottom 70% occupations/jobs in total female employment

	1985-1989	2013-2017	Difference
Occupational level			
Top 30% occupations	0.121	0.244	0.123
Bottom 70% occupations	0.879	0.751	-0.129
Individual (job) level			
Top 30% jobs	0.16	0.201	0.04
Bottom 70% jobs	0.84	0.799	-0.04

Source: SOEP v34, own calculation. – Notes: Occupation-level analysis at ISCO 2-digit level. The table displays the female share in wage categories. The share of women in a wage category (occupational level/individual (job) level) add up to 100%. The wage classification at occupational level is based on the period 1985-89. Occupations with no observations in the year 1985-89 cannot be classified. Therefore, the shares at occupational level do not add up to 100% for the period 2013-2017.

Table A6

Decomposition of the change in the female share in top 20% occupations, top 20% jobs, 1985-89 vs. 2013-17.

	Top 20% Occupation Occupation-level wage distribution		**Top 20% Job** Individual-level wage distribution	
		(%)		(%)
Group: 1985-89	0.217***		0.187***	
	(0.009)		(0.007)	
Group: 2013-17	0.386***		0.294***	
	(0.008)		(0.008)	
Raw Difference	0.169***	100	0.107***	100
	(0.012)		(0.010)	
Explained		**57.4**		**74.4**
Family composition	0.026***	15.7	0.022***	20.3
	(0.003)		(0.003)	
Age	-0.002**	-1.0	0.004*	3.5
	(0.001)		(0.002)	
Education	0.001	0.5	-0.004**	-3.3
	(0.001)		(0.001)	
Migration background	-0.004*	-2.2	-0.001	-1.4
	(0.002)		(0.002)	
Full-time employment	0.027***	16.1	0.032***	30.1
	(0.003)		(0.004)	
Experience	0.048***	28.3	0.027***	25.3
	(0.004)		(0.003)	
Unexplained		**42.6**		**25.6**
Family composition	0.073***	43.1	0.099***	92.8
	(0.019)		(0.020)	
Age	0.040***	23.5	0.039**	36.9
	(0.012)		(0.018)	
Education	0.079***	46.5	0.006	5.9
	(0.029)		(0.021)	
Migration background	-0.004	-2.5	-0.002	-1.8
	(0.003)		(0.003)	
Full-time employment	0.204***	120.9	0.243***	227.6
	(0.042)		(0.038)	
Experience	-0.160***	-94.5	-0.103***	-97.0
	(0.025)		(0.029)	
Constant	-0.160**	-94.5	-0.255***	-238.9
	(0.063)		(0.059)	
Observations	14,513		14,286	

Source: SOEP v34, own calculation. – Notes: Results from a linear probability model. Robust standard errors are reported in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01. Family composition: number of children in the household, being married; age: 16-29, 30-54, 55-65; education: low, medium, high; work experience in part-time and full-time employment (in years). The categorical variables education and age are normalized for the decomposition.

Table A7

Characteristics of women and men in Top 20% (Bottom 80%) occupations and Top 20% (Bottom 80%) Jobs

		Top 20% Occupation Occupation-level wage distribution		**Top 20% Job** Individual-level wage distribution	
		1985 -1989	2013 -2017	1985 -1989	2013 -2017
Women in Top 20% Occupations or Top 20% Jobs					
Number of children in the household		0.45	0.39	0.43	0.42
Married and cohabiting with a partner		0.49	0.46	0.55	0.56
Age Group	16-29	0.20	0.14	0.12	0.03
	30-54	0.69	0.72	0.75	0.73
	55-65	0.11	0.13	0.14	0.24
Education	Low	0.06	0.01	0.07	0.02
	Medium	0.18	0.20	0.41	0.33
	High	0.76	0.79	0.52	0.65
Migration Background		0.07	0.16	0.07	0.17
Full-time employment		0.69	0.68	0.63	0.61
Experience	Full-time	12.60	10.40	15.43	15.15
	Part-time	2.53	4.63	2.78	5.26
Women not in Top 20% Occupations or Top 20% Jobs					
Number of children in the household		0.32	0.36	0.32	0.36
Married and cohabiting with a partner		0.58	0.54	0.57	0.52
Age Group	16-29	0.33	0.15	0.34	0.16
	30-54	0.59	0.63	0.58	0.64
	55-65	0.08	0.22	0.08	0.20
Education	Low	0.27	0.11	0.27	0.10
	Medium	0.61	0.71	0.59	0.65
	High	0.12	0.18	0.14	0.25
Migration Background		0.11	0.26	0.11	0.25
Full-time employment		0.66	0.44	0.66	0.46
Experience	Full-time	10.93	11.58	10.61	10.85
	Part-time	3.73	7.25	3.72	6.97

Source: SOEP v34, own calculation.

Table A7 continued

		Top 20% Occupation Occupation-level wage distribution		Top 20% Job Individual-level wage distribution	
		1985 -1989	2013 -2017	1985 -1989	2013 -2017
Men in Top20 Jobs or in Top20					
Number of children in the household		0.64	0.50	0.62	0.51
Married and cohabiting with a partner		0.79	0.59	0.83	0.69
Age Group	16-29	0.08	0.09	0.05	0.02
	30-54	0.78	0.70	0.79	0.70
	55-65	0.14	0.21	0.16	0.28
Education	Low	0.01	0.01	0.03	0.01
	Medium	0.29	0.23	0.43	0.31
	High	0.70	0.76	0.54	0.68
Migration Background		0.05	0.17	0.07	0.17
Full-time employment		0.98	0.93	0.99	0.95
Experience	Full-time	18.46	17.25	21.35	22.00
	Part-time	0.28	1.28	0.16	0.88

Source: SOEP v34, own calculation.

Table A8

Regression results for the share of women in top 20% occupations and top 20% jobs in total female employment, 1985-89 vs. 2013-17

		Top 20% Occupations		Top 20% Jobs	
		1985-89	2013-17	1985-89	2013-17
Number of children in the household		0.019***	0.009**	0.024***	0.023***
		(0.005)	(0.004)	(0.006)	(0.004)
Married and cohabiting with a partner		-0.025***	-0.000	-0.030***	0.014*
		(0.008)	(0.007)	(0.009)	(0.007)
Age group	30-54	0.027***	0.056***	0.044***	0.061***
		(0.009)	(0.014)	(0.011)	(0.010)
	55-64	0.042**	0.045**	0.055**	0.065***
		(0.017)	(0.018)	(0.023)	(0.014)
Education	medium	0.014**	0.012*	0.061***	0.034***
		(0.006)	(0.006)	(0.007)	(0.006)
	high	0.338***	0.424***	0.269***	0.234***
		(0.015)	(0.011)	(0.015)	(0.009)
Migration background		-0.016	-0.086***	-0.024**	-0.034***
		(0.011)	(0.008)	(0.010)	(0.007)
Full-time employment		-0.008	0.105***	-0.049***	0.031***
		(0.009)	(0.008)	(0.011)	(0.008)
Experience	Full-time	0.001**	-0.003***	0.005***	0.004***
		(0.001)	(0.000)	(0.001)	(0.000)
	Part-time	-0.001	-0.002***	-0.002**	-0.000
		(0.001)	(0.001)	(0.001)	(0.001)
Constant		-0.002	0.021	-0.019	-0.086***
		(0.012)	(0.013)	(0.013)	(0.010)
Observations		8,283	26,934	8,284	27,052
R-squared		0.223	0.296	0.133	0.118

Source: SOEP v34, own calculation. – Notes: Results from a linear probability model. Robust standard errors are reported in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01. Reference group has no children, is not married or in a registered civil partnership or married and not cohabiting with partner, age between 16-29, low educated, no migration background and in part-time or marginal employment.

Table A9

Regression results for the female share in top 20% occupations and top 20% jobs, 1985-89 vs. 2013-17

		Top 20% Occupation Occupation-level wage distribution		**Top 20% Job** Individual-level wage distribution	
		1985-89	2013-17	1985-89	2013-17
Number of children in the household		0.001	-0.060***	-0.017**	-0.059***
		(0.008)	(0.008)	(0.007)	(0.008)
Married and cohabiting with a partner		-0.219***	-0.060***	-0.241***	-0.074***
		(0.025)	(0.017)	(0.022)	(0.017)
Age group	30-54	-0.141***	0.020	0.017	0.148***
		(0.038)	(0.033)	(0.038)	(0.047)
	55-64	-0.173***	-0.030	0.028	0.152***
		(0.046)	(0.040)	(0.045)	(0.052)
Education	medium	-0.281***	0.001	-0.051	-0.016
		(0.075)	(0.054)	(0.038)	(0.058)
	high	-0.231***	0.023	-0.058	-0.042
		(0.074)	(0.053)	(0.038)	(0.058)
Migration background		-0.004	-0.048**	-0.004	-0.022
		(0.032)	(0.021)	(0.024)	(0.020)
Full-time employment		-0.498***	-0.270***	-0.648***	-0.378***
		(0.040)	(0.025)	(0.032)	(0.028)
Experience	Full-time	0.002**	-0.007***	-0.001	-0.006***
		(0.001)	(0.001)	(0.001)	(0.001)
	Part-time	0.025***	0.019***	0.015***	0.018***
		(0.004)	(0.002)	(0.003)	(0.002)
Constant		1.142***	0.702***	1.029***	0.672***
		(0.090)	(0.062)	(0.060)	(0.073)
Observations		2,685	11,828	3,793	10,493
R-squared		0.286	0.198	0.354	0.266

Source: SOEP v34, own calculation. – Notes: Results from a linear probability model. Robust standard errors are reported in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01. Reference group has no children, is not married or in a registered civil partnership or married and not cohabiting with partner, age between 16-29, low educated, no migration background and in part-time or marginal employment.