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Getting ahead in the social sciences: How parenthood and publishing contribute to gender gaps in academic career advancement

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Abstract
How do parenthood and publishing contribute to gender gaps in academic career advancement? While extensive research examines the causes of gender disparities in science, technology, engineering, and mathematics (STEM) careers, we know much less about the factors that constrain women’s advancement in the social sciences. Combining detailed career- and administrative register data on 976 Danish social scientists in Business and Management, Economics, Political Science, Psychology, and Sociology (5703 person-years) that obtained a PhD degree between 2000 and 2015, we estimate gender differences in attainment of senior research positions and parse out how publication outputs, parenthood and parental leave contribute to these differences. Our approach is advantageous over previous longitudinal studies in that we track the careers and publication outputs of graduates from the outset of their PhD education and match this data with time-sensitive information on each individual's publication activities and family situation. In discrete time-event history models, we observe a ~24 per cent female disadvantage in advancement likelihoods within the first 7 years
After PhD graduation, with gender differences increasing over the observation period. A decomposition indicates that variations in publishing, parenthood and parental leave account for ~ 40 per cent of the gender gap in career advancement, suggesting that other factors, including recruitment disparities, asymmetries in social capital and experiences of unequal treatment at work, may also constrain women’s careers.

**KEYWORDS**
career progression, gender, parenthood, scientific performance, social sciences

## 1 | INTRODUCTION

Despite gender parity in university enrollment and degree attainment for the past 3 decades (Vincent-Lancrin, 2008), women continue to be underrepresented in senior research positions in many university systems worldwide. While extensive research focuses on the reasons for the gender gap in science, technology, engineering, and mathematics (STEM) careers, we know less about the factors that hinder women’s career advancement in the social sciences. Although the supply-side problem of women obtaining university degrees has been less significant historically in the social sciences compared to STEM fields (Charles & Bradley, 2009), disparities still exist in the upper ranks of the social sciences. Recent data shows that women constitute only 31% and 29% of social science full professors in Europe and the United States (US), respectively (Casad et al., 2022; European Commission, 2021).

Longitudinal research on gender and career progression in the social sciences is scarce and inconclusive. Recent studies from Sweden and Germany indicate that women social scientists enter the professoriate with lower performance levels than men. However, these studies only focus on the careers of currently active scientists, leading to potential survivorship bias (Lutter et al., 2022; Lutter & Schröder, 2016; Madison & Fahlman, 2021; Schröder et al., 2021). On the other hand, the few existing studies from the US that follow individuals longitudinally throughout their careers show persistent gender disparities in advancement rates, even when accounting for differences in research performance and institutional context (Sherman & Tookes, 2022; Weisshaar, 2017).

Using detailed career and administrative register data on 976 Danish social scientists in Business and Management, Economics, Political Science, Psychology, and Sociology, we estimate gender disparities in the advancement to senior research positions and analyze the contributions of publication outputs, parenthood, and parental leave to these differences. Our study contributes to the existing literature in two significant ways. First, previous time-series studies have examined the drivers of gender differences in career progression in promotion-based research systems. Similar research into competition-based systems, such as the one in Denmark, is scarce and hampered by selection issues. Unlike the promotion-based career model in the US, the Danish academic system has high competition for advancement at all career stages (Frølich et al., 2018).

Secondly, although many studies have demonstrated the adverse effect of parenthood on women’s STEM careers, longitudinal research on the impact of children and parental leave on social science careers is limited, particularly in competition-based systems. By studying Danish social scientists, we can directly link individual-level career information to administrative registers. This enables us to investigate the impact of parenthood and parental leave on the careers of women and men with greater accuracy than previous survey studies.
2 | BACKGROUND

Gender stratification in science has been a focus of sociologists for many decades (Astin, 1967; Rossi, 1965). However, most studies on the slower career progression for women have focused on STEM fields. In the social sciences, early evidence from questionnaires in the US has provided some insights. Ginther and Kahn (2004) examined the advancement rates of economists using the biannual Survey of Doctorate Recipients in the US and found slower progression for women than men. Models adjusting for past performance and parenthood still left a significant portion of the gender gap unexplained. Using the same data, Ginther and Kahn (2014a, 2014b) found similar but less pronounced gender differences in promotions to tenure and full professorships for the social sciences as a whole. McDowell et al. (1999, 2001) analyzed panel data on members of the American Economic Association from selected years between 1964 and 1989 and found lower promotion probabilities for women compared to men, even when accounting for PhD institution and publication output before the promotion.

While informative, these surveys have some methodological limitations. First, they do not systematically follow representative cohorts over time. For example, the NSF Survey of Doctorate Recipients can track some, but not all, participants across survey waves. Second, non-responses in survey-based career studies may be associated with attrition (Weisshaar, 2017). Third, retrospective survey questions about scientific performance and career advancement are susceptible to recall and social desirability bias (Lutter & Schröder, 2016).

Recent research has attempted to overcome these limitations through CV-based studies of career progression in German sociology (Lutter & Schröder, 2016), political science (Schröder et al., 2021), and psychology (Lutter et al., 2022). These studies show a consistent female advantage across disciplines, in statistical analyses accounting for institutional context and scientific output: Ceteris paribus, women attain permanent research employment faster than men, and on average with fewer publications. A recent Swedish study also compared the scientific output and visibility of men and women scientists (including researchers in psychology and political science) at the time of appointment for full professorships, using CV and publication data. Women appointees were found to have lower publication and citation scores than men appointees (Madison & Fahlman, 2021). However, survivorship bias is a possible limitation of these studies. By focusing on currently active university researchers (Lutter et al., 2022; Lutter & Schröder, 2016; Schröder et al., 2021) or full professors (Madison & Fahlman, 2021), they likely overestimate women’s promotion probability due to unmeasured differences in attrition and in the characteristics of leavers across genders. For instance, if more high-performing women than men opt out of the academic career track due to work-family conflicts, precarious employment conditions, hostile climates, or experiences of unequal treatment at work, these studies may exaggerate the female advantage in progression to senior research positions.

The few existing studies that follow the same representative samples of individuals through their careers reach different results. Weisshaar (2017) used detailed career data to trace the progress of 475 randomly selected tenure-track assistant professors in US sociology departments. She found persistent gender disparities in tenure promotions, even when adjusting for research performance and institutional context. Sherman and Tookes (2022) traced the careers of 2009 assistant professors in US finance departments using CVs and faculty roster data. Adjusting for research productivity, they found that women were less likely than men to become full professors and obtained employment at lower ranked institutions. Despite their advantageous approach, these studies are also vulnerable to survivorship bias, as they only analyze scientists who are already on the tenure track. If women are less likely to advance to such roles, then the studies could be underrepresenting the challenges women face in progressing to associate professorships. In other words, the tenure-track assistant professors considered in these studies represent a unique subset that has “survived” the initial selection process, likely possessing specific characteristics that have enabled them to succeed. Therefore, the results might not fully capture the extent of the disadvantages faced by a broader population of women in the social sciences.

Here, we build on these recent US-focused contributions to estimate differences in the career progression of men and women PhDs in a broader range of social-science disciplines and with register data on individual level characteristics such as parenthood and parental leave, which are not covered in these studies. While previous
research has harnessed administrative registry data to highlight gender disparities in the attainment of senior research positions, this work has been descriptive, stopping short of delving into the underlying factors driving these discrepancies. Danell and Hjerm (2013) analyze extensive registry data on academics at Swedish universities from 1990 to 2010 and find a 37% lower chance for women of becoming full professors compared to men, a difference that has not decreased over time. Similarly, Aksnes et al. (2022) employ registry data on the entire population of Norwegian PhD graduates over 5 decades and find a 15% slower progression for women into professorships compared to men. These studies, which are less vulnerable to selection bias, serve as a clear indication that disparities in advancement remain, even in gender-equal Nordic countries like Sweden and Norway. But they leave us asking: what are the driving factors behind these persistent disparities? Below, we elaborate on key theoretical explanations for women’s lower advancement rates in social science.

2.1 Drivers of gender disparities in career progression

Our examination of the factors contributing to gender disparities within social-science careers is anchored in Joan Acker’s theory of gendered organizations (Acker, 2010). Acker contends that organizations, despite being represented as gender-neutral, are often imbued with gender-based assumptions, affecting their structure and functioning. A central starting point of her theory is that organizational structures and processes are gendered, impacting everything from job roles and career ladders to reward structures and performance assessments. Acker’s theory focuses on the processes that rationalize and legitimize gender hierarchies in contemporary organizations, including the symbolic and material/structural aspects of organizations. Acker outlines five key processes: (1) the perpetuation of gendered divisions of employee tasks and responsibilities, vertically as well as hierarchically; (2) the use of gendered symbols and images that perpetuate these gender divisions; (3) interactional norms within the organization that are influenced by gender roles and norms; (4) the shaping of individual identities in line with gendered expectations, as reflected in the subjective strivings and behaviors of employees; and (5) the perpetuation of an allegedly gender-neutral organizational logic structured around the preferences, approaches and career profiles of a historically dominant group of male organization members.

In the following, we relate these theoretical ideas to previous empirical research on four key factors contributing to gender differences in academic career progression: (1) gender disparities in scientific outputs; (2) the differential impact of parenthood on women’s and men’s careers; (3) gender dynamics in recruitment and selection; and (4) women’s disproportionate selection out of academic careers due to experiences of hostile work, gendered interactional norms and unequal treatment. Due to data limitations, studies usually focus on one or a few of these factors (Weisshaar, 2017).

2.1.1 Publishing

The strong emphasis on publication outputs and impact in universities’ performance assessments may be tied to Acker’s ideas of how allegedly gender-neutral organisational logics can reinforce gender disparities in organizations (Nielsen, 2018). Numerous studies highlight publishing disparities as a key explanation for women’s delayed career progression in social science (see e.g. Lutter & Schröder, 2016; Weisshaar, 2017). Decades of research find lower average publication rates for women than for men (Mairesse & Pezzoni, 2015), although differences vary by career stage and appear to have diminished over time (Huang et al., 2020; Xie and Shauman, 2005). Sociological studies associate the gender performance gap with broader, structural disparities in the science system (Madsen et al., 2022). On average, women are employed in lower ranked positions than men, they are more likely to hold temporary jobs, and they more often work in teaching-heavy departments with limited access to resources (Bland et al., 2006; Morgan et al., 2021; Xie & Shauman, 1998). All three factors partially explain the gender gap in
research productivity. Yet, research also documents gender differences in average teaching loads, administrative duties and weekly time for research, which may lower women’s productivity rates more so than men’s (Eagly, 2020; Guarino & Borden, 2017; Leišytė, 2016; Cf.: Madsen et al., 2022). Further, women scientists tend to specialize less in their research activities than men, which may impede their productivity (Leahey, 2007), and they are less likely to be credited as authors for their contributions (Ni et al., 2021; Ross et al., 2022). Despite such systemic disparities, publication productivity remains a central assessment criterion in tenure and hiring decisions and is positively correlated with funding, academic salary levels, and promotions (Leahey, 2007; Orupabo & Mangset, 2022; van Leeuwen & Moed, 2012).

2.1.2 | Parenthood

The role of parenthood in academic careers relates to Acker’s notion that organisational structures, such as career models and the rhythm and timing of advancement opportunities, take as default the characteristics of a historically dominant group of male scientists. Longitudinal survey research in the US suggests that family demands, particularly those related to children, contribute to the gender gap in early-career scientific advancement, but the effects on advancement into tenure remain uncertain (Ceci et al., 2014; Ginther & Kahn, 2009; Mason et al., 2013). Mothers in academia typically bear the brunt of parenthood responsibilities, experience higher levels of family-related stress, and take longer leaves of absence than fathers (Mason et al., 2013; O’Laughlin & Bischoff, 2005). Additionally, women are more likely than men to cite family considerations as a primary reason for leaving an academic job (Goulden et al., 2011; Martinez et al., 2007). Paradoxically, the introduction of stop-the-tenure-clock leave policies at US universities, which usually involves giving tenure candidates that become parents an extra year to qualify for tenure evaluation, has had little impact on diminishing the male advantage in tenure and promotion rates (Antecol et al., 2018; Fox & Gaughan, 2022). The gender gap in publishing also tends to be more pronounced among parents than non-parents (Hunter & Leahey, 2010; Lutter & Schröder, 2020; Morgan et al., 2021), although the magnitude of this gap may also vary across national contexts. For example, paid maternity and paternity leave schemes in Scandinavia are considerably longer and more generous than in the US, resulting in longer periods of absence for women and men during the early stages of their careers, but most saliently for women (Seierstad & Healy, 2012). Further, the gap in the length of parental leave between genders is markedly wider in Denmark than in Norway and Sweden. Numerous studies also suggest that precarious employments—which are on the rise in the social sciences—may reinforce women’s turnover rates more so than men’s, and particularly so for academic mothers, due to unattractive work conditions, short-term contracts and boundless workloads (Bataille et al., 2017; Bozzon et al., 2017; Murgia & Poggio, 2018; Nielsen, 2018).

2.1.3 | Remaining factors: Recruitment and chilly climates

In addition to differences in publishing and parenthood, gender gaps in career progression and attrition may be attributed to disparities in recruitment processes and experiences of chilly climates at work. Following Weissshaar (2017), we conceptualize these factors as the “residual” gender gap left unexplained in our statistical models, which account for publishing, parenthood and other relevant covariates, including discipline, institutional context, age and graduation year.

Unconscious bias, here conceptualized as discriminatory acts based on negative stereotypes about social groups that people are unaware off, is a major concern in studies of gender in science (Nelson & Zippel, 2021). This view of gender disparities relates to Acker’s descriptions of how gendered expectations shape individual behaviors and interactions within organizations. Yet, experimental evidence on its prevalence in recruitment and selection is scarce. A few survey experiments show a bias in favor of female candidates in simulated hiring
scenarios (Ceci & Williams, 2015; Williams & Ceci, 2015). In a recent experiment targeting Icelandic, Norwegian and Swedish university faculty in Economics, Law, Physics, Political Science, Psychology and Sociology, Carlsson et al. (2021) found that fictitious female candidates for associate professor positions were viewed as more competent and hirable than male comparisons with identical CVs. As the authors concluded, gender biased evaluations of equally qualified candidates, do therefore not “seem to be the key explanation of the persistent gender gap in the Nordic region”. Importantly, however, such survey-experiments focus on attitudes rather than situated behavior (Jerolmack & Khan, 2014), and it is possible that evaluative outcomes would be different in real-world evaluation processes, where reviewers have more at stake and are not affected by experimenter demand effects.

Observational studies also indicate that gendered interactional dynamics may shape recruitment processes before evaluators make their judgments on who to hire, since recruiters sometimes use “closed hiring” (without advertisements and usually just a single candidate), or advertisements with narrow job descriptions to limit the number of qualified applicants for associate and full professorships (Husu, 2000; Marini et al., 2018; Nielsen, 2016; Van den Brink, 2010). Recruitment data indicates that closed hiring—where appointees are typically identified through informal networks—may put women at a disadvantage due to gender homophily in social connections (Husu, 2000; Nielsen, 2016). Further, the use of narrow job profiles—where advertisements are tailored to suit the characteristics of a particular candidate—may partially explain why fewer women than men apply for the available academic jobs (Nielsen, 2016; Van den Brink, 2010). Orupabo and Mangset’s (2022) qualitative study of associate and full professorship appointments in Norway shows that although recruiters initially consider gender as a parameter during the early phases of the recruitment process, they ultimately resort to narrow and quantifiable assessment criteria in the later phases, where hiring decisions are made. As documented in previous research these quantifiable criteria (including bibliometric measures) often disproportionately favor men, with potential implications for gender stratification (Lund, 2012; Nielsen, 2018; O’Connor & O’Hagan, 2016). Again, these findings serve as empirical examples of how allegedly gender-neutral organizations in some of their structural aspects reflect the performance characteristics of a historically dominant group of men.

More women than men may also feel “pushed out” and leave academic careers due to experiences of chilly climates and unequal treatment at work, relating to Acker’s notion of how interactional norms within organisations are influenced by gender roles and norms. Research highlights how hostile disciplinary and organisational cultures can sideline early-career women. In the US, women economists are twice as likely as men to indicate dissatisfaction with the climate of their discipline (Allgood et al., 2019) and surveys targeting political scientists reach similar results, with women reporting higher levels of direct and indirect discrimination and harassment than men (Briscoe & Mattocks, 2021; Sapiro & Campbell, 2018).

Similarly, gender asymmetries in social relationships and access to informal networks may exclude more women than men from interactions where new ideas are developed, research projects are planned, achievements are recognized, and relevant job openings and research results are disseminated (Belle et al., 2014; Van den Brink & Benschop, 2012; Villanueva-Felez et al., 2015).

3 | THE DANISH CONTEXT

The typical academic career path in Denmark comprises four stages, including completing a PhD, working as a postdoctoral researcher or assistant professor, advancing to an associate professor or senior research position, and eventually to a full professorship. The postdoctoral level, which is a common stage for academics to start families, is usually a temporary position that can last up to 4 years per employment, whereas associate and full professorships are generally permanent. The Danish academic system is distinct from the Anglo-American tenure-track system, due to its competition for advancement at every career stage (Frølich et al., 2018). This implies that most academic...
jobs, ranging from postdoc and assistant professor positions to full professorships, are advertised in open competition.

Denmark, like other Scandinavian countries, is known for its supportive welfare policies for families, including generous, job-protected parental leave with financial support and accessible, low-cost public childcare (Rostgaard & Ejrnæs, 2021). Danish parents are offered 18 weeks of maternity leave and 32 weeks of shared parental leave per child that can be extended if taken part-time (Kleven, Landais and Søndergaard, 2019), and according to recent data, 57% of Danish children ages 0–2 and 89% of 3-year-olds are enrolled in public childcare (Rostgaard & Ejrnæs, 2021).

Despite these favorable state-provided conditions, which have resulted in high female employment rates (Rostgaard & Ejrnæs, 2021), Denmark still exhibits persistent patterns of gender inequality in terms of vertical stratification (Klevens et al., 2019), which also extend to the country’s academic system. According to recent data, women make up 27% of full professors and 41% of associate professors in the Danish social sciences (Supplementary Figure S1), which is below Denmark’s Scandinavian neighbors (for a comparison with Norway and Sweden, see Supplementary Figure S2), and US and EU averages.

Seierstad and Healy (2012) speculate that the focus on mothers as primary caregivers in Scandinavia perpetuates gender-based disparities in research careers. Specifically, the generous maternity leave policies in Denmark may lead to longer periods of research inactivity and slower career progression for female academics compared to their peers in other Western countries (Madsen et al., 2022). Yet, the effects of parenthood and parental leave on women’s and men’s persistence and career advancement in Danish academia have not been determined empirically. According to OECD statistics, fathers take around 30% of the total number of days of leave allowances paid out per child in Norway and Sweden, but less than 10% in Denmark (OECD, 2023). Data from our own sample of Danish social scientists also show clear differences in the duration of parental leave for mothers and fathers (see Table 1 and Supplementary Figure S3).

Compared to their counterparts in Sweden and Norway, Danish universities have historically lagged in effectively promoting gender equality. Their focus has largely been on ‘fixing the women’ (e.g., through career development or mentoring schemes) rather than transforming organizational systems to better support women (Nielsen, 2017). Research from the Dutch university system suggests that such individualistic approaches have been largely ineffective in helping women reach senior academic positions (Timmers et al., 2010). A recent Nordic study by Drange and colleagues (2013) also supports this point. Examining gender equality measures at 37 universities in Sweden, Norway, and Finland over a 23-year period, they show that efforts aimed at merely ‘fixing women’ have low impact, while measures designed to change organizational structures lead to more women attaining professorships.

4 DATA AND METHODS

We use panel data on the careers of 973 individuals who graduated with a social-science degree from a Danish university between 2000 and 2015. We focused on core areas within the social sciences: Business and Management, Economics, Political Science, Psychology, and Sociology, while also covering researchers in interdisciplinary areas such as Human Geography, Science and Technology Studies and Political Economy. We decided not to include Anthropology due to its ambiguous classification within the social sciences or humanities. The sample of graduates was drawn from a public registry (The Research Portal) of PhD dissertations conducted and defended at Danish universities and was further validated by surveying department websites and local library lists of PhD dissertations. This process yielded an initial sample of 1508 PhD graduates. To gather information on the employment history of each graduate, we manually coded publicly available resumes and LinkedIn profiles (most academics in Denmark are active on LinkedIn). In instances where resumes were not publicly available, we contacted the graduates by email to request their CVs. We then manually coded the resumes to generate a dataset of career-histories that
included year-by-year position levels and institutional affiliation records. Full employment histories were obtained for 1286 individuals, representing 85% of the initial sample.

Through various name and affiliation-based matching strategies, we managed to link 973 individuals, or 65% of the initial sample, to Danish administrative registries, which provided data on each graduate’s family situation, including the number of children and birth years per child, as well as months of absence due to parental leave. The matching was based on first and last names, the institutions and departments where the graduates pursued their PhD programs, the year they started their PhD, and the year they graduated. Our matching methodology prioritised exact matches for names and institutions, while allowing for some variability in the PhD start and end dates, since this information was retrieved from LinkedIn. This approach presents two limitations. First, individuals who relocated out of Denmark either during or after their PhD may not be covered by the Danish administrative records for that period. Since male researchers are more likely than female researchers to relocate internationally for research jobs (Zhao et al., 2023), this could imply that the actual gender gap in advancement rates is larger than what we estimate in our analysis. Second, individuals who changed their surnames following their PhD, for instance due to marriage, might not be accurately matched in our dataset. This issue could disproportionately affect women, who are more likely than men to adopt their spouse’s surname, potentially introducing a slight bias in our sample.

Our final dataset consists of 973 individuals (565 men and 408 women) and 5703 person-years (Supplementary Figure S4 displays data inclusion and exclusion), including those researchers who were already parents at the time of graduation, researchers who became parents after graduating, and researchers who did not become parents within the timeframe of our study.

Data security and confidentiality procedures make it impossible to determine which of the 1286 scientists that could not be linked for analysis on Statistic Denmark’s data servers. However, in Supplementary Table S1, we present a side-by-side comparison of the composition of our initial sample (N = 1508) and the final sample (N = 973) in terms of gender, PhD universities, research areas, and graduation areas. This comparison only indicates minor variations, with women comprising 43% of the initial dataset and 42% of the final dataset.

### 4.1 Variables

Table 1 shows descriptive statistics for all variables, and Supplementary Table S2 details the variable coding and data sources. In the analysis of career progression, we use a dichotomous dependent variable that measures whether a graduate has advanced to a position at the associate or full professor level. Our main predictor, gender, is measured as a dichotomous variable (men = 0, women = 1). We account for publication outputs based on three individual-level measures: annual number of coauthor adjusted articles, annual number of books and annual number of book chapters. Bibliometric data was retrieved from Elsevier’s Scopus. To calculate the number of coauthor adjusted articles per year, we used the formula \( \frac{2}{(\text{number of authors} - 1)} \) for each article, such that a single-authored article amounts to 1 and an article written by 3 authors amounts to 0.5. As a robustness check, we use an additional measure of article output that weighs the coauthor adjusted publications by the source normalised impact per paper—SNIP (i.e., a field-normalised measure of the average citation impact of a journal’s publications, available via Scopus).

We measure parenthood by the number of children and the duration of parental leave. Number of children is a categorical variable, while parental leave is a count variable measured in months of absence from work. To account for changes in advancement probabilities over time, we estimate years after PhD graduation with time-dummies. Additionally, we control for the university and research area in which each scientist graduated. The disciplinary category “Undefined” (Table 1) refers to graduates educated at interdisciplinary social science departments without a clear anchoring in neither Business and Management, Economics, Political Science, Psychology or Sociology.
### Table 1: Descriptive statistics.

<table>
<thead>
<tr>
<th>Position 5 years after PhD graduation</th>
<th>All disciplines</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>University postdoc or researcher at public analytical institution</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>after 5 years</td>
<td>8%</td>
<td>13%</td>
</tr>
<tr>
<td>Assistant professor after 5 years</td>
<td>13%</td>
<td>16%</td>
</tr>
<tr>
<td>Associate professor or full professor after 5 years</td>
<td>32%</td>
<td>24%</td>
</tr>
<tr>
<td>Out of academia after 5 years</td>
<td>47%</td>
<td>47%</td>
</tr>
</tbody>
</table>

| Productivity measures 5 years after PhD graduation                         |                |        |
| Number of co-authored adjusted articles                                    | 1.980 (0.121)  | 1.392 (0.090) |
| Number of books                                                            | 0.036 (0.010)  | 0.044 (0.013) |
| Number of book chapters                                                    | 0.295 (0.046)  | 0.308 (0.043) |

| Parenthood measures                                                        |                |        |
| Children before PhD-graduation                                             |                |        |
| 0                                                                         | 62%            | 53%    |
| 1                                                                         | 19%            | 18%    |
| 2                                                                         | 15%            | 22%    |
| 3                                                                         | 4%             | 7%     |
| Number of children within 5 years after PhD graduation                     | 0.6 (0.03)     | 0.5 (0.03)     |
| Average parental leave days taken during the first 5 years after PhD graduation | 25.6 (2.1) | 102.3 (8.18) |

| Age when finishing PhD                                                      |                |        |
| 26–29                                                                     | 16%            | 9%     |
| 30–34                                                                     | 55%            | 46%    |
| 35–39                                                                     | 21%            | 33%    |
| 40                                                                        | 8%             | 13%    |

| University                                                                  |                |        |
| Copenhagen University                                                      | 21%            | 20%    |
| Aarhus University                                                           | 30%            | 32%    |
| Copenhagen Business School                                                 | 24%            | 22%    |
| Roskilde University                                                         | 9%             | 9%     |
| Aalborg University                                                          | 7%             | 8%     |
| University of Southern Denmark                                             | 10%            | 8%     |

| Research area                                                              |                |        |
| Economics                                                                  | 32%            | 20%    |
| Political science                                                          | 18%            | 13%    |
| Psychology                                                                 | 6%             | 14%    |

(Continues)
TABLE 1 (Continued)

<table>
<thead>
<tr>
<th>Year of PhD-graduation</th>
<th>All disciplines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
</tr>
<tr>
<td>Business &amp; management</td>
<td>25%</td>
</tr>
<tr>
<td>Sociology</td>
<td>3%</td>
</tr>
<tr>
<td>Undefined</td>
<td>16%</td>
</tr>
<tr>
<td>2000–2005</td>
<td>24%</td>
</tr>
<tr>
<td>2006–2010</td>
<td>32%</td>
</tr>
<tr>
<td>2011–2015</td>
<td>44%</td>
</tr>
</tbody>
</table>

These departments educate graduates in social-science disciplines, but also cover interdisciplinary areas such as Human Geography and Science and Technology Studies. We also control for age and age-squared to account for temporal changes in the probability of obtaining an associate professor or professor position. Finally, we include as control variables the year in which individuals received their PhD degrees and the number of children they had before graduating.

4.2 | Analytical strategy

Our analytical approach involves two steps. First, we use discrete time event models and hazard plots to estimate average gender differences in advancement rates without controls for publishing, children and parental leave. Next, we examine the marginal effects of parenthood and productivity derived from discrete time event models, and use the Karlson et al. (2012) decomposition method (KBH) to parse out how publishing, parenthood and parental leave contribute to disparities in predicted advancement rates.

4.2.1 | Event-history analysis

We use event-history analysis to estimate gender differences in obtaining senior research positions (i.e., positions at the associate or full professor level), accounting for publishing rates, family situation, disciplinary and institutional context and career-timing measures. In our analysis of career progression, time units are measured in years, and each individual contributes one observation year for each year that individual is at risk of obtaining a senior research position. To keep the dataset balanced, we only observe individuals during the first 6 years following the year of the attainment of the PhD degree (i.e., 7 years from year 0–6). Following Allison (2014), we use a maximum likelihood method appropriate for dealing with discrete time data. This method has the advantage that time-varying covariates (e.g., number of children, parental leave and annual publishing) can enter the model in the same way as time-constant covariates. For ease of interpretation, we use an alternative to the logistic model—the complementary log-log model:

$$
\log (-\log (1 - P_t)) = b_0 + b_1 x_1 + b_2 x_2 t
$$
Like the logistic model, this model ensures that the predicted values are bounded by 0 and 1, in this case when using a time-constant \( (x_1) \) and time-varying \( (x_2) \) covariate. This model is equivalent to the Cox proportional hazards model for continuous-time data, and exponentiated beta coefficients give us hazard ratios.

### 4.2.2 Decomposition

To examine how publishing, parenthood and parental leave relate to gender gaps in career advancement, we first examine the marginal effects from nested time-event history models, where our measures of parenthood and productivity are introduced in a stepwise manner. We focus on marginal effects, as opposed to hazard rates, to appropriately adjust the coefficients for scaling effects in non-linear models. In a complementary analysis, we use the KHB-method to decompose the total gender effect into a direct effect (the effect of gender, controlling for children, parental leave and publishing) and an indirect effect (the effect of gender on career advancement, mediated through children, parental leave and publishing). The model output reports a reduced model, a full model and the difference between the models. The estimated difference will be interpreted as the indirect effect (Karlson et al., 2012).

### 5 RESULTS

Table 1 presents descriptive statistics by gender. In year five after PhD graduation, 47% of women and 47% of men are occupied in jobs outside of academia. Yet, more men than women have advanced to associate professorships (associate professorships, men: 32%, women 24%). In contrast, the percentage shares in lower-ranked appointments as assistant professor, postdoc and researcher are slightly higher for women than men (assistant professorships, men: 13%, women 16%; postdocs and researcher positions, men: 8%; women: 13%). In terms of children born during the first 5 years after PhD graduation, women’s and men’s average numbers are comparable (men: \( \mu = 0.6, \text{S.E.} = 0.03 \); women: \( \mu = 0.5, \text{S.E.} = 0.03 \)). However, women, on average, have four times as many days of absence due to parental leave than men (men: \( \mu = 25.6, \text{S.E.} = 2.1 \); women: \( \mu = 102.3, \text{S.E.} = 8.18 \)). The average number of coauthor adjusted articles published within the first 5 years after PhD graduation is smaller for women than men (men: \( \mu = 1.980, \text{S.E.} = 0.121 \); women: \( \mu = 1.392, \text{S.E.} = 0.090 \)), while gender differences in published books and book chapters are marginal (books, men: \( \mu = 0.036, \text{S.E.} = 0.010 \); women: \( \mu = 0.044, \text{S.E.} = 0.013 \); book chapters, men: \( \mu = 0.295, \text{S.E.} = 0.046 \); women: \( \mu = 0.308, \text{S.E.} = 0.043 \)). Additionally, women’s age at PhD graduation tends to be slightly higher than men’s, which may partially be explained by the higher share of women having children before graduating as PhDs (men: 38%, women: 47%).

In our sample, 52% of subjects are Business and Management or Economics graduates, compared to just 9 and 5% for Psychology and Sociology, respectively (see Supplementary Table S1). The underrepresentation of the latter two is partly due to many psychologists and sociologists earning degrees from interdisciplinary departments, categorized as ‘Undefined’ in our study. Meanwhile, this skew also mirrors a broader dominance of Business, Management and Economics in the Danish social sciences. For example, last year the University of Copenhagen admitted 364 Economics BA students versus 94 Sociology BA students.

### 5.1 Gender variations in career advancement

Figure 1 displays four hazard plots predicting women’s and men’s cumulative likelihood of obtaining a senior employment. These hazard plots are derived from discrete time-event history models (Table 2, Model 1–4) that account for PhD graduation year, PhD institution, discipline and age. On average, men's cumulative likelihood of
advancing beyond the assistant professorship within the first 7 years after PhD graduation (year 0–6) is larger than women’s (Men: 0.51; Women: 0.39) (Figure 1, upper left panel). Importantly, the gender gap in cumulative likelihoods in year seven has increased over time, from a small difference for the cohort period 2000–2005 (Men: 0.69; Women: 0.66) to a more substantial difference for the cohort period 2011–2015 (women: 0.25; men: 0.40) (Figure 1, upper right panel, and lower panels).

In Table 2, we report coefficients at the log-rate level from time-event history models. In the text, we exponentiate these coefficients and their confidence intervals to get hazard rates. On average, women’s likelihood of advancing beyond the assistant professor level is $-24\% = \text{Exp}(-0.271) - 1$ lower than men’s in any given year after PhD graduation (95% CI: $-39$ to $-4$). As reported in Models 2–4 (Table 1), the gender coefficients are statistically inconclusive for the 2000–2005 and 2006–2010 cohorts (as indicated by a confidence interval that spans zero), while women’s likelihood of advancing beyond the assistant professor level is $-39\% = \text{Exp}(-0.496) - 1$ lower than men’s in any given year after PhD graduation for the 2011–2015 cohort (95% CI: $-59$ to $-10$). To examine cohort differences in the gender gap, we used the z-test proposed by Paternoster et al. (1998), which did not indicate any statistically significant differences between the gender coefficients in Models 2, 3 and 4. Hence, while our findings clearly indicate increased disparities over time, our data sample is too small to confirm this trend statistically.
## Table 2: Discrete time-event history models estimating the probability of advancing beyond the assistant professorship.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Est.</td>
<td>CI</td>
<td>S.E.</td>
<td>Est.</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.271</td>
<td>[-0.50: -0.04]</td>
<td>0.12</td>
<td>-0.042</td>
</tr>
<tr>
<td>Years after PhD-graduation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>-0.228</td>
<td>[-0.83:0.37]</td>
<td>0.31</td>
<td>-0.637</td>
</tr>
<tr>
<td>2</td>
<td>1.335</td>
<td>[0.88:1.79]</td>
<td>0.23</td>
<td>0.808</td>
</tr>
<tr>
<td>3</td>
<td>1.722</td>
<td>[1.26:2.18]</td>
<td>0.24</td>
<td>1.112</td>
</tr>
<tr>
<td>4</td>
<td>1.569</td>
<td>[1.08:2.06]</td>
<td>0.25</td>
<td>0.675</td>
</tr>
<tr>
<td>5</td>
<td>1.016</td>
<td>[0.46:1.57]</td>
<td>0.28</td>
<td>0.156</td>
</tr>
<tr>
<td>6</td>
<td>0.957</td>
<td>[0.37:1.54]</td>
<td>0.30</td>
<td>-0.320</td>
</tr>
<tr>
<td>Discipline (ref. Business and Management)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economics</td>
<td>-0.816</td>
<td>[-1.19: -0.44]</td>
<td>0.19</td>
<td>-0.826</td>
</tr>
<tr>
<td>Political science</td>
<td>0.19</td>
<td>[-0.15:0.52]</td>
<td>0.17</td>
<td>0.27</td>
</tr>
<tr>
<td>Psychology</td>
<td>-0.417</td>
<td>[-0.87:0.03]</td>
<td>0.23</td>
<td>-1.184</td>
</tr>
<tr>
<td>Sociology</td>
<td>0.564</td>
<td>[0.05:1.08]</td>
<td>0.26</td>
<td>0.562</td>
</tr>
<tr>
<td>Undefined</td>
<td>0.075</td>
<td>[-0.43:0.58]</td>
<td>0.26</td>
<td>-0.696</td>
</tr>
<tr>
<td>Age</td>
<td>0.151</td>
<td>[-0.24:0.54]</td>
<td>0.20</td>
<td>0.282</td>
</tr>
<tr>
<td>Age^2</td>
<td>-0.002</td>
<td>[-0.01:0.00]</td>
<td>0.00</td>
<td>-0.004</td>
</tr>
</tbody>
</table>

Note: All models also include dummy controls for PhD institution and PhD graduation year.
Model 1 suggests substantial variations depending on the field of graduate study. Specifically, within any given year after earning their PhD, individuals with degrees in Economics are 56% (\( \exp[-0.816] \) – 1) less likely to reach the rank of associate or full professor (95% CI: −70 to −36) when compared to their counterparts in Business and Management, which serves as the reference group. Those in Psychology are 34% (\( \exp[-0.417] \) – 1) less likely than the reference group to advance to similar roles, although this result is inconclusive given a confidence interval that spans zero (95% CI: −58 to 0.03). Contrarily, sociologists demonstrate a 76% (\( \exp[0.564] \) – 1) higher likelihood of career advancement compared to the reference group. However, the wide confidence interval (95% CI: 5 to 94) necessitates caution in interpreting this result. For scholars in Political Science and Undefined disciplines, the advancement rates are inconclusive and more closely mirror those in Business and Management—the reference group—with coefficients of 21% (\( \exp[0.19] \) – 1) (95% CI: −14 to 68) and 8% (\( \exp[0.075] \) – 1) (95% CI: −36 to 79), respectively.

Due to a lack of statistical power, we cannot reasonably use the time-event history models to estimate how gender differences in annual advancement rates differ across disciplines. However, a descriptive analysis (Table 3) suggests notable variations. The gender gap is relatively narrow in Political Science and Economics, but markedly wider in Psychology, Business and Management, "Undefined", and particularly in Sociology. While these descriptive results do not capture possible differences in the pace of advancement during the first 7 years, they highlight a discipline-specific gender divide worthy of deeper investigation in future studies.

### 5.2 Indirect effects of publishing, parenthood, and parental leave

Comparing coefficients in nested nonlinear models is challenging due to scaling changes across models (Karlson et al., 2012). This makes it hard to directly assess the indirect impact of variables like publishing and parenthood on gender career gaps using hazard ratios. Therefore, we use marginal effects from time-event history models to better understand each factor’s role in the observed gender disparity presented in Table 2.

Models 5–7 (Table 4) summarize the marginal effects of our key variables of interest, with control variables set at their mean values. Figure 2 complements these results by showing predicted probabilities derived from the three models to illustrate how family characteristics and scientific outputs contribute to the gender gap in career advancement. In Model 5, which serves as our baseline model and controls for discipline, university, age, and career age, women have an average 1.6 percentage-point lower probability (95% CI: −2.9 to −0.2) of advancing beyond the assistant professor level than men in any given year. The predicted probability of advancement by year, as shown in Figure 2, is 6.9% for men (95% CI: 5.9 to 7.7) and 5.3% for women (95% CI: 4.4 to 6.2), corresponding to a relative gender difference—referred to here as the relative risk—of 1.29, or 29%.

### Table 3 Proportion advancing to senior-research positions within 7 years by gender and discipline.

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Men Proportion</th>
<th>SE</th>
<th>CI</th>
<th>Women Proportion</th>
<th>SE</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business and Mgmt.</td>
<td>0.413</td>
<td>0.041</td>
<td>0.334:0.495</td>
<td>0.354</td>
<td>0.047</td>
<td>0.266:0.450</td>
</tr>
<tr>
<td>Economics</td>
<td>0.251</td>
<td>0.032</td>
<td>0.193:0.320</td>
<td>0.213</td>
<td>0.046</td>
<td>0.136:0.316</td>
</tr>
<tr>
<td>Political science</td>
<td>0.52</td>
<td>0.050</td>
<td>0.422:0.616</td>
<td>0.491</td>
<td>0.067</td>
<td>0.362:0.621</td>
</tr>
<tr>
<td>Psychology</td>
<td>0.412</td>
<td>0.084</td>
<td>0.261:0.581</td>
<td>0.310</td>
<td>0.061</td>
<td>0.205:0.440</td>
</tr>
<tr>
<td>Sociology</td>
<td>0.722</td>
<td>0.106</td>
<td>0.481:0.880</td>
<td>0.452</td>
<td>0.089</td>
<td>0.289:0.626</td>
</tr>
<tr>
<td>Undefined</td>
<td>0.374</td>
<td>0.051</td>
<td>0.281:0.477</td>
<td>0.268</td>
<td>0.049</td>
<td>0.184:0.374</td>
</tr>
</tbody>
</table>

Note: N = 973.
<table>
<thead>
<tr>
<th></th>
<th>Model 5 dy/dx</th>
<th>CI</th>
<th>S.E.</th>
<th>Model 6 dy/dx</th>
<th>CI</th>
<th>S.E.</th>
<th>Model 7 dy/dx</th>
<th>CI</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>−0.0156</td>
<td>[−0.2890: −0.0024]</td>
<td>0.0067</td>
<td>−0.0145</td>
<td>[−0.2754: −0.0014]</td>
<td>0.0067</td>
<td>−0.0091</td>
<td>[−0.0222: 0.0039]</td>
<td>0.0066</td>
</tr>
<tr>
<td>Family</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st child</td>
<td>0.0103</td>
<td>[−0.0054: 0.0260]</td>
<td>0.008</td>
<td>0.0186</td>
<td>[0.0026: 0.0034]</td>
<td>0.008</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd child</td>
<td>−0.0053</td>
<td>[−0.2980: 0.0191]</td>
<td>0.013</td>
<td>0.0146</td>
<td>[−0.0153: 0.0444]</td>
<td>0.015</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental leave</td>
<td>−0.0039</td>
<td>[−0.010: −0.0018]</td>
<td>0.003</td>
<td>−0.0045</td>
<td>[−0.0101: 0.0011]</td>
<td>0.003</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Productivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Articles</td>
<td>0.0141</td>
<td>[0.0114: 0.0167]</td>
<td>0.0014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Books</td>
<td>0.0311</td>
<td>[−0.0019: 0.0641]</td>
<td>0.0168</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Book chapters</td>
<td>0.0101</td>
<td>[0.0019: 0.0183]</td>
<td>0.0042</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: All models include dummy controls for PhD institution, age, PhD graduation year, years since PhD graduation, and discipline.
In Model 6, which includes covariates related to family characteristics, the marginal gender effect diminishes slightly to −1.5% points (95% CI: −2.8 to −0.14). The predicted yearly advancement probability in this model is 6.8% for men (95% CI: 5.9 to 7.6) and 5.4% for women (95% CI: 4.4 to 6.3), yielding a relative risk of 1.27. As outlined in Model 6, each additional month of parental leave decreases the probability of advancing beyond the assistant professor level by −0.39% point (95% CI: −1.0 to −0.18). The marginal effects of having first-born and second-born children post-PhD are statistically inconclusive, with confidence intervals that span zero. We ran a supplementary analysis to check if these inconclusive findings are due to the inclusion of parental leave as a separate variable in the model, which could absorb some of the variance that might otherwise be attributed to having children. In a Model including children but not parental leave, the marginal effects of having first-born and second-born children remained statistically inconclusive (see Supplementary Table S3).

In Model 7, which adds covariates for annual research outputs (articles, books, and book chapters), the marginal gender effect is further reduced to −0.91% points, and its confidence interval now spans zero (95% CI: −2.2 to 0.3). The predicted probability for this model is 6.5% for men (95% CI: 5.7 to 7.4) and 5.6% for women (95% CI: 4.7 to 6.5), resulting in a relative risk of 1.16. Each additional co-author-adjusted article, book, or book chapter increases the probability of advancing beyond the assistant professor level by 1.41% points (95% CI: 1.14 to 1.67).

**FIGURE 2** Predicted probabilities of attaining senior research positions by gender. The figure reports outcomes from three separate time-event history models. Panel A presents predicted probabilities from Model 5 (Table 4), using baseline controls, including discipline and years post-PhD. Panel B presents predicted probabilities from Model 6 (Table 4), factoring in additional controls such as childbirth and parental leave. Panel C presents predicted probabilities from Model 7 (Table 4), which further adjusts for annual scholarly output.
3.1% points (95% CI: −0.2 to 6.4), and 1% point (95% CI: 0.2 to 1.8), respectively. When journal impact is accounted for in our measurement of article output, the results are qualitatively similar (see Supplementary Table S4), suggesting that output, more so than journal impact, contribute to gender disparities in advancement.

One limitation of Models 7 and 8 is that they fail to account for the different impacts that having children and taking parental leave might have on the careers of women and men. For example, if women are disproportionately responsible for caregiving tasks and are also less likely to sustain their research activities during parental leave, the influence of family factors on career advancement could vary significantly between genders. To investigate these potential heterogeneous effects, we conducted an additional analysis incorporating interaction terms for gender and parental leave, as well as for gender and having children (Supplementary Table S5). Although the interaction terms for gender and children did not yield conclusive results, we observed a gender-based variation in the impact of parental leave, with this factor negatively affecting women’s advancement more so than men’s (interaction coefficient: −0.247, 95% CI: −0.488 to −0.007). However, the interpretation of this effect should be approached cautiously, as illustrated in Figure 3A. The large and expanding confidence intervals for men, who generally take short leave periods, indicate unreliable estimates for this group. Conversely, the trend is clearer and more pronounced for women (Figure 3B), with additional months of parental leave markedly lowering their likelihood of career advancement. Therefore, while we cannot conclude that the impact of parental leave varies by gender—largely because men, on average take far fewer months of leave—our analysis does highlight how parental leave adversely affects women’s advancement rates.

Our decomposition based on the KHB method in Table 5 yields qualitatively similar results. Our baseline model (the reduced model) is based on a discrete time-event history model that estimates the advancement likelihood (here reported in hazard rates), adjusting for years since PhD graduation, PhD graduation year, PhD institution, discipline, age, and children born before PhD graduation. Compared to men, women are −24% (Exp [−0.274] − 1) lower in the probability of attaining a senior research position by months of parental leave, as illustrated in Figure 3A and B.

![Figure 3](image-url)

**Figure 3** Predicted probabilities of attaining a senior research position by months of parental leave. Panel A presents the predicted probabilities by gender and the duration of parental leave. Panel B presents predicted probabilities by months of parental leave for women.
<table>
<thead>
<tr>
<th>Total effect</th>
<th>Indirect effect</th>
<th>Direct effect</th>
<th>% Explained variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Est.</td>
<td>S.E.</td>
<td>CI</td>
<td>Est.</td>
</tr>
<tr>
<td>$-0.274$</td>
<td>$0.119$</td>
<td>$[-0.51: -0.04]$</td>
<td>$-0.109$</td>
</tr>
<tr>
<td>First child</td>
<td>$-0.015$</td>
<td>$0.007$</td>
<td>$[-0.03: -0.00]$</td>
</tr>
<tr>
<td>Second child</td>
<td>$-0.006$</td>
<td>$0.006$</td>
<td>$[-0.02:0.01]$</td>
</tr>
<tr>
<td>Parental leave</td>
<td>$-0.040$</td>
<td>$0.258$</td>
<td>$[-0.09:0.01]$</td>
</tr>
<tr>
<td>Articles</td>
<td>$-0.048$</td>
<td>$0.010$</td>
<td>$[-0.07: -0.03]$</td>
</tr>
<tr>
<td>Books</td>
<td>$0.001$</td>
<td>$0.019$</td>
<td>$[-0.00:0.00]$</td>
</tr>
<tr>
<td>Book chapters</td>
<td>$-0.001$</td>
<td>$0.002$</td>
<td>$[-0.01:0.00]$</td>
</tr>
</tbody>
</table>

Note: These estimates were derived using the KHB method with Complementary log-log regression. All models adjust for years since PhD graduation, PhD graduation year, PhD institution, discipline, age and children before PhD graduation.
less likely to advance to an associate or full professorship within the first 7 years after PhD graduation (95% CI: −40 to −4). Accounting for children, parental leave and publication outputs reduces the direct effect to a −15% (Exp[−0.165] − 1) lower likelihood for women than men, but with a confidence interval that spans zero (95% CI: −33 to 8). As indicated in the right column, 39.71% of the total gender gap in advancement is mediated through parent- and productivity-related factors, with parental leave and coauthor adjusted articles accounting for most of the indirect effect (14.63% points and 17.43%, respectively). In contrast, the role played by first and second born children is less salient (5.54% and 2.11%, respectively). Results are qualitatively similar when we use the SNIP-weighted measure to account for publication output (see Supplementary Table S6). We also ran the decomposition based on a model accounting for children and parental leave, but not productivity. In this decomposition, parenthood and parental leave reduced the indirect effect by 4.59%, from a −26% lower likelihood (95% CI: −41 to −7) to a −23% lower likelihood (95% CI: −39 to −2) for women (see Supplementary Table S7).

6 | DISCUSSION AND CONCLUSION

This study examined gender differences in the career progression of Danish social scientists. Our approach adds to previous evidence by (i) focusing on a competition-based research system, (ii) by tracking individual careers longitudinally from PhD graduation and onward, and (iii) by combining career information and public registry data to estimate the impact of parenthood and parental leave on career progression.

Through time-event history models, we found that women were less likely than men to advance beyond the assistant professor level during the first 7 years after PhD graduation. Notably, we also found suggestive evidence that this gender gap was more pronounced in the most recent cohort (2011–2015) than in earlier ones (2000–2005 and 2006–2010). A decomposition further indicated that variations in publishing and parenthood accounted for less than half (−40%) of the total gender gap in career advancement thus highlighting the continued importance of also considering how social dynamics within organisations perpetuate gender disparities in scientific careers (Acker, 2010). These factors, widely documented in previous research, include gendered processes in recruitment and selection, precarious employment conditions, experiences of unequal treatment, and asymmetries in social capital.

Importantly, having children may still disadvantage individual mothers and fathers. Indeed, a time-event history model considering family characteristics indicated that each additional month of parental leave decreased the probability of advancing beyond the assistant professor level in any given year by 0.39% points, given a base-rate predicted probability of 6.8% for men and 5.4% for women. This finding is notable considering the disproportionate amount of parental leave taken by women in our sample (see Table 1 and Supplementary Figure S3). Further, a moderation analysis suggested a marked reduction in advancement rates for women for each month of additional parental leave taken, while no clear trend could be determined for fathers, because men in our sample, on average, took very few months of leave.

These results hold substantial relevance for policy and practice. They highlight the need to account for child-rearing and parental leave when assessing applicants’ achievements for career advancement. While many universities claim to consider this, it remains unclear whether and how career breaks for family reasons genuinely impact performance evaluations and hiring decisions (Nielsen, 2018). In 2022, the Danish government rolled out a reformed parental leave policy, reserving 11 weeks exclusively for fathers and adjusting the optional full-time leave duration for mothers from 46 to 37 weeks. This reform aims to diminish gender inequality in the workforce and is anticipated to mitigate the disparities observed between academic mothers and fathers.

Our research corroborates recent studies indicating that differences in publishing are a key contributor to gender gaps in social scientists’ progression, evident in both Germany and the US (Lutter & Schröder, 2016; Weisshaar, 2017). Some construe this as indicative of the central role that ‘meritocratic factors’ play in producing gender disparities in career outcomes (Lutter & Schröder, 2016). However, science’s persistent gender-productivity
gap may both be a symptom and a driver of women’s broader disadvantages in the social sciences, and our analysis does not account for important “non-meritocratic” factors that may perpetuate disparities in research outputs. These include gender differences in average teaching loads, administrative duties, stricter editorial standards for women in peer-reviewing, or the under-recognition of women’s contributions in collaborative work (Eagly, 2020; Guarino & Borden, 2017; Hengel, 2022; Leïsytė, 2016; Ni et al., 2021; Ross et al., 2022). Further, while our analysis attempted to tease apart the impacts of parenthood and productivity on career advancement, these factors are inherently intertwined, posing a challenge for full decomposition with the available data. Consequently, our findings regarding the partial effects of parenthood and productivity warrant cautious interpretation. Nonetheless, our examination of their combined influence still represents an important contribution to extant literature, which rarely accounts for children and parental leave, due to data limitations.

The advancement gender gap identified in our study contrasts with findings from retrospective studies in Germany and Sweden showing female promotion advantages (Lutter et al., 2022; Lutter & Schröder, 2016; Madison & Fahlman, 2021; Schröder et al., 2021), but aligns with U.S. prospective studies less susceptible to survivorship bias (Sherman & Tookes, 2022; Weisshaar, 2017). Future research could benefit from a better understanding of how designs with and without outcome-dependent sampling influence statistical conclusions regarding gender and career advancement. This could be done by employing both approaches in the same higher-education context with extensive data on both the careers of graduating PhDs and current faculty.

Our statistically uncertain finding that gender gaps in career advancement have increased over time (Figure 1) should be understood in the context of the Danish Globalisation Strategy implemented in 2006 that aimed to double the annual PhD admission number before 2010 (Stage & Aagaard, 2020). This expansion increased the competition for academic jobs and likely deterred more women than men from applying for senior research positions. Previous research suggests that women disproportionately shy away from competitive settings, and these findings may also apply to Denmark’s increasingly competitive academic job market (see e.g., Balafoutas & Sutter, 2012; Flory et al., 2015; Niederle & Vesterlund, 2007). Meanwhile, research on recruitment and selection at Danish universities indicates that closed hiring procedures (without public advertisements) and research appointments with very few applicants became increasingly common from the mid-2000s onwards, which suggests that many appointees during this period were pre-selected by recruiters. This trend may have put women at a disadvantage (Nielsen, 2016). Importantly, throughout the 2000s, universities in Denmark also trailed behind their Scandinavian neighbors in actively advancing gender equality, placing less emphasis on transformative organizational policy measures proven to be most effective in fostering gender equality (Drange et al., 2023; Timmer et al., 2010).

While our analysis contributes insights on gender disparities in social scientists’ career advancement broadly, it is critical to acknowledge the heterogeneous patterns observed across disciplines, and the dominance of Economists and Business and Management graduates in our sample. Compared to the reference group in Business and Management, Economics graduates were shown to have much lower likelihoods of reaching associate or full professor levels, while sociologists, on average, had much higher likelihoods of career advancement. Findings for Psychology, Political Science, and “Undefined” disciplines were inconclusive. Further, a descriptive analysis highlighted varying gender gaps across disciplines, with gaps being narrower in Political Science and Economics, and wider in Psychology, Business and Management, and notably in Sociology. These discipline-specific gender divides are indicative of underlying variations and call for more focused investigations in future studies.

Importantly, the examined disciplines vary in their evaluative cultures (Becher & Trowler, 2001) and publication practices, which should be considered when interpreting our results. In Economics, for instance, publications in the “top-five” journal outlets appear to be a key marker of future research potential (Heckman & Moktan, 2020), while there is less consensus around the journal hierarchy in a field like Sociology. Previous research also suggests that the duration of the publication process is longer in Economics than in Political Science, Sociology, and Psychology (Björm & Solomon, 2013). This implies that the relative setbacks associated with parental leave and its
influence on publishing and career advancement may vary across disciplines. Due to a lack of statistical power, we cannot reasonably estimate this heterogeneity.

Our findings raise additional empirical questions. First, beyond gender, demographic factors such as socio-economic roots, sexual orientation, and ethnicity may also shape social scientists’ career progression, and future studies should examine how these factors, in conjunction, affect career outcomes (Weisshaar, 2017). Second, our study focuses on academic jobs, but it does not investigate PhD graduates’ career paths outside the university sector. A promising avenue for future research would be to explore possible gender disparities in pay levels across sectors and job types for social science PhDs. Third, while our study focuses on the influence of parenthood and parental leave on women’s and men’s career progression, it does not account for how partnership status and differences in partners’ occupations and workloads may mediate this influence. This question is crucial because men tend to have non-academic partners more often than women (Schiebinger et al., 2008). Finally, our study only tracks career progression from year zero to six after PhD graduation and lacks information on longer-term gender disparities in career outcomes. Hence, a follow-up study should examine potential gender gaps in career advancement to the full professor level over a more extended period.

Our study is not without limitations. First, although our sampling strategy is an improvement over previous approaches, we acknowledge the possibility of selection bias due to gender imbalances in access to PhD positions and completion rates. If women master’s degree graduates are less likely to enroll in and complete social science PhD programs, this could make them a selective group in terms of characteristics (e.g., social background or academic performance) relative to their male counterparts. Future studies could use administrative register data to illuminate how such potential imbalances contribute to gender differences in career advancement. Second, our dataset is not without its own selection concerns. Of the original 1508 graduates, our analysis includes 973. Since the career data were derived from publicly available CVs, the omission suggests that the missing graduates are potentially not a representative subset of the larger graduate pool. In particular, those absent from our dataset are likely to have transitioned into non-academic roles in either the public or private sectors, where career information is less readily accessible online. Despite this limitation, the comparable gender composition between our initial and final samples suggests that the selection bias may have a minor impact on our gender-related findings.

Finally, the time span of our analysis (2000–2021) limits our access to consistent information on all factors influencing career progression and attrition. External funding, teaching evaluations, service, and invited research talks may play a role, but previous research from the US suggests they account for a negligible portion of the gender gap in career progression (Weisshaar, 2017). In addition, external funding—in and off itself—has been found to be a weak predictor of advancement to professorships in Germany once differences in publishing are accounted for (Lutter & Schröder, 2020). However, Denmark’s more diverse funding landscape, featuring multiple private research funders and a significant portion of the university system’s research budget coming from external sources (Aagaard, 2017; Madsen & Aagaard, 2020), may make funding a more critical factor for career advancement in Denmark compared to Germany or the US. This possibility underscores the value of future research in this area.

Despite limitations, our study provides important insights into the persistent gender gap in social science careers. While Denmark’s generous family-friendly welfare policies make it a unique case, we believe our conclusions about the important but relatively limited influence of parenthood and parental leave on the gender gap in career advancement may be relevant to other countries.

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CONFLICT OF INTEREST STATEMENT
The authors have no conflicts of interest to declare.
DATA AVAILABILITY STATEMENT

Administrative register data maintained by Statistics Denmark can only be accessed remotely from institutions with a license agreement. Due to regulations, we are not allowed to share these data publicly. The Stata-data file used for this analysis is available via the Open Science Framework: https://osf.io/x5jhf/?view_only=b704012-d09924638ac963e5718172df. Full regression outputs for all models are also available via OSF.

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**SUPPORTING INFORMATION**

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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