Received: 29 December 2023 | Accepted: 25 September 2024

DOI: 10.1111/sjpe.12405

SPECIAL ISSUE ARTICLE

Scottish Journal of Political Economy WILEY

# Unraveling the gender wage gap: Exploring early career patterns among university graduates

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## Abstract

A large body of literature has shown that the gender wage gap is small in the first years after graduation and increases gradually with age, largely because of family decisions, often a penalty caused by childbirth. However, the gender wage gap immediately after graduation has received less attention. Using a unique dataset that links 5000 university graduates with master's degrees or equivalent from a large German university to detailed employment records from the German social security register, we specifically analyze the gender wage gap at the first job and its dynamics during the initial years of their careers after graduation. We find that a significant gender wage gap already exists in the first job after graduation, even before most young individuals make family decisions. However, this gender wage gap decreases in the first year after entering the labor market and then increases slowly over time. We attribute this initial decrease in the gender wage gap to female university graduates experiencing greater returns from firm and occupational changes than their male counterparts. This suggests that women may use these changes to address skill mismatches, which are more common among women than men in their first job.

KEYWORDS
early career, gender wage gap, university graduates

JEL CLASSIFICATION
I23, J16, J31, J71

## 1 | INTRODUCTION

Despite advances in women's education and career opportunities in recent decades, a persistent gender wage gap remains prevalent in economically advanced nations (Goldin, 2014; Olivetti & Petrongolo, 2016), this gap is even larger among individuals with higher levels of education (Blau & Kahn, 2017; OECD, 2022). Many studies have examined the gender wage gap among highly educated individuals and found that women's lower labor supply and more frequent career interruptions (mainly due to child care) compared to those of men are the main reasons for this gender wage gap.[1]

Less is known about the existence and development of a gender wage gap at the beginning of a career. This lack is surprising given the large relevance of starting wages and early career wage growth on university graduates' future labor market outcomes and potentially on the gender wage gap. For example, Oyer (2006), Kahn (2010), and Oreopoulos et al. (2012) show that labor market conditions at the beginning of the career, such as recessions, can have an impact on entry wages and, consequently, on wages in the long run. Moreover, prior wages usually determine wage increases due to promotions within the same firm (Graham et al., 2000); even wage increases as a result of a job change are usually based on previous wages (Hansen & McNichols, 2020). These findings indicate that entry wages play a crucial role in determining future wages over the long run, significantly contributing to the origin of the gender wage gap. Knowledge about the early gender wage gap is also important for developing new or adapting existing counseling policies to provide effective job search strategies and to challenge gender norms in career choices for graduates.

Whether a gender wage gap exists in the first years after graduation is theoretically ambiguous. Particularly in the first job, some common reasons for pay differences between men and women, such as family-related decisions (e.g., childbirth or marriage), career-related developments (e.g., promotions), work experience, and firm-specific networks, may not yet be relevant or less relevant than later in the career.[2] Therefore, we expect no or only a small gender wage gap in the initial job, especially when we account for gender differences in the field of study and the characteristics of the employer in the first job.

However, particularly in the first job, both the applicants and the firms face considerable uncertainty. Firms can assess only the labor market productivity of candidates without prior work experience based on their university grades and interview performance. Given that women currently tend to have higher GPAs than men (Becker et al., 2010; Francesconi & Parey, 2018), we may even expect a gender wage gap that is conditional on differences in the field of study choice and employer characteristics to favor women in the first job. On the other hand, existing studies show that female applicants negotiate less in job interviews than male applicants do (Babcock & Laschever, 2009; Bertrand, 2011) and may face statistical discrimination at labor market entry (Altonji & Pierret, 2001; Pinkston, 2006). Furthermore, differences in preferences or personality traits, such as risk aversion or overconfidence, can be particularly important at the beginning of a career. Studies show that women are more risk-averse (e.g., Cortés et al., 2023) and less self-confident than men (e.g., Adamecz-Völgyi & Shure, 2022), which may lead them to accept lower-paying job offers. As a result, the gender wage gap could be substantially in favor of men, given differences in field of study and employer characteristics at the first job.

This ambiguity about the gender wage gap may be even greater in the years after labor market entry when firms have observed the productivity of their employees or when graduates change jobs to increase their wages. If women earn less than men in their first job as a result of discrimination, this gap may narrow over time as women move to less discriminatory firms or as employers learn about employees' true productivity over time (Altonji & Pierret, 2001; Farber & Gibbons, 1996). Additionally, women may correct initial job choices

[1]For example, see Adda et al. (2017), Kuziemko et al. (2018), Kleven et al. (2019a), and Cortes and Pan (2020).

[2]The mean age of German mothers at first birth was 30.5 in 2021 (Federal Statistical Office, 2022), while the average age of labor market entry for women in our sample is 27. Moreover, the average age of women at birth is expected to increase with the level of education. Therefore, this issue is not expected to be of high magnitude in the case of women with a master's degree at labor market entry.

based on gender norms rather than preferences by changing jobs. However, the gender wage gap may also increase over time due to job changes in the early stages of a career, as the literature shows that women generally realize lower returns to job mobility than men (Albrecht et al., 2018; Topel & Ward, 1992). In addition, the gap may widen over time as family-related decisions become more important over time. Overall, the gender wage gap at labor market entry and the dynamics of the gender wage gap in the early years of a career remain unclear and thus require examination.

This study examines the gender wage gap immediately after entering the labor market and its evolution during the initial years of a career for more than 5000 university graduates with a master's degree or equivalent. We use unique administrative data on graduates of a large German university linked with detailed social security data from the Integrated Employment Biographies (IEB). This linked administrative dataset provides a wide range of information from these two data sources, including sociodemographic characteristics of the graduates, the attained university degree, field of study, the final high school and university grades, the date of enrollment, and the exact timing of graduation, labor market entry, and any occupation or firm changes.

Using these data, we first estimate the gender wage gap at labor market entry among university graduates. Our findings show that males have significantly higher wages than females in their first full-time job immediately after graduation, despite our homogeneous and highly educated sample with high labor market attachment. The estimated unadjusted gender wage gap of approximately 12.5 log points corresponds to approximately 10 euros per day or 300 euros per month. The adjusted gender wage gap is conditional on a comprehensive set of personal and pregraduation controls, including graduation year, age, non(German) citizenship status, field of study, the final university grades, having an apprenticeship degree, worked during study, and the place of the final high school examination, is equal to 6.2 log points. Including occupation fixed effects reduces the gender wage gap to 4.7 log points. Other post-graduation characteristics, such as the timing of the first job, firm fixed effects, the share of women in the firm, and the location of the firm, do not substantially alter the gender wage gap.

Second, since both career paths and wages vary widely across fields of study (Altonji et al., 2016), we conduct a subgroup analysis of four broad groups of fields of study: economics and business, mathematics and natural sciences, humanities and social sciences, and medical studies. The results show that the unadjusted (raw) gender wage gap in the first job is prominent in almost all field groups except medical studies. The raw gender wage gaps in each field group are 8.6 log points, 14.1 log points, 10.2 log points and 1.5 log points, respectively. For mathematics and natural sciences, the gender wage gap disappears after controlling for the major subject within the field of study. The adjusted gender wage gap is the highest in the humanities and social sciences, at 9.7 log points. This field group also has the lowest average daily wage in the first job, the highest variation in wages, and the highest share of females.

Third, as dynamics are very important, particularly in the early years of a career, and have an impact on future wage growth, we examine the dynamics of the gender wage gap over the first years after labor market entry. Our findings reveal a decrease in the estimated gender wage gap in the first 3 years after labor market entry, followed by an increase in subsequent years. The largest reduction in the wage gap occurs 1 year after labor market entry. Moreover, we demonstrate that this decrease is observed only among economics and business graduates and humanities and social sciences graduates who change both firms and occupations within 1 year of entering the labor market. However, this decline does not occur for graduates from other fields of study or for those who remain in the same firm and occupation.

Finally, our analysis focuses on two field groups: economics and business and humanities and social sciences. This analysis shows that women who change firms and occupations after their first job drive the decline in the gender pay gap, as women benefit more from these changes than men. Our data reveal that women are more likely than men to work in a mismatched occupation at the first job. By changing both firms and occupations, women move out of the lowest-paid occupations and are able to correct this mismatch, leading to a greater increase in wages than men. After comparing these empirical findings with several theories in the gender wage gap literature, one explanation for our finding may be that women immediately after graduation

have strong preferences for certain job and firm amenities, such as job meaning and relevance, or they follow certain gender norms about firms and occupations leading them to initially accept mismatched jobs. One year after labor market entry, individuals' preferences or willingness to follow gender norms may change, and they may correct this mismatch by changing occupation and firm. However, our data do not allow for a definitive test of this hypothesis.

Our study contributes to the literature in important ways. First, several studies examine the dynamics of the gender wage gap over the life cycle and find evidence that the gender wage gap is smaller at younger ages but increases over time, mainly due to family-related decisions (Albrecht et al., 2018; Bertrand et al., 2010; Manning & Swaffield, 2008).[3] Although these studies provide valuable insights into the dynamics of the gender wage gap in general, they do not focus on the first job after graduation. The few papers that examine the gender wage gap at the beginning of a career rely primarily on survey data. For example, Cortés et al. (2023) find in a survey of US graduates that women earn 10% less than men in their first job. In a related German study, Francesconi and Parey (2018) found an adjusted gap of 5–10 log points among German college graduates 12–18 months after graduation. In contrast to this literature, we are the only study to investigate the gender wage gap among university graduates using administrative data, with a focus on the first job after graduation.[4]

Administrative data help to avoid reporting bias that can occur in survey-based studies at the beginning of a career due to frequent job changes. Furthermore, the administrative nature of the data overcomes concerns associated with missing data, response rates, or measurement error due to retrospective questions. Most of the other data used to study the gender wage gap either lack comprehensive information on graduates' pregraduation characteristics (field of study, GPA) or are unable to track graduates as they transition into the labor market and lack information on graduates' occupation, industry, and other important employment characteristics. In contrast, our linked data provide access to accurate and comprehensive measures of human capital determinants of productivity, including academic grades and field of study, as well as detailed information on employment, wages, and occupations.

Second, our study provides unique insights into early career job dynamics and their impact on the gender wage gap. At the beginning of careers, a high level of information friction can lead to poor job matches in the labor market for recent graduates (Vesterlund, 1997). Fredriksson et al. (2018) highlight high separation rates and job changes among inexperienced employees due to limited information about the labor market. The literature shows that job changes are in general associated with wage growth but also that men are more likely to change jobs and tend to benefit more from job mobility than women, thereby exacerbating the gender wage gap over time (Albrecht et al., 2018; Del Bono & Vuri, 2011; Manning & Swaffield, 2008; Topel & Ward, 1992). However, these studies do not focus on the first years after labor market entry because observing this crucial early period where returns to job changes may be different is difficult without detailed administrative data. In contrast, we are able to follow all graduates without attrition over time, which allows us to observe the exact timing of any job changes or job search periods within the first few years after labor market entry. This information allows us to observe the share of female and male graduates from each field of study who change jobs and to observe the returns to their mobility, which may have long-lasting effects on their future labor market careers.

The remainder of this paper is structured as follows. Section 2 describes the dataset and its advantages and shortcomings, characterizes the sample of university graduates used in the analysis, and presents some descriptive statistics. The results of the estimated gender wage gap at labor market entry and the dynamics of the gender wage gap over the first few years of a career are presented in Sections 3 and 4, respectively. We examine gender differences in firm and occupational mobility in Section 5 and the underlying reasons for this mobility in Section 6 before concluding the paper in Section 7.

[3]The effect of the child penalty on females' labor market outcomes is explored in several studies, for example, Kleven et al. (2019b) and Dustmann et al. (2009).

[4]The studies by Kunze (2003, 2005) used administrative data but focused on younger graduates who had completed an apprenticeship.

# 2 | THE LINKED ADMINISTRATIVE DATASET AND UNIVERSITY GRADUATES

## 2.1 | Data

This study is based on a unique administrative dataset of graduates from a large university linked with registry data from the German Integrated Employment Biographies (IEB) of the Institute for Employment Research (IAB). The linked dataset combines detailed study information on each graduate from the university registry with information on individual employment records covering the whole employment biography of jobs subject to social security contributions from the IEB dataset.

The available dataset from the university covers all graduates of this university from 1995 until 2016. During the observation period, almost all the fields of study are considered except for engineering degrees. The data are highly reliable, as they are based on administrative records from the university registry. The dataset provides information on the personal characteristics of each graduate, such as year of birth, gender, nationality, district, and grade of the certificate of general qualification for university admission (*Abitur*), hereafter referred to as the final high school grade point average (GPA). The dataset also includes study-related characteristics at the university, such as the field of study, the type of university degree attained, the final GPA, and the dates of enrollment and graduation.

The IEB is a large administrative dataset of individuals' employment biographies provided by the IAB for the period 1975–2019. The information provided by the dataset is highly reliable, as it is a legal requirement in Germany for all employers to provide information on their employees to the German Social Security Administration. The IEB dataset includes individuals in employment covered by social security, excluding self-employed individuals and civil servants. Thus, the IEB dataset covers approximately 80% of the total labor force in Germany. In addition to the precise timing of employment and out-of-employment spells, the dataset provides information on gross daily wages, industry, occupation (three-digit), full-time status, and other employment characteristics (Dorner et al., 2010). The data from the university are merged with the IEB dataset using a linkage procedure established at the IAB based on an individual's full name, sex, and date of birth, with a 90% match rate (Möller & Rust, 2017).[5]

## 2.2 | Sample choice

The focus of this study is on individuals with a master's degree or equivalent with available university GPA data. We further focus on graduates who are working full-time in their first regular job with a daily wage of at least 10 euros[6] and we omit graduates who are not full-time employed in their first job after graduation, that is, part-time, mini-jobs, internships, working students, etc., even if they subsequently switch to full-time employment. If an individual has more than one wage spell at a given time, we choose the "main" employment spell as defined by the IAB.[7]

[5]Please see the study by Möller and Rust (2017) for a more detailed explanation of the matching procedure.
[6]Wages are deflated to the year 2010 using the consumer price index.
[7]Since information on working hours is not available in the linked dataset, we focus on full-time jobs in order to eliminate a potential bias in the gender wage gap induced by differences in working hours. Since we focus on full-time employees in our main analysis, the working hours of men and women should be reasonably comparable. However, even if employees are fairly homogeneous in terms of full-time employment, males may still work more hours than females, allowing them to earn higher wages (e.g., Goldin & Katz, 2016). The study by Francesconi and Parey (2018) documents that differences in hours worked among full-time employees do not significantly explain the gender wage gap among German graduates approximately 12 to 18 months after graduation. Therefore, we expect that our results are not driven by differences in working hours between full-time employed female and male graduates.

We focus on master's or equivalent graduates to consider the most policy-relevant group with greater labor market attachment, and the results are easier to interpret for a more homogeneous group.[8] Furthermore, returns to master's graduates expected to be higher compared to vocational training, high school education, or only a bachelor's degree (Altonji et al., 2016). In addition, master's graduates have a higher degree of attachment to the labor market and form a relatively homogeneous group, making it easier to identify factors that impact entry-level wages. They are also an ideal group to study early career gender wage gaps, as child care, a key factor in the wage gap for highly educated individuals, has less of an impact at this stage.

Furthermore, we exclude individuals who are older than 35 years (1.5% or 104 individuals). We also omit graduates with a gap of more than 15 months between graduation and their first employment spell (14% or 999 individuals), as these individuals may have spent time abroad or already worked on a self-employed basis (which is not captured by the data). Since our main analysis focuses on the first full-time job after graduation and subsequent years, we keep graduates with wage spells at the beginning of their first job and 1 year after their first job (8.6% or 478 individuals were dropped). Finally, after dropping observations with missing values, the final sample for the main wage estimations consists of 5212 individuals.

## 2.3 | Descriptive statistics

Table 1 presents descriptive statistics on labor market entry for our preferred sample of university graduates in full-time employment, which we use for the wage analysis in the following sections. While Panel A of Table 1 documents pre-graduation characteristics, such as university and high school GPA, duration of study, non-German citizenship, and others, Panel B presents post-graduation characteristics, including characteristics of the first job. Graduates' university and high school GPAs range from 1 (the best possible grade) to 4 (the lowest passing grade).

Panel A of Table 1 shows that both men and women complete their degrees in approximately five and a half years on average, although women graduate at a younger age. The majority of graduates at the university (around 70%) acquire some form of work experience before graduation, with females being more likely to work during their studies than males. In addition, consistent with the literature, the share of female graduates increases with graduation cohort, with the male–female ratio reversing even in the most recent cohort group (2007–2010). This finding is also in line with the overall population of German graduates. Consistent with the literature (see, e.g., Becker et al., 2010), female graduates enroll at the university with better final high school grades and leave the university with slightly better university grades (by around 11% of the sample standard deviation) than males.[9] Females are also more than twice as likely to graduate in the humanities and social sciences. Graduates in mathematics and natural sciences account for nearly a quarter of all male graduates, compared to only 8% of all female graduates. Nevertheless, economics and business remain the dominant fields of choice for both genders. Finally, the share of women studying medicine is approximately 10 percentage points higher than that of men. Table 1 also shows that female graduates are more likely than male graduates to earn a magister or state examination degree. The vast majority of graduates have a diploma degree, with a greater proportion of men than women.

Table C2 in the Appendix 3 compares our estimation sample with official German register data and other representative studies. For 2010, our sample shows a slightly higher proportion of women (50%) than the data from the Federal Statistical Office (46%). The share of females by field of study is also comparable. The largest difference is observed in mathematics and natural sciences. According to our data, the proportion of females in this field is 18%,

[8]Another reason for focusing on this group is that the Bologna Process reform was implemented in Germany between 2005 and 2010, and only a small proportion of graduates in the sample have a master's degree. Before the Bologna Process, bachelor's and master's degrees were combined into diploma or magister degrees.

[9]In our data, final high school grades are available only for the data beginning with the 2001 graduation cohort.

**TABLE 1** Descriptive statistics.

| | Male | | Female | | |
|---|---|---|---|---|---|
| | Mean | (Std. dev.) | Mean | (Std. dev.) | Diff. |
| Panel A: Pre-graduation and personal characteristics | | | | | |
| Final high-school grade (*Abitur*) | 2.245 | (0.616) | 2.077 | (0.594) | 0.168*** |
| Individuals | 1476 | | 1200 | | |
| Final university grade | 2.058 | (0.604) | 1.998 | (0.568) | 0.060*** |
| Non-German citizenship | 0.015 | (0.121) | 0.033 | (0.179) | −0.019*** |
| Age at graduation | 27.238 | (1.864) | 26.579 | (1.906) | 0.660*** |
| Duration of study | 5.592 | (1.308) | 5.631 | (1.372) | −0.039 |
| Apprenticeship | 0.065 | (0.247) | 0.061 | (0.239) | 0.004 |
| Worked during studies | 0.673 | (0.469) | 0.742 | (0.438) | −0.069*** |
| Origin in the same federal state as the university | 0.876 | (0.329) | 0.861 | (0.346) | 0.016 |
| Graduation year | | | | | |
| 1995–1998 | 0.283 | (0.451) | 0.156 | (0.363) | 0.127*** |
| 1999–2002 | 0.227 | (0.419) | 0.172 | (0.377) | 0.055*** |
| 2003–2006 | 0.227 | (0.419) | 0.269 | (0.443) | −0.042*** |
| 2007–2010 | 0.263 | (0.440) | 0.403 | (0.491) | −0.141*** |
| Field of study | | | | | |
| Economics and business | 0.469 | (0.499) | 0.328 | (0.469) | 0.141*** |
| Mathematics and natural sciences | 0.224 | (0.417) | 0.077 | (0.267) | 0.147*** |
| Humanities and social sciences | 0.111 | (0.314) | 0.300 | (0.458) | −0.189*** |
| Medical studies | 0.196 | (0.397) | 0.295 | (0.456) | −0.099*** |
| Type of degree | | | | | |
| Diploma | 0.747 | (0.435) | 0.576 | (0.494) | 0.172*** |
| Magister | 0.046 | (0.210) | 0.114 | (0.317) | −0.068*** |
| Master | 0.010 | (0.102) | 0.015 | (0.123) | −0.005 |
| State examination (Staatsexamen) | 0.196 | (0.397) | 0.295 | (0.456) | −0.099*** |
| Individuals | 3258 | | 1954 | | |
| Panel B: Post-graduation characteristics | | | | | |
| Left the state | 0.196 | (0.397) | 0.179 | (0.383) | 0.118 |
| Left the city | 0.683 | (0.465) | 0.655 | (0.476) | 0.028* |
| Mean job search duration | 3.747 | (3.128) | 3.817 | (3.039) | −0.070 |
| Duration of job search | | | | | |
| Less than 1 month | 0.190 | (0.392) | 0.161 | (0.368) | 0.028*** |
| 1–3 months | 0.326 | (0.469) | 0.319 | (0.466) | 0.007 |
| 3–5 months | 0.214 | (0.410) | 0.247 | (0.431) | −0.033*** |
| More than 5 months | 0.270 | (0.444) | 0.272 | (0.445) | −0.002 |

(Continues)

**TABLE 1** (Continued)

| | Male | | Female | | |
|---|---|---|---|---|---|
| | Mean | (Std. dev.) | Mean | (Std. dev.) | Diff. |
| Firm size | | | | | |
| Less than 25 employees | 0.238 | (0.426) | 0.247 | (0.432) | −0.009 |
| 25–250 employees | 0.273 | (0.445) | 0.266 | (0.442) | 0.007 |
| 250–2000 employees | 0.254 | (0.436) | 0.273 | (0.446) | −0.018 |
| More than 2000 employees | 0.235 | (0.424) | 0.214 | (0.411) | 0.020* |
| Share of women in the firm | | | | | |
| Less than 40% | 0.356 | (0.479) | 0.201 | (0.401) | 0.155*** |
| 40%–70% | 0.405 | (0.491) | 0.383 | (0.486) | 0.022 |
| More than 70% | 0.239 | (0.427) | 0.417 | (0.493) | −0.177*** |
| Individuals | 3258 | | 1954 | | |

*Note*: This table shows summary statistics of graduates' pre-graduation and post-graduation characteristics. The sample consists of graduates with a master's degree or the equivalent, who worked full-time at their first job after graduation and who have a wage spell 1 year after their first job. ***, ** and * indicate significance at the 1%, 5%, and 10% levels.

while according to the register data, it is 35%. In our sample, students have a slightly better final high school GPA than in the survey data taken from the study Simeaner et al. (2014) and university grades that are similar to those of the representative sample taken from the survey data used by Francesconi and Parey (2018). The graduates in our sample are, on average, about 5 months younger because we use examination rather than ex-matriculation dates. Notably, 11% of our students are non-German, compared to 22% in the survey data used by Francesconi and Parey (2018), as we cannot observe individuals in our data if they move to another country after graduation.

Panel B of Table 1 presents post-graduation and employment characteristics, such as mobility, the time between graduation and the first full-time job,[10] establishment size, and the share of women in the establishment of the first job.[11] The table shows that approximately 70% of the graduates find their first full-time job outside the city of the university location, with males being slightly more mobile than females. On average, female graduates take longer to find their first job than male graduates, that is, approximately 3.7 and 3.8 months, respectively. A breakdown of the duration of job searches into different categories shows that the share of male graduates with a job search duration of less than 1 month is greater. Finally, female and male graduates tend to work in establishments of similar size. However, in line with the literature, women are more likely to work in establishments with a higher proportion of female employees. A potential explanation for this situation might be the sorting of university graduates into specific industries by gender, resulting in female-dominated industries (Hellerstein et al., 2011).

## 3 | THE GENDER WAGE GAP AT LABOR MARKET ENTRY

We begin our analysis by examining gender wage differences at labor market entry.[12] To identify gender differences, we estimate the following regression equation:

$$Y_i = \alpha + \gamma Female_i + \beta X_i + \epsilon_i \quad (1)$$

[10]Hereafter referred to as "job search duration", even though this time is not necessarily spent searching for a job.
[11] The data include information only on establishments, not firms. However, in this paper, we use the terms "establishment" and "firm" interchangeably.
[12] The term labor market entry refers to the first job after university graduation; we use these terms interchangeably.

**TABLE 2** The gender wage gap at labor market entry.

| Dependent variable: Log daily wage | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Personal and pre-graduation characteristics | | | | | Additional post-graduation characteristics | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Female | −0.125 *** | −0.130 *** | −0.068 *** | −0.064 *** | −0.062 *** | −0.045 *** | −0.047 *** |
| | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.011) | (0.011) |
| Graduation year | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Personal characteristics | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Field of study FE | No | No | Yes | Yes | Yes | Yes | Yes |
| Final university grade | No | No | No | Yes | Yes | Yes | Yes |
| Pre-graduation characteristics | No | No | No | No | Yes | Yes | Yes |
| Occupation FE | No | No | No | No | No | Yes | Yes |
| Post-graduation characteristics | No | No | No | No | No | No | Yes |
| *R*-squared | 0.036 | 0.038 | 0.211 | 0.225 | 0.235 | 0.334 | 0.399 |
| Individuals | 5212 | 5212 | 5212 | 5212 | 5212 | 5212 | 5212 |

*Note*: This table shows the gender wage gap at labor market entry based on the OLS model specified in Equation (1). The sample consists of graduates with a master's degree or equivalent who work full-time at their first job after graduation and have a wage spell 1 year after their first job. The dependent variable is the log gross daily wage at the first job. The control variables are added stepwise. Column (1) shows the results with only the year of graduation as a control. Column (2) adds personal characteristics such as age and (non) German citizenship status, and Column (3) adds field of study (17 categories). Column (4) adds the final university grades and Column (5) adds pre-graduation characteristics, that is, duration of study, location of the final high school examination, a dummy for apprenticeship, and a dummy for working while studying. Column (6) adds three-digit occupation fixed effects. Column (7) shows the results after adding post-graduation characteristics, that is, job search duration, job location, one-digit industry fixed effects, firm size (7 categories), the share of women in the firm (3 categories), and the starting month of the first job. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

where $Y_i$ presents the log real daily wage at the first job. The analysis of the dynamics of the gender wage gap uses log daily wages 1–5 years after the initial job as the dependent variable. $Female_i$ is a dummy equal to one if the graduate is female. $X_i$ includes the following set of control variables: graduation year (1995–2010), personal characteristics; age and non(German) citizenship status, pre-graduation characteristics: field of study (17 categories), the final university grades, having an apprenticeship degree, worked during study (dummy), the place of the final high school examination (*Abitur*), post graduation characteristics: occupation fixed effects (three-digit), time between graduation and the first job, industry fixed effect (one-digit), region of the job, firm size, share of women in the firm and the starting month of the first job.[13] A detailed description of the control variables is provided in Table 1.

Table 2 presents the first results of our empirical analysis for the 1995–2010 graduation year cohorts. Column (1), which controls for only the year of graduation, shows a significant negative coefficient of 12.5 log points for the female dummy, which is around 13.3%.[14] This unadjusted (raw) gender wage gap indicates that female graduates earn 12.5 log points less in daily wages than their male counterparts in their first job after graduation. This gap is smaller than that in the study by Francesconi and Parey (2018), who reported a raw gender wage gap of approximately 20 log points based on survey data collected in a few selected years between 1988 and 2010, with the survey being conducted among graduates 12–18 months after graduation. This difference in the raw gender wage gap may reflect the timing of their data (they do not focus on the first job after graduation), as well as our conservative definition of the first job; that is, we have a more homogeneous group of graduates with higher labor market attachment.

While we add personal characteristics in Columns (2) and (3), we additionally control for 17 fields of study (see Table C1 in the Appendix 3 for a list of these 17 fields), which leads to a large decline in the gender wage gap to 6.8 log points (around 7%) in the first job after graduation. This striking decrease in the gender wage gap confirms the findings of previous studies (e.g., Black et al., 2008; Machin & Puhani, 2003) that female students sort into fields of study associated with lower wages.

Columns (4) and (5) show the extent to which the results change when we include final university grades and other pre-graduation characteristics (duration of study, location of high school, completion of an apprenticeship, and having worked while studying) in the regression. The estimated gender wage gap barely changes after we control for these characteristics, suggesting that neither final university grades nor other pre-graduation characteristics explain a large part of the gender wage gap.[15] Table C4 in the Appendix 3 presents additional results from an Oaxaca-Blinder decomposition. The decomposition also shows that the most important contributor to the gender wage gap among pre-graduation characteristics is the field of study, accounting for 40% of the total gender wage gap at the first job. Since the field of study explains the largest part of the gender wage gap and, therefore, explanations for the pay gap may strongly vary between fields of study, in the next section, we examine the gender wage gap within a broader set of fields of study.

In addition, Columns (6) and (7) include occupation fixed effects (at the three-digit level) and other post-graduation characteristics in the estimation. However, it is not clear whether these post-graduation variables should be included in the estimation, as they may themselves be outcomes of the variable of interest, such as choice of location or type of job (or occupation).[16] After adding occupation-fixed effects to the estimation, the gender wage gap decreases to 4.5 log points (around 4.6%), indicating that, similar to what is the case in the field of study, the occupation of the first job after graduation explains a large part of the gender wage gap. Finally, Column (7) adds all post-graduation controls, which does not reduce the gender wage gap further.

Overall, the gender pay gap remains significant at 6.2 log points for graduates in the same field of study with similar grades and other pre-graduation and personal characteristics and at 4.7 log points when we also condition

[13] Except in Table 2, the post-graduation characteristics are not added in the estimations. Only the month of the first job is added in all estimations.
[14] The exact wage difference in percent can be calculated by taking $\exp\beta_{male} - 1 \times 100$.
[15] When we add final high school grades to the estimation, the gender wage gap decreases by only 0.003 log points.
[16] Angrist and Pischke (2009) define controls that can be dependent variables as "bad controls".

on occupation and other post-graduation characteristics. These gaps are highly significant, as the unadjusted (raw) gender wage gap (12.5 log points) corresponds to 10 euros per day, or approximately 300 euros per month, signifying less pay for women than for men in their first job.[17]

*Field of study*:

Since earnings vary by field of study,[18] and we have shown that field of study is the main contributor to the gender wage gap at labor market entry, we next examine the gender wage gap across different fields of study. The results in Table 3 show that the gender wage gap is high for all fields of study, except medical studies. The raw gender wage gap (controlling only for the year of graduation) is 8.6 log points for economics and business graduates. This gap is comparable to the findings of Bertrand et al. (2010), who found a raw gender wage gap of 8.9 log points at the time of graduation for MBA graduates, and to those of Francesconi and Parey (2018), who reported a raw gender wage gap of 10.3 log points for economics and business graduates.

For the remaining fields of mathematics and natural sciences, humanities and social sciences, and medical studies, the raw gender wage gaps are 14.1 log points, 10.2 log points, and 1.5 log points, respectively. The raw gender wage gap for mathematics and natural sciences is similar to the finding of Francesconi and Parey (2018) for the STEM field. The greatest difference from the study of Francesconi and Parey (2018) is found in the field of medical studies, where we find no gender wage gap. This finding is not surprising since the wages of medical graduates (especially doctors) are set by collective bargaining agreements at the beginning of their careers; therefore, the gender wage gap is very small.

After we control for the specific field of study categories, the gender wage gap becomes insignificant for mathematics and the natural sciences. The gap is not significantly different from zero anymore because women in these fields tend to sort into lower-paid fields such as biology rather than physics. After adding controls, the largest and most significant gender wage gap is observed in those fields typically characterized by higher rates of female participation and lower earnings.

The finding that the gender wage gap is greater in fields with a greater share of females aligns with the literature on peer effects and gender norms, which suggests that a greater proportion of females in the classroom may influence females to choose lower-paid occupations (Brenøe & Zölitz, 2020) and positions with lower wage growth (Zölitz & Feld, 2018), ultimately exacerbating the gender wage gap over time. In addition, there may also be some unobserved labor market characteristics (such as labor demand and discrimination) that are more relevant for these field groups. For example, if women observe discrimination, they may not choose male-dominated fields (Blau & Kahn, 2017).

To investigate this explanation further, we employ Oaxaca-Blinder decomposition by field and find that the unexplained component of the gender wage gap is most pronounced within the humanities and social sciences field. Specifically, the unexplained part constitutes 82% and 86% of the gender wage gap for economics and business, and humanities and social sciences, respectively. The unexplained part is only 23% for mathematics and natural sciences. However, as we mentioned earlier, the unexplained part could also stem from other unobserved characteristics of the labor market that remain beyond the scope of our available data (Blau & Kahn, 2017).

## 4 | THE GENDER WAGE GAP IN THE FIRST YEARS AFTER LABOR MARKET ENTRY

After analyzing the gender wage gap at the first job, we now explore how the gender wage gap at the beginning of the career evolves during the first 5 years after labor market entry. For the analysis, we include only individuals

[17]We also estimate the same equation including all types of first jobs and document the results in Table C3 of the Appendix.
[18]Several studies demonstrate that different fields of study yield varying labor market returns, for example, Deming and Noray (2020), Kirkeboen et al. (2016), Kelly et al. (2010), and Altonji et al. (2012).

**TABLE 3** Gender wage differences at labor market entry by field of study.

| Dependent variable: Log daily wage | | | | |
|---|---|---|---|---|
| | Economics and business | Mathematics and natural sciences | Humanities and social sciences | Medical studies |
| | (1) | (2) | (3) | (4) |
| Add | | | | |
| Graduation year | −0.086 *** | −0.141 *** | −0.102 *** | −0.015 |
| | (0.018) | (0.032) | (0.030) | (0.021) |
| Personal characteristics | −0.091 *** | −0.142 *** | −0.102 *** | −0.010 |
| | (0.018) | (0.032) | (0.032) | (0.021) |
| Field of study | −0.091 *** | −0.038 | −0.124 *** | −0.030 |
| | (0.018) | (0.031) | (0.032) | (0.019) |
| Final university grade | −0.086 *** | −0.029 | −0.121 *** | −0.029 |
| | (0.018) | (0.032) | (0.032) | (0.019) |
| Pre-graduation characteristics | −0.085 *** | −0.000 | −0.123 *** | −0.033 * |
| | (0.018) | (0.031) | (0.032) | (0.019) |
| Occupation FE | −0.063 *** | −0.005 | −0.097 *** | −0.029 * |
| | (0.018) | (0.030) | (0.032) | (0.017) |
| Post-graduation characteristics | −0.060 *** | −0.018 | −0.097 *** | −0.029 * |
| | (0.017) | (0.030) | (0.032) | (0.015) |
| Share of females | 0.295 | 0.171 | 0.619 | 0.475 |
| Average daily wage (Euro) | 108.4 | 110.4 | 84.25 | 105.18 |
| Individuals | 2167 | 882 | 947 | 1216 |

*Note*: This table shows the gender wage gap at labor market entry based on the OLS model specified in Equation (1). The sample consists of graduates with a master's degree or equivalent who work in a full-time job as their first job after graduation and who have a wage spell 1 year after their first job. The control variables are added gradually. Row (1) shows the results with only the graduation year as a control. Row (2) adds personal characteristics such as age and (not) having German citizenship and Row (3) adds a detailed field of study category. Row (4) adds the final university grade and Row (5) adds pre-graduation characteristics, that is, duration of study, location of the final high-school examination, a dummy for apprenticeship, and a dummy for working while studying. Row (6) adds three-digit occupation fixed effects. Row (7) shows the results after adding post-graduation characteristics, that is, job search time, job location, one-digit industry fixed effects, firm size (7 categories), the share of women in firms (3 categories), and the beginning month of the first job. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

with high labor market attachment who are employed full-time more than 5 years after their first job. We decided to use a balanced sample to avoid individuals leaving the sample because of family decisions, which are likely to occur more often for females. We include only full-time employees because our data do not include the exact number of hours worked for part-time employees, which leads to bias in the hourly wage for part-time employees.

This restriction results in a sample size of 2280 male and 1205 female graduates, with approximately two-thirds of the graduates having high labor market attachment. The blue line in Figure 1 shows the unadjusted gender wage gap for the new sample corresponding to the specification in Column (1) of Table 2, with only the year of graduation added as a control. The red line shows the gender wage gap adjusted for pre-graduation and personal characteristics corresponding to the specification in Column (5) of Table 2.

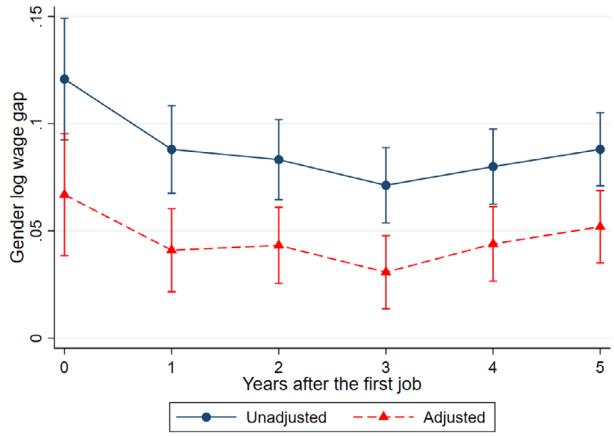


**FIGURE 1** The Dynamics of the Gender Wage Gap in the First Years After Labor Market Entry. This figure plots the gender wage gap over the first 5 years after the first job. Each year is estimated separately based on the OLS model specified in Equation (1). The sample size is 3585 (2280 males, 1205 females). The sample consists of individuals who have wage spells in a full-time job within the first 5 years after labor market entry. The dependent variable is the log gross daily wage. The unadjusted gender wage gap includes only the year of graduation as a control variable. The adjusted gender wage gap includes personal and pre-graduation characteristics as controls. The personal characteristics include age and German citizenship. The pre-graduation characteristics include duration of study, place of the final high school exam, and working while studying. All estimations include the starting month of the first job as a control.

In the first job (0 years after the first job on the *X* axis in Figure 1), the unadjusted gender wage gap is approximately 12 log points and drops to approximately 6.9 log points after additional controls are included. Although the sample is somewhat more restricted, and the adjusted wage gap is slightly greater, these gaps are consistent with the results presented in Table 2.

With regard to the evolution of the unadjusted gender wage gap over time, we observe a sharp decrease of approximately 3 log points 1 year after labor market entry, that is, from 12 to 9 log points. After this initial drop, the gender wage gap remains relatively stable over the subsequent 4 years, with a slight increase after year 3. We also observe a similar pattern for the adjusted gender wage gap, which falls by approximately 4 log points 1 year after the first job and remains relatively stable thereafter. These results are robust to focusing on an unbalanced sample of individuals with a first job spell, as documented in Figure B1 in the Appendix 2.[19]

Given that we have shown that the gender wage gap at the first job varies considerably by field of study, Figure 2 examines whether the evolution of the gender wage gap in the first 5 years of employment also shows some variation across fields of study. The path of the graphs indicates that the phenomenon of the gender wage gap narrowing 1 year after the first job concentrates on graduates in economics, business, humanities, and social sciences, the fields with the largest gender wage gap at labor market entry. Among medical graduates, the gender wage gap is small and does not change significantly over time.[20]

Until now, no other study has thoroughly investigated the development of the gender wage gap at a very early point in the career and has shown that this gap declines in the first 12 months after entering the labor market. We investigate the rationale underlying this decline in the next sections.

[19]To assess the consistency of the findings among students who received a bachelor's degree at this university, we applied the same estimations to this group. However, due to the small sample size—bachelor's degrees were introduced only after the Bologna reform in 1995—we could not obtain meaningful results.

[20]We investigated the gender wage gap at the first job and 1 year after the first job across different graduation cohorts. The fact that similar patterns were observed among each cohort suggest that the results are not driven by a single cohort.

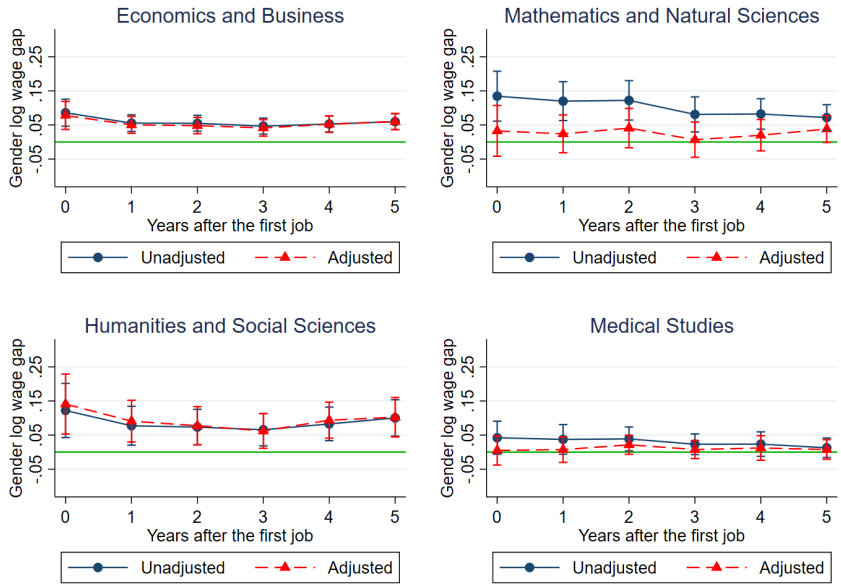


**FIGURE 2** The Dynamics of the Gender Wage Gap in the First Years After the Labor Market Entry by Field of Study. The sample sizes are 1698, 677, 541, and 624, respectively. The dependent variable is the log gross daily wage. The unadjusted gender wage gap includes only graduation year as a control variable. The adjusted gender wage gap contains personal and pre-graduation characteristics as controls. The personal characteristics include age and having German citizenship. The pre-graduation characteristics include duration of study, place of high school final exam, and working during study. All estimations include the beginning month of the first job as a control. Additionally, we control for having a child between these years.

## 5 | FIRM AND OCCUPATION MOBILITY IN THE FIRST YEAR AFTER LABOR MARKET ENTRY

After having established that the gender wage gap narrows in the first 12 months after labor market entry, we want to examine this reduction in further detail. As a starting point, we estimate the evolution of the gender wage gap 1 year after labor market entry via the following regression:

$$Y_i = \beta_0 + \beta_1 Female_i + \beta_2 1YearAfter_i + \beta_3 Female_i \cdot 1YearAfter_i + \gamma X_i + \epsilon_i. \quad (2)$$

Our outcome for Table 4 is $Y_i$, the log real daily wage of student $i$. $1YearAfter_i$ is a dummy that takes the value of 1 if it is 1 year after the first job and 0 if it is the first job. For details on the control variables ($X_i$), see section 3. Standard errors are clustered at the person level. $\beta_1$ documents the gender wage gap at the first job, $\beta_2$ captures the change in men's wages 1 year after the first job. $\beta_3$ shows the gender difference in the wage increase 1 year after the first job.

Table 4 documents the results for those fields of study with a decrease in the gender wage gap after 1 year, namely, economics, business, humanities, and social sciences (Panel A), and those without a decrease, namely, mathematics, natural sciences and medical studies (Panel B). The result in Column (1) shows that controlling for year of graduation and pre-graduation characteristics, women earn 9.8 log points less than men at labor market entry among economics and humanities graduates. Moreover, both female and male wages increase 1 year after their first job. However, female wages increase on average by 3.6 log points more than male wages. In line with Figure 2, we do not find a decrease in the gender wage gap 1 year after the first job for graduates in mathematics, natural sciences, or medical studies (Panel B).

**TABLE 4** The gender wage gap by job change status.

| Dependent variable: Log daily wage | | | | | |
|---|---|---|---|---|---|
| | Pooled | Stayers | Only firm changers | Only occupation changers | Firm and occupation changers |
| | (1) | (2) | (3) | (4) | (5) |
| Panel A: Economics, business, humanities, and social sciences | | | | | |
| 1 year after × female | 0.036 *** | −0.000 | 0.038 | 0.061 | 0.193 *** |
| | (0.012) | (0.008) | (0.063) | (0.083) | (0.070) |
| 1 year after | 0.130 *** | 0.098 *** | 0.252 *** | 0.248 *** | 0.271 *** |
| | (0.007) | (0.006) | (0.042) | (0.063) | (0.039) |
| Female | −0.098 *** | −0.056 *** | −0.156 ** | −0.139 * | −0.340 *** |
| | (0.015) | (0.014) | (0.068) | (0.074) | (0.069) |
| Share of females | 1 | 0.737 | 0.115 | 0.101 | 0.131 |
| Share of males | 1 | 0.796 | 0.091 | 0.058 | 0.105 |
| *R*-squared | 0.240 | 0.274 | 0.306 | 0.323 | 0.328 |
| Individuals | 3114 | 2407 | 267 | 194 | 312 |
| Panel B: Mathematics, natural sciences, and medical studies | | | | | |
| 1 year after × female | −0.001 | 0.006 | −0.010 | −0.140 | −0.088 |
| | (0.011) | (0.009) | (0.042) | (0.132) | (0.095) |
| 1 year after | 0.150 *** | 0.127 *** | 0.182 *** | 0.341 *** | 0.386 *** |
| | (0.008) | (0.007) | (0.031) | (0.098) | (0.054) |
| Female | −0.019 | −0.024 | 0.008 | 0.074 | 0.049 |
| | (0.016) | (0.016) | (0.034) | (0.171) | (0.096) |
| Share of females | 1 | 0.783 | 0.144 | 0.032 | 0.081 |
| Share of males | 1 | 0.838 | 0.086 | 0.037 | 0.070 |
| *R*-squared | 0.393 | 0.399 | 0.624 | 0.499 | 0.382 |
| Individuals | 2098 | 1718 | 204 | 60 | 137 |

*Note*: This table shows the gender wage gap at labor market entry by job change status based on the OLS model specified in Equation (2). The sample consists of graduates with a master's degree or equivalent who work in a full-time job as their first job after graduation and who have a wage spell 1 year after their first job. The dependent variable is the log gross daily wage at the first job. The estimations include personal and pre-graduation characteristics as controls. The personal characteristics include age and having German citizenship. The pre-graduation characteristics include duration of study, place of high school final exam, and working during studying. All estimations include the beginning month of the first job as a control. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Previous research shows that firm and/or occupational mobility affects wages and contributes to wage growth (Bartel & Borjas, 1981; Topel & Ward, 1992); mobility is especially important in the early stages of a career (Albrecht et al., 2018) and that men tend to benefit more from job mobility than women (Del Bono & Vuri, 2011; Manning & Swaffield, 2008). To analyze whether and to which extend job changes in the earliest career stage explain the drop in the gender wage gap, we continue our investigation by separating the sample into graduates who stay in the same firm and/or occupation (Column 2 of Table 4), those who change occupations but remain in the same firms (Column 3), those who change firms but remain in the same occupation

(Column 4), and those individuals who change firms and take up a new occupation (Column 5).[21] Our job move categories follow Fitzenberger et al. (2015) who analyze the returns to occupation and firm switcher in a sample of apprentices.

Panel A of Table 4, which focuses on graduates in economics, business, humanities, and social sciences, demonstrates that the gender wage gap does not decrease significantly for those individuals who either stay in the same firm and/or occupation 1 year after starting their first job (Columns 2–4). In contrast, female firms and occupation changers increase their wages on average by approximately 19 log points more than their male counterparts (Column 5). This increase must be considered in the context that males who change either firm, occupation, or both benefit from these changes by approximately 25–27 log points, while the stayers increase their wages by only 10 log points. In addition, the initial gender wage gap is larger for individuals who change firms, occupations, or both than for individuals who remain in their occupation in the same firm. The group that changes firms and occupations has the largest initial gap (almost 34 log points). Interestingly, the allocation of men and women to the four groups is relatively similar; thus, differences in shares do not seem to explain the different evolutions of the gender wage gap after 1 year.

For mathematics, natural sciences, and medical studies, we find no reduction in the gender wage gap in the first 12 months after starting the first job, and we observe no initial gap for any of the changer groups (Panel B of Table 4). However, even for these fields, the results show that movers have the highest wage growth, between 18 and 39 log points. Overall, the table shows that women in economics, business, humanities, and social science benefit more than men from a completely new start after their first job, which includes a change in firm and occupation. This new start drives the observed reduction in the gender wage gap within 1 year after the first job.

As a next step in our analysis, Figure 3 shows the dynamics of wages over 5 years after the first job for stayers and those graduates who change both occupation and firm. Confirming the results shown in Table 4, female and male movers initially earn lower wages on average than stayers. However, the wage difference between stayers and movers is greater for females than for males, due to the very low entry wages of those females who later change both occupation and firm. In summary, women with low entry wages appear to correct their low wages more than men by changing their firm and occupation within 1 year of labor market entry.

## 6 | WHY IS SWITCHING FIRM AND OCCUPATION IN THE BEGINNING OF THE CAREER MORE BENEFICIAL FOR FEMALES THAN FOR MALES?

In this section, we use our rich administrative data to investigate why women benefit more than men from changing firms and occupations after their first job after graduation. Although we are not aiming to identify causal effects for this higher female benefit, we are confident to relief some interesting patterns. We use two estimation approaches to conduct our analysis. First, we estimate whether women who change firms and occupations differ from men who change firms and occupations in terms of demographic characteristics, university outcomes, and characteristics of their first job and whether these gender differences differ from those of stayers. Second, we estimate whether firm and occupation characteristics change differently for males and females after job transitions. At the end of the section, the results of the two estimation approaches are discussed with respect to common theoretical explanations for the gender wage gap. With regard to binary outcomes, we also applied logit estimations, which yielded similar results.

Table 5 compares gender differences in personal and pre-graduation characteristics (both of which are constant over time) between firms and occupation changers and stayers. In Table 6, Panel A compares gender differences in the characteristics of the first job for individuals who change firms and occupations with those who

[21]We define an occupation change as when the three-digit occupation code changes.

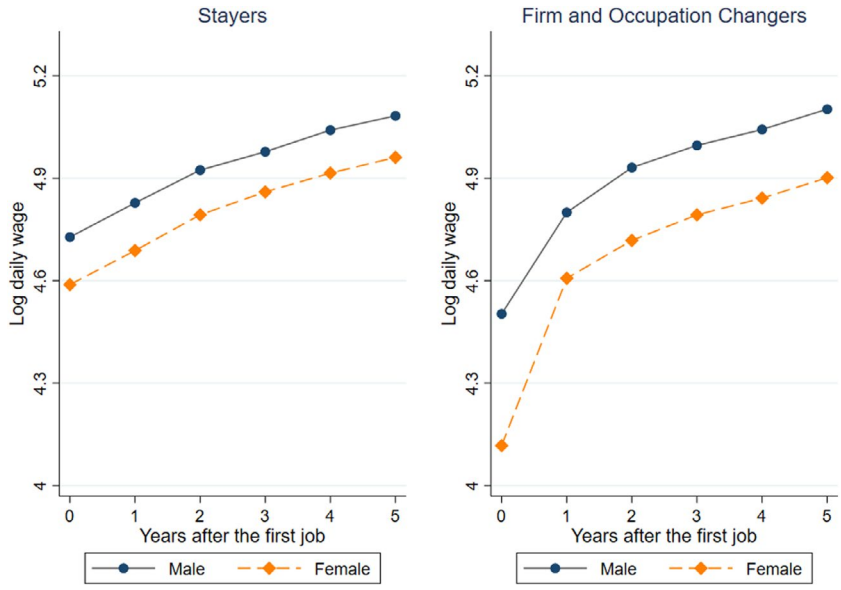


**FIGURE 3** The Dynamics of Wages for Job Stayers and Occupation and Firm Changers by Gender. These figures plot the dynamics of wages over 5 years after the first job for stayers (left panel) and for firm and occupation changers (right panel), and the sample sizes are 312, and 137 respectively. The dependent variable is the log gross daily wage. The graduation year, and personal and pre-graduation characteristics are added as controls. The personal characteristics include age and having German citizenship. The pre-graduation characteristics include duration of study, place of high school final exam, and working during study. All estimations include the beginning month of the first job as a control. Additionally, we control for having a child between the years.

stay in the same position. Panel B of Table 6 examines gender differences in the characteristics of the first and subsequent jobs 1 year later for occupation and firm changers. Table C5 in the Appendix 3 shows the mean values of all variables in Tables 5 and 6 by gender and the corresponding mean gender differences for stayers and for firm and occupation changers.

Row (1) of Table 5 reports the interaction coefficients between the female variable and a dummy for firm and occupation change. The coefficients in Row (1) indicate that none of the personal characteristics, pre-graduation characteristics, or job search characteristics exhibit greater differences between males and females who change firms and occupations than between males and females who stay in the same firm and occupation.

However, Table 6 demonstrates that out of several characteristics, job-education mismatch and occupational rank (Columns 6–11) are two characteristics that differ between males and females who switch occupations and firms in their first job and develop differently after the job change. We separate job-education mismatches into two types: horizontal and vertical mismatches. A horizontal mismatch is a field-occupation mismatch in which the employee's field of study does not match the field required for the job. A vertical mismatch is a skill mismatch where the skill level of the employee's qualification does not match the requirements of the job. Since our sample includes highly skilled university graduates, only jobs for which university graduates are overqualified are defined as vertical mismatches.[22] In addition, occupation rank is a measure that ranks occupations by their average wage (Column 9 of Table 6).[23]

[22]A large body of literature has reported that both vertical and horizontal mismatches have a negative effect on wages (Boudarbat & Montmarquette, 2009; Heijke et al., 2003; Robst, 2007; Wolbers, 2003).
[23]Average wages within three-digit occupation codes are calculated using the SIAB data, which represent 2% of the IEB data.

**TABLE 5** Personal and pre-graduation characteristics of firm and occupation changers.

| Dependent variables | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Personal characteristics | | Pre-graduation characteristics | | | | | Finding first job characteristic |
| | Age at the first job | Non-german | Duration of study | Working during studying | Apprent | Origin same state as the Uni. | Final Uni. grade | Duration of job search |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Female × firm and occupation changers | 0.058 | −0.021 | 0.226 | −0.012 | −0.019 | −0.031 | 0.071 | −0.342 |
| | (0.269) | (0.017) | (0.171) | (0.053) | (0.037) | (0.041) | (0.073) | (0.366) |
| Firm and occupation changers | 0.444 *** | 0.003 | 0.063 | 0.002 | 0.054 ** | 0.021 | 0.026 | −0.035 |
| | (0.156) | (0.010) | (0.096) | (0.037) | (0.026) | (0.027) | (0.045) | (0.246) |
| Female | −0.803 *** | 0.026 *** | −0.053 | 0.126 *** | −0.010 | 0.034 ** | −0.206 *** | 0.141 |
| | (0.082) | (0.007) | (0.053) | (0.018) | (0.010) | (0.014) | (0.023) | (0.131) |
| Means of dependent variable | 27.309 | 0.023 | 5.515 | 0.719 | 0.074 | 0.858 | 2.115 | 3.859 |
| *R*-squared | 0.042 | 0.006 | 0.003 | 0.018 | 0.004 | 0.002 | 0.030 | 0.001 |
| Individuals | 2719 | 2719 | 2719 | 2719 | 2719 | 2719 | 2719 | 2719 |

*Note*: The table documents gender differences in personal, pre-graduation, and first-job characteristics, between firms and occupation changers and stayers. The sample size is 2719, including stayers (Column 2, Table 4) and firm and occupation changers (Column 5, Table 4). Each Column is a different estimation that is time invariant. We use the following estimation equation,

$$Y_i = \beta_0 + \beta_1 Female_i + \beta_2 JobChangers_i + \beta_3 Female_i \cdot JobChangers_i + \gamma gradyear_i + \varepsilon_i, \quad (4)$$

where the dependent variable changes in each column. The estimations include a female dummy, a dummy variable for firm and occupation changer dummy ($JobChangers_i$) (=1 if an individual changes her or his firm and occupation within 1 year after labor market entry, =0 if an individual stays at the same firm and occupation), and an interaction of these dummies. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

**TABLE 6** Job characteristics of firm and occupation changers.

| Dependent variables | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Median daily Log wage of full-time employees | Share of Part-time employees | Share of High qualified employees | Share of Women in a firm | Log Firm size | Horizontal Mismatch | Vertical Mismatch | Horizontal or Vertical mismatch | Occupation Rank | Occupation Rank < quantile 10 | Occupation Rank > quantile 90 |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| Panel A: First job characteristics of firm and occupation changers | | | | | | | | | | | |
| Female × firm and occupation changers | −0.086 * | −0.059 | −0.013 | 0.044 | −0.204 | 0.008 | 0.117 ** | 0.070 | −22.371 * | 0.098 ** | −0.025 |
| | (0.049) | (0.041) | (0.032) | (0.027) | (0.252) | (0.056) | (0.058) | (0.053) | (11.815) | (0.044) | (0.034) |
| Firm and occupation changers | −0.120 *** | −0.007 | −0.063 *** | −0.006 | −0.341 ** | 0.119 *** | 0.122 *** | 0.150 *** | −7.680 | 0.017 | −0.002 |
| | (0.028) | (0.032) | (0.021) | (0.017) | (0.166) | (0.035) | (0.039) | (0.037) | (7.488) | (0.024) | (0.026) |
| Female | −0.041 *** | −0.034 ** | −0.016 | 0.071 *** | −0.102 | 0.122 *** | 0.005 | 0.051 ** | −15.238 *** | 0.013 | −0.036 *** |
| | (0.014) | (0.016) | (0.011) | (0.009) | (0.090) | (0.017) | (0.021) | (0.021) | (3.602) | (0.012) | (0.013) |
| Mean of dependent variables | 4.617 | 0.220 | 0.372 | 0.482 | 5.099 | 0.219 | 0.506 | 0.594 | 226.031 | 0.104 | 0.104 |
| *R*-squared | 0.029 | 0.003 | 0.009 | 0.035 | 0.005 | 0.032 | 0.014 | 0.018 | 0.016 | 0.009 | 0.004 |
| Individuals | 2719 | 2719 | 2719 | 2719 | 2719 | 2719 | 2719 | 2719 | 2719 | 2719 | 2719 |
| Panel B: Jobs characteristics before and after the job change within firm and occupation changers | | | | | | | | | | | |
| Female × year after | 0.046 | 0.103 * | 0.011 | −0.007 | −20.260 | −0.060 | −0.131 * | −0.153 ** | 21.816 | −0.115 ** | −0.035 |
| | (0.053) | (0.054) | (0.036) | (0.032) | (483.871) | (0.048) | (0.079) | (0.071) | (14.263) | (0.049) | (0.049) |
| 1 year after | 0.123 *** | −0.030 | 0.033 | −0.022 | 377.790 | −0.028 | 0.006 | 0.028 | 13.199 | −0.040 | 0.057 |
| | (0.031) | (0.039) | (0.024) | (0.020) | (364.812) | (0.034) | (0.055) | (0.049) | (9.661) | (0.030) | (0.040) |
| Female | −0.161 *** | −0.048 | −0.051 * | 0.119 *** | −488.739 ** | 0.127 ** | 0.139 ** | 0.122 ** | −38.079 *** | 0.102 ** | −0.061 * |
| | (0.047) | (0.040) | (0.030) | (0.027) | (235.755) | (0.055) | (0.055) | (0.050) | (11.476) | (0.044) | (0.033) |

(Continues)

TABLE 6 (Continued)

| Dependent variables | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Median daily Log wage of full-time employees | Share of Part-time employees | Share of High qualified employees | Share of Women in a firm | Log Firm size | Horizontal Mismatch | Vertical Mismatch | Horizontal or Vertical mismatch | Occupation Rank | Occupation Rank < quantile 10 | Occupation Rank > quantile 90 |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| Means of dependent | 4.558 | 0.203 | 0.338 | 0.484 | 4.829 | 0.296 | 0.619 | 0.721 | 223.341 | 0.128 | 0.114 |
| *R*-squared | 0.113 | 0.039 | 0.059 | 0.085 | 0.035 | 0.065 | 0.060 | 0.044 | 0.054 | 0.047 | 0.053 |
| Individuals | 312 | 312 | 312 | 312 | 312 | 312 | 312 | 312 | 312 | 312 | 312 |

*Note*: Panel A documents the gender differences in the first job characteristics between firm and occupation changers and stayers based on the OLS model specified in Equation (4) The sample size is 2719, including stayers (Column 2, Table 4) and firm and occupation changers (Column 5, Table 4). Panel B uses firm and occupation characteristics as dependent variables, which are time-variant; that is, they may vary before and after the job change. This is similar to the OLS model specified in Equation (2), however, here the focus is only on firm and occupation changers, and the time-variant dependent variables are different in each column. In addition, we control only for graduation year. The sample size is 312 and includes only firm and occupation changers (Column 5, Table 4). The estimations include a female dummy, a dummy variable for 1 year after the job change (=0 for the first job, =1 for the new job 1 year after the first job) and an interaction of these dummies. Robust standard errors in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Specifically, Columns (6) and (7), Panel B of Table 6 show that female job changers are more likely than male job changers to work in horizontally (by 12.7 percentage points) and vertically (by 13.9 percentage points) mismatched first jobs after graduation. However, compared with males, female job changers reduce the frequency of vertical mismatch 1 year after the first job by 13.1 percentage points.

After correcting the vertical mismatch, one might expect women to receive a higher wage as soon as they correct their mismatch. Although Column (9), Panel B of Table 6 shows that female job changers work in lower-ranked occupations in their first job after graduation, they do not move to (significantly) higher-paid occupations on average compared to men (Row 1, Column 9, Panel B).

However, Figure B2 in the Appendix 2 shows that the occupational rank distributions of male and female job changers are quite different at the first job, as females are less likely to work in higher-paid occupations and more likely to work in lower-paid occupations than males are. After the job change, the distributions of males and females converge, especially in the lower tail, as females predominantly move from lower-paid occupations to higher-paid occupations. In line with the convergence in the lower tail, Panel B, Column (10) of Table 6 shows that after a firm and occupation change, women reduce the probability of being in the bottom decile of ranked occupations relative to men by 11.5 percentage points.

Overall, the results of Tables 5 and 6 demonstrate that females are more likely than males to start in an occupation that is in the bottom tail of the occupation rank distribution and change to higher-paid occupations if they switch both occupation and firm. Moreover, they start in occupations in which they are overqualified and correct this vertical mismatch by changing both occupation and firm. As our data show that correcting the vertical mismatch at the first job explains the decrease in the gender wage gap, the question arises as to why women need to change both firms and occupations to correct the mismatch. We now test common hypotheses in the gender wage gap literature that may explain our findings.

*Different types of discrimination*:

A first potential explanation for the decline in vertical mismatch and the gender wage gap within 1 year after the first job is that firms discriminate against women at the hiring stage, when employers do not have sufficient information about the productivity of new hires (Altonji & Blank, 1999). As a first type of discrimination, namely, "screening discrimination", Pinkston (2003) documents that the productivity signals that employers receive from females are noisier than from males. Therefore, productivity signals at the hiring stage have a smaller or no effect on women's wages, while they have a larger effect on men's wages. In our case of university graduates, since the employer is able to observe the curricula vitae of the applicants, the final university grades may comprise the only signal for the employer. We would expect men with higher grades to not change jobs because they already have a good match in their first job. In contrast, women with higher grades may experience a mismatch compared to their male counterparts at the beginning of their careers and thus change jobs to correct the mismatch. However, our results show that female movers and stayers have better grades on average than their male counterparts do, and both female and male movers have worse grades than stayers. Nevertheless, the difference in the gender gap between movers and stayers is insignificant, as the interaction term is insignificant (Column 7, Table 5).

The literature on the gender wage gap suggests that females may face statistical discrimination in the labor market. Accordingly, employers may expect lower productivity from females and hire them for less suitable jobs. Consequently, conditional on being hired, females work in more mismatched jobs and receive lower initial wages at the beginning of their careers. However, over time, as employers learn about the actual productivity of new hires ("employer learning"), such mismatches could be corrected, resulting in higher wages for women (Altonji & Blank, 1999; Altonji & Pierret, 2001; Pinkston, 2003). If females face statistical discrimination, we would expect the gender wage gap to likely narrow not only for those who change firms and occupations but also for stayers. Since we do not find a significant reduction in the gender wage gap for stayers, statistical discrimination is unlikely to explain the differential returns to changing occupations and firms.

Another form of discrimination suggested by the literature is taste-based discrimination, where employers pay women lower wages to compensate for their (or their coworkers') disutility.[24] The greater mismatch and lower initial wage of female movers relative to male movers (Table 6) may indicate some form of taste-based discrimination (Becker, 1971). However, if firms discriminate against women, switching to nondiscriminatory firms should be sufficient for women to improve their wages relative to those of men, while an additional change in occupation should not be necessary. As Table 4 shows, this is not the case, as the gender wage gap does not narrow significantly for those who change only firms. Furthermore, if taste-based discrimination explains the gender wage gap, we should observe that women who change firms will move to firms with more women, as these firms typically discriminate less. Contrary to this hypothesis, women who change their firm and occupation are more likely to work in firms with a greater share of women in their first job (Panel A of Table 6). Moreover, our estimation results show that women do not switch to firms with a greater female share than men (Column 4, Panel B of Table 6).

*Risk aversion, confidence and job searching time*:

The literature shows that risk aversion and (over)confidence may be an important component of early career job search, with women typically having higher levels of risk aversion (Cortés et al., 2023; Niederle & Vesterlund, 2007) and lower levels of (over)confidence compared to men (Adamecz-Völgyi & Shure, 2022). More risk-averse and less self-confident women may have lower reservation wages at the beginning of their careers (Acemoglu & Shimer, 1999; Cox & Oaxaca, 1992; Feinberg, 1977; Pannenberg, 2010; Pissarides, 1974) and thus accept job offers earlier, even if the job pays less and is not a good match (Cortés et al., 2023). However, these women may not be satisfied with lower wages and mismatches and change jobs when they find a higher-paid and better match job. In this case, we would expect women to spend less time searching for a job after graduation than men would, and women who find a job more quickly would be more likely to change jobs. Column (8) of Table 5 shows that although job changers find their first job slightly earlier than stayers, there is no significant gender difference in job search duration for stayers and job changers in the fields of economics, business, humanities and social sciences. In addition, wages do not decrease significantly with the duration of the job search.

*Job amenities and gender norms*:

As an alternative explanation, a growing body of literature has reported that women prefer nonwage job amenities such as flexibility or meaning, relevance, or responsibility for the occupation more than men, who have a greater preference for wages (Brenøe & Zölitz, 2020; Flabbi & Moro, 2012; Goldin, 2014; Goldin & Katz, 2011) Additionally, women may follow gender norms when they make their initial career decisions. Changing preferences for certain job attributes or shifting away from gender norms may also be a mechanism for job change. On the one hand, females may change to more flexible jobs in anticipation of having children in the future. However, these changes may not lead to higher wage gains. On the other hand, at the beginning of their careers, women may prefer lower-paying jobs with a vertical mismatch to compensate for some job amenities and to respond to certain gender norms; however, over time, they change their preferences and switch to higher-paying and less flexible jobs.

Based on the assumption that larger firms offer more flexible work arrangements (Albrecht et al., 2018), we test whether women switch to smaller firms. We do not find that females are more likely than men to sort into larger or smaller firms as a result of a job change (Column 5, Table 6). However, our data do not cover other proxies for job amenities, such as the meaning of jobs, schedule adaptability, or telecommuting (De Schouwer & Kesternich, 2022) or whether a job fulfills gender norms. Therefore, we believe that changing preferences for job amenities or shifts away from gender norms may still be important explanations for why women reduce their vertical mismatches and increase their wages when they switch firms and occupations.

Overall, this section reveals that women tend to make less optimal decisions than men when they make choices regarding their first job after graduation, leading to mismatches. Women attempt to correct such mismatches by switching firms and occupations. However, since they cannot fully close the initial wage gap through these changes, the results suggest that women should aim to make more informed choices for their first job to avoid the

[24] Becker (1964) shows in the model that firms practicing taste-based discrimination cannot survive in the competitive market in the long run.

need for later corrections. Enhanced counseling programs could provide the information necessary to help women make better initial job choices.

## 7 | CONCLUSION

Although many studies have investigated the gender wage gap, the existence and potential explanations for early career gender wage differences remain unclear. This paper analyses the gender wage gap among graduates of a German university with a master's degree or equivalent at the beginning of their careers and over the first years after their labor market entry. We rely on a unique dataset that links administrative data on graduates of a German university with employment registers of the German social security system. This dataset includes extensive information on students' sociodemographic characteristics, educational and labor market outcomes, as well as the exact timing of graduation, labor market entry, and any job changes.

We find a significant gender wage gap among university graduates in their first job, which persists even after we include an extensive set of controls. The largest gender wage gap is observed among humanities and social sciences graduates, where the share of females is highest and the average daily wage is lowest. We find no significant gender differences in the wages of mathematics, natural sciences, or medical graduates in their first job after graduation. Moreover, in contrast to previous studies, we find an immediate decrease in the gender wage gap 1 year after labor market entry, which remains relatively stable thereafter.

Further analysis shows that the decline in the gender wage gap is concentrated among individuals who change firms and occupations after their first job with a degree in economics, business, humanities, or social sciences. To explain this decrease in the gender wage gap, we also show that female graduates are more likely to start their careers in jobs for which they are overqualified and subsequently correct this skill mismatch, leading to an increase in wages. Correcting this mismatch is costly for females, which may be an additional explanation for the wage gap that emerges later in their careers.

Universities have an important opportunity to mitigate the risk of future skill mismatches by implementing counseling interventions. These interventions can provide valuable information on effective job search strategies that can overcome gender norms in career choice, and potential wage losses resulting from skill mismatches, particularly for female students. Our study also highlights significant differences in labor market entry and early career paths depending on the chosen field of study. For this reason, counseling programs that help students understand their career prospects should be tailored specifically to each field of study. By implementing such counseling, universities can provide graduates with the insight they need to navigate the dynamic labor market successfully.

### ACKNOWLEDGEMENTS

We are thankful for valuable comments from Silke Anger, Alex Bryson, Bernd Fitzenberger, Astrid Kunze, Markus Nagler, Uta Schönberg, Nikki Shure, David Wilkinson, and all participants at the Annual LERN Conference 2019, ESPE 2019, AASLE 2019, Workshop on Labour Economics 2021, Research Seminar at the TH Nürnberg, International Conference on The German Labor Market in a Globalized World (ZEW) 2022. Additionally, we are grateful to Joachim Möller and Christopher Rust for support.

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**How to cite this article:** Sandner, M. & Yükselen, I. (2025) Unraveling the gender wage gap: Exploring early career patterns among university graduates. *Scottish Journal of Political Economy*, 72, e12405. Available from: https://doi.org/10.1111/sjpe.12405

## APPENDIX 1

### Data and additional descriptive statistics

This section describes all the data preparation steps taken before the main analysis. If there are multiple contemporaneous employment spells for an individual, we use the main employment spell and exclude the remaining employment spells. The main employment spell as defined by the IAB is the spell with the longest job duration and the highest daily wage. Furthermore, to eliminate errors in daily wages for full-time employees, we follow the literature and exclude daily wages less than 10 euros from the main sample (Bruns, 2019; Dustmann et al., 2009).

One issue to consider is that wages in the IEB dataset are only reported up to the social contribution threshold, as the information on wages is obtained from the German social security report. Thus, wages above the social contribution limit are right-censored. However, since we analyze the gender wage gap at the beginning of the career, there are few censored wages in our restricted sample; censored wages account for only 1.3% for the first job and approximately 4.7% a year after the first job, with a small increase in subsequent years after graduation.

Moreover, working hours are not recorded in the IEB dataset, as only information about whether a person works full-time or part-time (working more or less than 30 h per week) is available. For this reason, we focus only on graduates who have a full-time job in their first job after graduation. An individual is considered a full-time employee if he or she works more than 35 h per week.

We include occupational categories using three-digit occupational codes (KldB 1988) in the estimations. Since the occupational structure has changed over time, the Federal Employment Agency introduced a new classification (KldB 2010) in 2011 that better fits the current German occupational structure. Since the new classification is more detailed (five-digit) than the old one, there is a significant increase in missing values in the occupation variable in 2011 (Antoni et al., 2016). To address this issue, we fill in the missing values in 2011 by keeping the last occupation spell before the change in occupational classification and replacing it with the next missing spells if the place of residence and work, industry code and establishment ID did not change. Following this procedure, the number of missing values in the occupation code decreases significantly for 2011.

Finally, childbirths are not directly observed in our linked data. However, we can identify family-related interruptions in employment based on the IEB data by applying a reliable approach developed by Müller and Strauch (2017). This method allows us to identify the timing of employment interruptions and (approximately) the timing of childbirth.

## APPENDIX 2

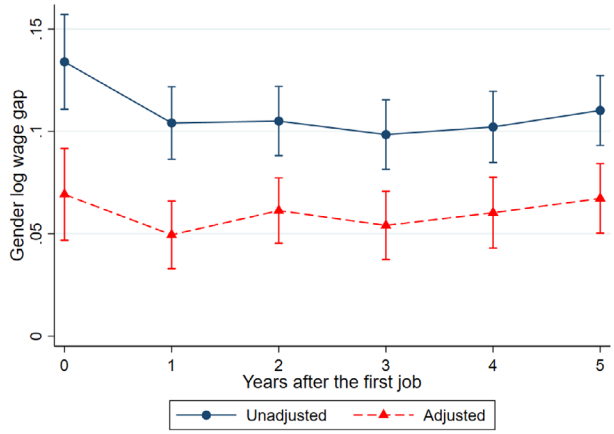


**FIGURE B1** Unbalanced sample: dynamics of the gender wage gap over years after labor market entry. The sample size is 3409 (2262 male, 1147 female). The sample consists of graduates who work in a full-time job as their first job after graduation. The dependent variable is the log gross daily wage. The unadjusted gender wage gap includes only graduation year as a control variable. The adjusted gender wage gap contains personal and pre-graduation characteristics as controls. The personal characteristics include age and having German citizenship. The pre-graduation characteristics include duration of study, place of high school final exam and working during study. All estimations include the beginning month of the first job as a control. Additionally, we control for having a child between the years.

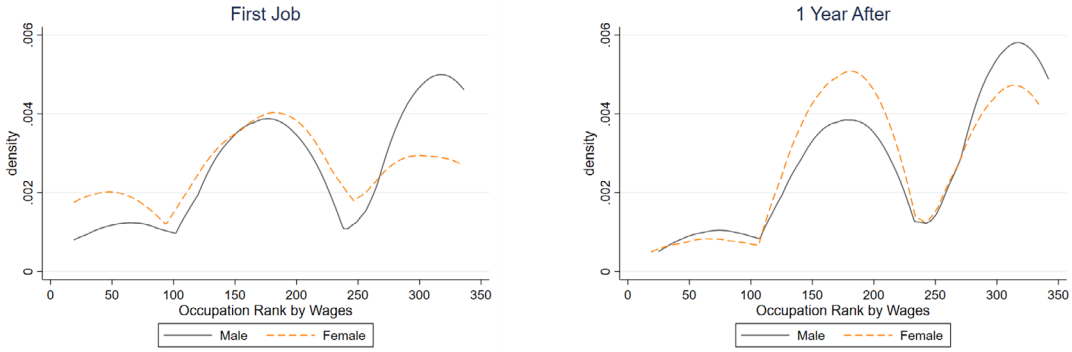


**FIGURE B2** Distribution of occupations for female and male job changers. The figure shows the distribution of male and female job changers across occupations. The sample size is 312 and includes only firm and occupation changers (Column 5, Table 4). The plot on the left shows the distribution before the job change (at the first job), and the plot on the right shows that after the job change (1 year after the first job) by gender. The *x*-axis plots occupations ranked by average earnings from the lowest paying occupation to the highest paying occupation. The ranking of occupations by average earnings is calculated from the SIAB dataset, which represents a 2% sample of the entire IEB dataset.

## APPENDIX 3

**TABLE C1** Field of study categorization.

| Field of study (combined) | Field of study (detailed) |
|---|---|
| Economics and business | Economics |
| | Business and management |
| Mathematics and natural sciences | Information systems |
| | Mathematics and computer science |
| | Physics |
| | Chemistry |
| | Biology |
| Humanities and social sciences | Geography |
| | Theology |
| | History, archaeology, and humanities |
| | Languages, literature, and culture |
| | Philosophy, sociology, and political |
| | Psychology |
| | Education and sport |
| Medical studies | Medicine |
| | Dental medicine |
| | Pharmacy |

**TABLE C2** Descriptive statistics—sample comparison to population.

| | Estimation sample | Population |
|---|---|---|
| Share of females[a] | 0.498 | 0.457 |
| Economics and business | 0.415 | 0.484 |
| Mathematics and natural sciences | 0.182 | 0.353 |
| Humanities and social sciences | 0.761 | 0.713 |
| Medical studies | 0.518 | 0.581 |
| Final high-school GPA[b] | 2.20 | 2.15 |
| Economics and business | 2.36 | 2.45 |
| Mathematics and natural sciences | 2.17 | 1.99 |
| Humanities and social sciences | 2.31 | 2.27 |
| Medical studies | 1.81 | 1.88 |
| University GPA[c] | 2.04 | 2.02 |
| Graduation Age[a] | 27.37 | 27.80 |
| Share of non-German graduates[c] | 0.217 | 0.110 |

*Note*: This table presents summary statistics on the characteristics of graduates before and after graduation and compares them with official register data and representative survey data from other studies. Our estimation sample consists of graduates with a master's degree or equivalent working full-time in their first job after graduation.

[a]The reference year for both sets of data is 2010. *Source*: Federal Statistical Office, 2011.

[b]The reference year is WS 2006/2007 according to the survey data from Simeaner et al. (2014) and 2007 in our sample.

[c]The years are pooled for 1993–2009 in the survey data from Francesconi and Parey (2018) and pooled for 1995–2010 in our data.

**TABLE C3** Gender wage gap in all types of first jobs.

| Dependent variable: Log daily wage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Personal and pre-graduation characteristics | | | | | | Additional post-graduation characteristics | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Female | −0.271 *** | −0.201 *** | −0.212 *** | −0.109 *** | −0.101 *** | −0.097 *** | −0.045 *** | −0.045 *** |
| | (0.018) | (0.014) | (0.014) | (0.014) | (0.014) | (0.014) | (0.013) | (0.012) |
| Graduation year | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Full-time employment | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Personal characteristics | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Field of study FE | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Final university grade | No | No | No | Yes | Yes | Yes | Yes | Yes |
| Pre-graduation characteristics | No | No | No | No | Yes | Yes | Yes | Yes |
| Occupation FE | No | No | No | No | No | Yes | Yes | Yes |
| Post-graduation characteristics | No | No | No | No | No | Yes | No | Yes |
| *R*-squared | 0.050 | 0.417 | 0.424 | 0.493 | 0.498 | 0.501 | 0.630 | 0.652 |
| Individuals | 10,149 | 10,149 | 10,149 | 10,149 | 10,149 | 10,149 | 10,149 | 10,149 |

*Note*: This table shows the gender wage gap at labor market entry based on the OLS model specified in Equation (1). The sample consists of all individuals who work in any kind of job after graduation. The dependent variable is the log gross daily wage at the first job. The control variables are added gradually. Column (1) shows the results with only the graduation year as a control. Column (2) adds a full-time indicator. Column (3) adds personal characteristics such as age and (not) having German citizenship and Column (4) adds a field of study (17 categories). Column (5) adds the final university grades, and Column (6) adds pre-graduation characteristics, that is, duration of study, location of the final high-school examination, a dummy for apprenticeship, and a dummy for working while studying. Column (7) adds three-digit occupation fixed effects. Column (8) shows the results after adding post-graduation characteristics, that is, job search time, job location, one-digit industry fixed effects, firm size (7 categories), the share of women in firms (3 categories), and the beginning month of the first job. Robust standard errors are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels.

**TABLE C4** Oaxaca-Blinder decomposition.

| Dependent variable: Log daily wage | | | | |
|---|---|---|---|---|
| | First job | | 1 year after | |
| Mean of male daily wage | 4.691 | | 4.832 | |
| Mean of female daily wage | 4.570 | | 4.733 | |
| Raw gender wage gap | 0.121*** | | 0.099*** | |
| | Log points | Percent of gap explained | Log points | Percent of gap explained |
| Total explained | 0.052*** | 43 | 0.050*** | 50 |
| Total unexplained | 0.069*** | 57 | 0.049*** | 50 |
| Explained by | | | | |
| Graduation year | 0.005 | 4 | 0.006** | 6 |
| Age | 0.005** | 4 | 0.004** | 4 |
| Non-German | −0.002** | 2 | −0.002** | 2 |
| Field of study | 0.048*** | 40 | 0.044*** | 44 |
| Duration of study | −0.000 | 0 | −0.000 | 0 |
| Working during studying | −0.001 | 1 | −0.001 | 1 |
| Apprenticeship | −0.000 | 0 | −0.000 | 0 |
| Grade | −0.006** | 5 | −0.004*** | 4 |
| Place of the final high-school examination | 0.004* | 3 | 0.004 | 4 |

*Note*: This table shows the Oaxaca-Blinder decomposition results. Decomposition methods allow to split the mean wage gap into an explained component (due to differences in characteristics) and an unexplained component (due to differences in returns to these characteristics). The decomposition model used in this table is the aggregate twofold decomposition. Fortin et al. (2011) provide detailed information on the methodology, and Jann (2008) provide a description of the STATA application.

**TABLE C5** Descriptive statistics – stayers and firm and occupation changers.

| Dependent variables | | | | | | |
|---|---|---|---|---|---|---|
| | Stayers | | | Firm and occupation changers | | |
| | Male | Female | Male–female | Male | Female | Male–female |
| Panel A: Economics, business, humanities and social sciences | | | | | | |
| Age at the first job | 27.467 | 26.674 | 0.793*** | 27.899 | 26.990 | 0.908*** |
| Non-German | 0.014 | 0.038 | −0.024*** | 0.017 | 0.015 | 0.003 |
| Duration of study | 5.527 | 5.463 | 0.064 | 5.576 | 5.716 | −0.140 |
| Working during studying | 0.659 | 0.784 | −0.124*** | 0.676 | 0.787 | −0.110** |
| Apprenticeship | 0.074 | 0.063 | 0.011 | 0.133 | 0.096 | 0.037 |
| Origin in the same federal state as the university | 0.843 | 0.876 | −0.033** | 0.867 | 0.875 | −0.008 |
| Final Uni. grade | 2.187 | 1.976 | 0.210*** | 2.223 | 2.082 | 0.140** |
| Duration of job search | 3.388 | 3.518 | −0.129 | 3.110 | 3.010 | 0.100 |
| Median daily log wage of full-time employees in a firm | 4.662 | 4.622 | 0.041*** | 4.543 | 4.416 | 0.126*** |
| Share of part-time employees in a firm | 0.791 | 0.757 | 0.035*** | 0.809 | 0.767 | 0.042* |
| Share of high qualified employees in a firm | 0.395 | 0.379 | 0.016 | 0.332 | 0.302 | 0.030 |
| Share of women in a firm | 0.452 | 0.524 | −0.071*** | 0.446 | 0.561 | −0.115*** |
| Log firm size | 5.222 | 5.119 | 0.102 | 4.881 | 4.575 | 0.306 |
| Horizontal mismatch occupation | 0.148 | 0.270 | −0.122*** | 0.267 | 0.397 | −0.130** |
| Vertical mismatch | 0.469 | 0.475 | −0.005 | 0.591 | 0.713 | −0.122** |
| Horizontal or vertical mismatch | 0.538 | 0.588 | −0.051** | 0.688 | 0.809 | −0.121** |
| Occupation rank | 236.061 | 220.823 | 15.238*** | 228.381 | 190.772 | 37.609*** |
| Occupation rank < quantile 10 | 0.090 | 0.118 | −0.029** | 0.102 | 0.213 | −0.111*** |
| Occupation Rank > Quantile 90 | 0.121 | 0.085 | 0.036*** | 0.119 | 0.059 | 0.060* |
| Observations | 1503 | 904 | | 176 | 136 | |
| Panel B: Mathematics, natural sciences and medical studies | | | | | | |
| Age at the first job | 27.476 | 26.993 | 0.482*** | 28.120 | 27.027 | 1.093*** |
| Non-German | 0.014 | 0.018 | −0.004 | 0.024 | 0.060 | −0.036 |
| Duration of study | 5.692 | 5.870 | −0.178** | 5.938 | 6.008 | −0.070 |
| Working during studying | 0.660 | 0.661 | −0.002 | 0.747 | 0.720 | 0.027 |

(Continues)

TABLE C5 (Continued)

| Dependent variables | | | | | | |
|---|---|---|---|---|---|---|
| | Stayers | | | Firm and occupation changers | | |
| | Male | Female | Male–female | Male | Female | Male–female |
| Apprenticeship | 0.043 | 0.041 | 0.001 | 0.133 | 0.120 | 0.013 |
| Origin in the same federal state as the university | 0.914 | 0.855 | 0.059*** | 0.880 | 0.820 | 0.060 |
| Final Uni. grade | 1.858 | 2.007 | −0.149*** | 1.835 | 1.845 | −0.010 |
| Duration of job search | 3.330 | 3.671 | −0.341** | 2.748 | 3.462 | −0.714 |
| Median daily log wage of full-time employees in a firm | 4.576 | 4.499 | 0.077*** | 4.306 | 4.236 | 0.070 |
| Share of part-time employees in a firm | 0.689 | 0.609 | 0.080*** | 0.677 | 0.625 | 0.053 |
| Share of high qualified employees in a firm | 0.317 | 0.242 | 0.075*** | 0.219 | 0.198 | 0.021 |
| Share of women in a firm | 0.552 | 0.714 | −0.162*** | 0.522 | 0.755 | −0.233*** |
| Log firm size | 5.594 | 5.690 | −0.095 | 3.934 | 4.046 | −0.111 |
| Horizontal mismatch occupation | 0.196 | 0.084 | 0.112*** | 0.425 | 0.260 | 0.165* |
| Vertical mismatch | 0.121 | 0.100 | 0.021 | 0.402 | 0.460 | −0.058 |
| Horizontal or vertical mismatch | 0.263 | 0.139 | 0.124*** | 0.575 | 0.500 | 0.075 |
| Occupation rank | 285.685 | 290.981 | −5.296 | 227.080 | 199.800 | 27.280 |
| Occupation rank < quantile 10 | 0.116 | 0.098 | 0.018 | 0.172 | 0.180 | −0.008 |
| Occupation rank > quantile 90 | 0.372 | 0.584 | −0.212*** | 0.172 | 0.160 | 0.012 |
| Observations | 1148 | 570 | | 87 | 50 | |

*Note*: This table shows summary statistics of graduates' personal, pre-graduation, post-graduation and first job characteristics of stayers and of firm and occupation changers. The sample consists of graduates with a master's degree or equivalent who work in a full-time job as their first job after graduation and who have a wage spell 1 year after their first job. ***, **, and * denote significance at the 1%, 5%, and 10% levels.